FACTORS THAT AFFECT EFFICIENCY IN THE MANAGEMENT AND UTILISATION OF WATER RESOURCES

Zeleke Worku
Tshwane School for Business and Society, 159 Nana Sita Street, Pretoria 0001, South Africa

ABSTRACT

Although Bushbuckridge and Mbombela in the Province of Mpumanlanga, South Africa have groundwater resources, these resources are not utilised efficiently by residents. Various studies have shown that it is necessary to promote awareness about conservation and protection of groundwater resources. The study was conducted by collecting information from 420 households in Bushbuckridge and Mbombela to explore factors that undermine the optimal utilisation of ground resources. Efficiency in the utilisation and conservation of ground and spring water was assessed by using a composite index developed by Alamdarlo, Pourmozafar and Vakilpoor (2019) for conducting a similar study. The results showed that about 65% of respondents were efficient enough in the effective utilisation of ground water, whereas the remaining 35% were not. Results obtained from the study showed that the effective utilisation of spring and ground water at Bushbuckridge and Mbombela was significantly undermined by large family size (family sizes of 6 or more), low level of education of head of household (Grade 12 level formal education or less) and low household income (an average annual income of R100, 000 or less), in a decreasing order of strength.

KEYWORDS: Ground water, Effective utilisation of water, Factor analysis, Hierarchical log-linear modelling

JEL classification: P41, P47, Q01, Q25

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INTRODUCTION AND BACKGROUND TO STUDY

The overall objective of study was to assess and evaluate the efficiency with which groundwater resources are utilised by residents of Bushbuckridge and Mbombela in Mpumalanga Province. The purpose of study was to explore barriers to the optimal utilisation of groundwater resources at Bushbuckridge and Mbombela. Shortage of water at these two rural communities has stifled sustained growth in agriculture. South Africa is a water-scarce nation in which spring and groundwater must be conserved and utilised optimally (Baudoin, Vogel, Nortje & Naik, 2017). A report published by the South African National Department of Water and Sanitation (2020) shows that South Africa needs to build the capacity for conserve and protect its existing spring and groundwater resources as a matter of strategic priority in order to maintain economic development and growth on a sustainable basis. According to the South African National Department of Health (2020), it is essential to provide clean, piped water to all South Africans as a means of providing satisfactory primary health care services to South Africans. The South African National Water Act (Act no. 36 of 1998) (South African Government Communication and Information System, 1998) and the South African Municipal Systems Act (Act no. 32 of 2000) (South African Government Communication and Information System, 2000) the provision of clean, piped water to South Africans is a key strategic priority of the South African Government. The successful implementation of the two Acts requires the capacity to protect groundwater and spring water resources, repair and maintain water pipelines, storage and distribution systems, and adequate investment on technical skills at municipal level. Esterhuyse, Vermeulen and Glazewski (2019) and Asoka, Gleeson, Wada and Mishra (2017) have shown that poor and low-income households in Bushbuckridge and Mbombela experience shortage of water due to prolonged draught and failure to invest on modern technological infrastructure that is helpful for improving the availability of water to urban and rural communities.

Literature review

The shortage of clean, piped water at Bushbuckridge and Mbombela has reached a high level (Cahill, Steelman, Forde, Kuloyo, Ruff, Mayer & Parker, 2017; Goldin, 2015). The two communities depend on agriculture for livelihood. Dalin, Wada, Kastner and Puma (2017) have shown that the depletion of groundwater resources has disempowered rural communities who rely on livestock and agriculture in many Sub-Saharan African countries. The chronic shortage of water has effectively made it impossible for communities in Bushbuckridge and Mbombela to rely on agriculture and livestock as a viable economic means. The agriculture sector is the highest source of livelihood at these two communities at 63%, followed by the municipal and industrial sectors at 26% and 11% respectively (Carbo, Lopez Carrero, Garcia-Castillo, Tormos, Olivas, Folch & Martinez-Bisbal, 2018). Bushbuckridge Local Municipality is a presidential nodal point located in the north-eastern part of Mpumalanga Province. The municipality is one of the five constituents of Ehlanzeni District Municipality, and is bounded by Kruger National Park in the east and Mbombela in the South. It also forms part of the Kruger to Canyon Biosphere. The Municipal area provides a link to Limpopo Province and can therefore be called the gateway to the major tourism attraction points in Mpumalanga and the eastern part of the Limpopo Province. Bushbuckridge Local Municipality consists of 135 settlements and is divided into 34 wards.

Craig and Prescott (2017) have found that the shortage of water is a barrier to the alleviation of rural developmental programmes in which 61% of Reconstruction and Development Programmes fail due to lack of water supply. Mafuwane (2019) has shown that more than 60% of households at Bushbuckridge and Mbombela do not have access to potable water, 16% rely on tap water, while 7.3% rely on borehole and 10% on natural water (spring and rivers).Water reticulation and sanitation are routinely managed by the Mpumalanga Provincial Department of Water and Sanitation (2019). However, the supply of water is not reliable. Often, water taps run dry and residents are forced to fetch water from far-away locations for drinking and domestic use by using costly transportation (Kostyla, Bain, Cronk & Bartram, 2015: 333-343). These problems are well known to both the Mpumalanga Provincial Government (2019) and Rand Water (2019) and require massive investment in the current water infrastructure as well as highly skilled manpower. According to Khan (2015), the private sector should be provided with tangible economic incentives as a means of growing the current water infrastructure.

Yip, Brogioli, Hamelers and Nijmeijer (2016) have shown that water-scarce nations such as Israel use advanced water desalinisation technologies as a means of fulfilling their demand for fresh water. In Israel, the dire need for water has been resolved amicably by using advanced technology in which salt is removed from seawater at an affordable cost of production. Strategically, South Africa needs to invest in water desalinisation technology as a means of achieving water security in the long-term. Raveh and Ben-Gal (2016: 176-179) have shown that the main reason why Israel achieved adequate water security for its agricultural sector is by investing on modern technological methods of water desalinisation since it was established in 1948. The authors have shown that achieving water security for the agricultural sector requires sustained investment of several decades and macroeconomic stability.

The provision of clean and piped water to all South Africans is a key priority of the South African Government. It is a constitutional responsibility of the South African Government to ensure access to tapped water to all South Africans living at Bushbuckridge and Mbombela local municipalities. The people of Bushbuckridge and Mbombela are characterised by shortage of water, unemployment and poverty and a backlog of infrastructural upgrade (Lipczynska-Kochany, 2018). There is a huge backlog of maintenance and upgrade in the water supply, storage and distribution system at the two local municipalities. The two local municipalities are losing water due to leaking water pipes and lack of resources for maintenance and upgrade (Mpumalanga Provincial Government, 2019). Since April 1994, Bushbuckridge and Mbombela have been exposed to a high influx of migrants who have come into urban centres from rural areas in search of better municipal services, job opportunities and livelihoods. Although the two local municipalities have been exposed to a high influx of migrants, the water infrastructure had not been upgraded accordingly. As a result, the two local municipalities are experiencing a significant shortage of fresh water supply. There is a need for exploring new spring and groundwater resources so that the chronic shortage of water could be addressed at the two local municipalities effectively

(Mpumalanga Provincial Department of Water and Sanitation, 2019).

One proven method of alleviating the need for water is to optimise the current utilisation of water by using innovative methods of conservation. There is a need for health, environmental and sanitary education among the population living at Bushbuckridge and Mbombela. According to Dalin, Wada, Kastner and Puma (2017), it is possible to make a significant difference in the utilisation of water resources by providing effective health education to the general population. Howell (2016) has shown that it is not possible to address water-related problems without simultaneously addressing socioeconomic and infrastructural problems at Bushbuckridge and Mbombela. In order to raise the money and expertise needed for the upgrade and maintenance of the water infrastructure at Bushbuckridge and Mbombela, it is essential to provide tangible economic incentives to the private sector. Doing so would alleviate the pressure on local municipalities to raise large amounts of money. The private sector has access to advanced and innovative technological systems and skills for exploring and distributing water to all the people living in the two local municipalities (Kumar, 2017). The study conducted by the South African Centre for Scientific and Industrial Research (CSIR, 2019) has shown that the need for exploring fresh groundwater resources in South African local municipalities is a key strategic priority in view of the fact that people are demanding the right to fresh water supply for domestic as well as economic activity. In general, there is a need to invest substantially more on water-related technologies in order to ensure water security in all local municipalities. L'Hegaret, Carton, Louazel and Boutin (2016) have argued that developing local municipalities must budget adequately for year-on-year manpower development and infrastructural expansion in order to cater for population growth and increased demand for municipal services.

The Mpumalanga Provincial Department of Water and Sanitation (2019) manages the shortage of water in the province by using a network of water pipes that restrict the volume of water that is used for irrigation purposes. It also provides regulations and guidelines to residents and businesses in the province on how they should utilise water economically. Some people do not have water for flush toilets, and are forced to use pit latrines as a solution. Some people travel for kilometres in order to collect water for domestic use. Pickup trucks are commonly seen transporting water for domestic use by people who live in the various districts of the province. There is no regular supply of water in townships and settlements in Mpumalanga Province due to shortage of water. It is common to find dry taps in many townships and rural areas of the province. Some communities have last seen their taps running in 2015, and to date they are still without water (Mpumalanga Provincial Government, 2019).

Methods and materials of study

The research was conducted by collecting information from 420 households in Bushbuckridge and Mbombela, in Mpumalanga Province. The dependent variable of study (Y) was defined as a measure of the ability of households to utilise spring and groundwater efficiently enough based on a composite index developed by Alamdarlo, Pourmozafar and Vakilpoor (2019) for assessing the ability of respondents to utilise spring and ground water effectively in rural communities. At each household, data was collected by using a pre-tested and validated questionnaire. Data analyses was performed by using descriptive statistics, frequency tables and multivariate analyses.

Results

Table 1 shows that about 65% of respondents were efficient enough in the utilisation of spring and ground water, whereas about 35% of respondents were not efficient enough in the utilisation of spring and ground water. These figures are quite normal by the standards of the World Bank (2019) for Sub-Saharan African countries.

Table 1: Efficiency in the utilisation of spring and ground water (n=420)

Efficiency in the utilisation of spring and ground water	Number	Percentage
Adequate	274	65.24%
Inadequate	146	34.76%
Total	420	100.00%

Table 2 shows that more than 80% of respondents live in households in which between 4 and 6 people live. About 38% of respondents had ages of 31 to 40 years. Above 75% of respondents were male.

Table 2: Family size, age and gender of respondents (n=420)

Variable of study	Frequency (Percentage)
Family size	3 or fewer: 23 (5.48%) 4 to 6: 342 (81.43%) 7 or more: 55 (13.10%) 50 years or above: 38 (20.99%)
Age category of respondents	18 to 30 years: 78 (18.57%) 31 to 40 years: 157 (37.38%) 41 to 50 years: 143 (34.05% 51 to 60 years: 40 (9.52%) 61 years or more: 2 (0.48%)
Gender of respondents	Male: 325 (77.38%) Female: 95 (22.62%)

Table 3 shows that about 66% of respondents were married. About 26% of respondents had Grade 12 level education or less.

Table 3: Marital status and level of education and of respondents (n=420)

Variable of study	Frequency (Percentage)
Marital status of respondents	Single: 91 (21.67%) Married: 276 (65.71%) Divorced: 13 (3.10%) Widowed: 36 (8.57%) Living together: 4 (0.95%)

Highest level of education of respondents	Grade 12 or less: 110 (26.19%) Certificate: 207 (49.29%) Diploma: 76 (18.10%) Bachelor's degree: 25 (5.95%) Master's degree or higher: 2 (0.48%)

Table 4 shows that about 40% of households had an average annual household income of R100, 000 or less. About 95% of respondents in the study were Africans.

Table 4: Average annual income and race group of respondents (n=420)

Variable of study	Frequency (Percentage)
Average annual income of households in Rand	Less than R100, 000: 169 (40.24%) R100, 000 to R150, 000: 24 (5.71%) R150, 001 to R200, 000: 73 (17.38%) R200, 001 to R250, 000: 80 (19.05%) R250, 001 to R300, 000: 53 (12.62%) R300, 001 to R350, 000: 14 (3.33%) Above R350, 000: 7 (1.67%)
Race of respondents	Black African: 401 (95.48%) White: 6 (1.43%) Coloured: 9 (2.14%) Asian: 4 (0.95%)

About 88% of respondents indicated that water delivery constraints were identified effectively by local municipality officials. About 90% of respondents indicated that effective strategies were used for addressing water delivery constraints. About 90% of respondents indicated that water delivery officials had good working relationships with members of the community. About 81% of respondents indicated that impacts of water shortage were understood well enough by water service employees and officials. About 92% of respondents indicated that the impact of poor municipal service on water were understood well enough by water service employees and officials. About 78% of respondents indicated that working relationships between municipal officials and the local indunas (tribal councillors or headmen) were good enough. About 89% of respondents indicated that working relationships between municipal officials and their community were good enough. About 91% of respondents indicated that working relationships between municipal officials and local chiefs were good enough. About 92% of respondents indicated that expectations of members of local communities on service quality were met adequately by municipal employees and officials. These figures are quite normal according to comparative figures published for Sub-Saharan African countries by the World Bank (2019).

Table 5: Assessment of the quality of water-related services (n=420)

Statement	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
I am satisfied with the quality of water-related services that are provided to me by my local municipality (quality)	5.48%	3.57%	0.00%	84.52%	6.43%
Adequate consultation is done with community members by local municipality officials who are responsible for water-related services (consultation)	4.29%	4.29%	0.00%	85.71%	5.71%
Water delivery constraints are identified by local municipality officials (constraints)	6.43%	5.71%	0.00%	82.86%	5.00%
Appropriate strategies are in place to address water delivery constraints (appropriate)	5.00%	6.67%	0.00%	84.76%	6.43%
Effective strategies are used for addressing water delivery constraints (effective)	5.48%	5.00%	0.00%	83.10%	6.43%
Water delivery officials have good working relationships with members of the community (relationships)	4.29%	5.71%	0.00%	84.29%	5.71%
Impacts of water shortage are understood by water service employees and officials adequately (shortageimpact)	6.43%	12.86%	28.10%	46.19%	6.43%
Impacts of poor municipal service on water are understood by water service employees and officials adequately (municipal)	4.29%	4.05%	18.33%	56.90%	16.43%
Working relationships between municipal officials and the local induna are good enough (induna)	10.00%	11.90%	34.05%	37.14%	6.90%
Working relationships between municipal officials and your	2.86%	7.62%	32.62%	44.76%	12.14%

community are good enough (community)					
Working relationships between municipal officials and local chiefs are good enough (chiefs)	5.48%	3.57%	0.00%	84.52%	6.43%
Expectations of members of local communities on service quality are met adequately by municipal employees and officials (expectations)	4.29%	4.29%	0.00%	85.71%	5.71%

Table 6 shows that about 69% of respondents use ground water or water from the well for domestic use such as cooking, sanitation and washing.

Table 6: Main source of drinking water of households (n=420)

Variable of study	Frequency (Percentage)
Use of ground water or water from the well for domestic use	Yes: 288 (68.57%) No: 132 (31.43%)
Source of drinking water of respondents	Ground water: 184 (20.00%) Water from the well: 104 (20.00%) Spring water: 83 (19.76%) Tap water: 130 (30.95%) Water from the river: 39 (9.29%)
Number of boreholes used by households	None: 108 (25.71%) One: 179 (42.62%) Two: 126 (30.00%) Three or more: 7 (1.67%)

Table 7 provides information about the length of time needed for fetching water from the nearest source of water in the neighbourhood. About 38% of respondents indicated that water brought home from the nearest source of water in the neighbourhood lasts for a day or less. About half of the respondents indicated that water brought home from the nearest source of water lasts for two days. About 11% of respondents indicated that water brought home from the nearest source of water lasts for three days or longer. About 8% of respondents indicated that the length of time needed for fetching water home on foot from the nearest source of water was 15 minutes or less. About 81% of respondents indicated that between 16 to 30 minutes were needed for fetching water home from the nearest source of water in the neighbourhood. About 11% of respondents indicated that longer than half an hour was needed for fetching water home from the nearest source of water in the neighbourhood. The table shows that about 87% of households utilised water supplied by the local municipality.

Table 7: Length of time taken for fetching water (n=420)

Variable of study	Frequency (Percentage)
Length of time spring water lasts at home	For a day or less: 163 (38.31%) For 2 days: 209 (49.76%) For 3 days or longer: 48 (11.43%)
Length of time needed for fetching water home on foot from the nearest source of water	15 minutes or less: 32 (7.62%) 16 to 30 minutes: 342 (81.43%) Longer than 30 minutes: 46 (10.95%)
Utilisation of water supplied by municipality	Yes: 365 (86.90%) No: 55 (13.10%)

Table 8 provides information about the perception held by respondents about the safety of drinking spring and tap water. About 90% of respondents believed that it was safe enough to use spring water for drinking at home. About 90% of respondents believed that it was safe enough to use tap water for drinking. More than half of all respondents used a combination of ground and spring water daily at home.

Table 8: Perception of safety of spring and tap water (n=420)

Variable of study	Frequency (Percentage)
Perception about the safety of drinking spring water	Positive: 376 (89.52%) Negative: 44 (10.48%)
Perception about the safety of drinking tap water	Positive: 378 (90.00%) Negative: 42 (10.00%)

Number of people in the household using ground water daily	Two or fewer: 248 (59.05%) Three to five: 118 (28.10%) Six or more: 54 (12.86%)
Number of people in the household using spring water daily	Two or fewer: 326 (77.62%) Three to five: 77 (18.33%) Six or more: 17 (4.05%)

Table 9 provides information about the perception held by respondents about the safety of drinking ground water at home. About 66% of respondents believed that it was safe enough to use ground water for drinking at home. About 68% of respondents purified ground water at home before use on a regular basis. About 54% of respondents drank untreated ground water at home on a regular basis. About 68% of respondents experienced shortage of water at home at all times.

Table 9: Perception of safety of ground water for drinking (n=420)

Variable of study	Frequency (Percentage)
Perception about the safety of drinking ground water at home	Positive: 279 (66.43%) Negative: 26 (6.19%) Not sure: 115 (27.38%)
Purifying ground water at home before use	Always: 287 (68.33%) Sometimes: 127 (30.24%) No: 6 (1.43%)
Drinking untreated ground water at home	Always: 225 (53.57%) Sometimes: 97 (23.10%) No: 98 (23.33%)
Experience of shortage of water in community	Always: 284 (67.62%) Sometimes: 100 (23.81%) No: 36 (8.57%)

Table 10: Significant two-by-two crosstab associations (n=420)

Variable associated with lack of efficiency in the utilisation of ground and spring water at Bushbuckridge and Mbombela	Observed chi-square value	P-value
Large family size (Family size of 6 or more)	16.8940	0.031
Low level of formal education (Grade 12 or less)	16.5170	0.033
Low household income (An average annual income of less than R100, 000)	14.3201	0.034
Failure of municipal employees to consult with members of the community	12.2467	0.041
Failure of municipal employees to take appropriate remedial action to alleviate water shortage	11.3554	0.044

The results shown above indicate that failure to utilise ground and spring water efficiently was significantly associated with large family size (Family size of 6 or more), low level of formal education (Grade 12 or less), low household income (An average annual income of less than R100, 000), failure of municipal employees to consult with members of the community, and failure of municipal employees to take appropriate remedial action to alleviate water shortage, in a decreasing order of strength.

Table 11 shows results obtained from log-linear analysis. The results obtained from log-linear analysis show that failure to utilise ground and spring water efficiently was significantly associated with large family size (Family size of 6 or more), low level of formal education (Grade 12 or less), low household income (An average annual income of less than R100, 000), failure of municipal employees to consult with members of the community, and failure of municipal employees to take appropriate remedial action to alleviate water shortage, in a decreasing order of strength. These findings are in agreement with those obtained from crosstab analyses.

Table 11: Significant interactions of order 2 obtained from log-linear analysis (n=420)

Variable associated with lack of efficiency in the utilisation of ground and spring water at Bushbuckridge and Mbombela	Observed Z-value	P-value
Large family size (Family size of 6 or more)	103.4412	0.0000
Low level of formal education (Grade 12 or less)	101.3043	0.0000
Low household income (An average annual income of less than R100, 000)	94.5509	0.0000
Failure of municipal employees to consult with members of the community	72.3189	0.0000
Failure of municipal employees to take appropriate remedial action to alleviate water shortage	43.6051	0.0000

Table 12 shows results obtained from factor analysis. The table shows that failure to utilise ground and spring water efficiently was significantly influenced by 5 factors. These were large family size (Family size of 6 or more), low level of formal education (Grade 12 or less), low household income (An average annual income of less than R100, 000), failure of municipal employees to consult with members of the community, and failure of municipal employees to take appropriate remedial action to alleviate water shortage, in a decreasing order of strength. The Eigen values of each one of the 5 predictor variables are greater than 1. The 5 predictor variables jointly account for 90.20% of potential causes of failure in the effective utilisation of ground and spring water at Bushbuckridge and Mbombela.

Table 12: Significant predictors estimated from factor analysis (n=420)

Variable associated with lack of efficiency in the utilisation of ground and spring water at Bushbuckridge and Mbombela	Eigen value	Percentage of explained variation	Cumulative percentage of explained variation
Large family size (Family size of 6 or more)	3.49	37.45	37.45
Low level of formal education (Grade 12 or less)	2.88	24.62	62.07
Low household income (An average annual income of less than R100, 000)	2.72	17.33	79.40
Failure of municipal employees to consult with members of the community	2.46	8.09	87.49
Failure of municipal employees to take appropriate remedial action to alleviate water shortage	1.86	2.71	90.20

Discussion of results

The study has found that inability to utilise ground and spring water efficiently was significantly influenced by 5 factors. These were large family size (Family size of 6 or more), low level of formal education (Grade 12 or less), low household income (An average annual income of less than R100, 000), failure of municipal employees to consult with members of the community, and failure of municipal employees to take appropriate remedial action to alleviate water shortage, in a decreasing order of strength.

Studies conducted by Mafuwane (2019) and the South African Centre for scientific and industrial research (CSIR, 2019) have shown that local municipalities must be equipped with adequate capacity for preserving sources of water and natural habitat in rural communities as a means of safeguarding the general environment. Innovative methods of exploiting groundwater and springs must be utilised by the two rural communities in order to address the severe shortage of water in the two communities (Etani, Kataoka, Kanzaki, Sakoda, Tanaka, Ishimori & Yamaoka, 2016). The severe shortage of water experienced by the two rural communities in this study could be viewed as part of the global challenge to provide adequate water to rural and urban communities (Gorelick & Zheng, 2015: 3031-3051). Population growth rates in rural South Africa are quite high. As a result, the demand for potable sources of water has increased rapidly since April 1994. As the population grows, the demand for water keeps growing progressively. Thus, the demand for water by all South African rural and urban communities will keep growing as time goes on. Rural populations have been growing steadily since 1994. In the year 2012, about 60% of all South Africans lived in rural communities, whereas about 40% of all South Africans lived in urban or semi-urban areas (Statistics South Africa, 2018).

Residents are forced to self-supply water from wells, surface waters, vendors, and illegal connections to the mains distribution system (Rand Water, 2019; Gorelick & Zheng, 2015).). Groundwater is a vital natural resource for the economic and secure provision of potable water supply in both urban and rural environments, and plays a fundamental (but often little appreciated) role in human well-being, as well as that of many aquatic ecosystems. Worldwide, aquifers (geological formations containing useable groundwater resources) are experiencing an increasing threat of pollution from urbanization, industrial development, agricultural activities, and mining enterprises. Thus proactive campaigns and practical actions to protect the (generally excellent) natural quality of groundwater are widely required, and can be justified on both broad environmental sustainability and narrower economic-benefit criteria. For many rural residents, groundwater is a vital domestic water source because of its affordability and availability, but rapid population growth, unplanned land development and climate change are putting it under increasing strain.

Urban groundwater quality may be poor due to contamination from adjacent pit latrines, surface waste and other hazards such as the physical disturbance of land due to construction of houses, industries and roads, chemical pollution from industries and mines, inadequate sewage collection and treatment, and increased utilisation of fertilisers (Mengistu, Demlie & Abiye, 2019). This causes an increase in nutrients (nitrates and phosphates) in the water which causes enhanced plant growth (algal blooms). When under-water plant material dies and decays, the bacteria use the oxygen in the water. This lowering of oxygen levels results in the death of other water life that needs oxygen to survive. This process is called eutrophication; litter, which causes disease and has a negative visual impact. Use of such poor quality groundwater could contribute to diarrhoeal disease and infant mortality (Venteris, Skaggs, Coleman & Wigmosta, 2013: 4840-4849). The magnitude and locations of those affected remain unclear, but an estimated 41.4 million people in urban Sub-Saharan Africa use non-piped ‘improved’ sources, a source class that includes protected wells and boreholes Kostyla, Bain, Cronk and Bartram (2015: 333-343). Safe water provision to the urban poor remains an international priority, given the emphasis on reducing inequality in safe water access in post-2015 monitoring (Mafuwane, 2019; Hjort, Gordon, Gray & Hunter, 2015: 630-639).

Recommendations of study

Based on findings obtained from the study, the following recommendations are made to the local municipalities at Bushbuckridge and Mbombela with a view to help them promote the optimal utilisation of spring and groundwater among residents, ratepayers and the general population:

- Aggressive awareness campaigns must be waged by using community-based approaches in order to improve the current degree of awareness and understanding about the scarcity of spring and groundwater resources at Bushbuckridge and Mbombela;
- Poverty alleviation programmes must be promoted in partnership with the private sector among the rural population at Bushbuckridge and Mbombela as a means of reducing the high rate of influx of the rural population into urban centres in search of jobs and livelihood;
- Local municipalities at Bushbuckridge and Mbombela must make the effort to maintain, repair and expand water pipelines, storage systems, pumping machines and distribution systems by raising the required capital from the private sector. The private sector has enough technical expertise. As such, the private sector could be used by way of providing economic incentives to the private sector;
- Local municipalities at Bushbuckridge and Mbombela should provide skills-based training to employees working on water-related duties;
- Water should be used on an equitable manner, based on approved principles. All water users should be treated likewise;
- It is vital to provide tangible and attractive economic incentives to the private sector so

that the private sector could invest on infrastructural upgrade and expansion;

- It is necessary to enforce municipal bylaws on the utilisation of water strictly.

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