

Public Perception on Wastewater Reuse: A Case Study of Thabazimbi in Waterberg District, Limpopo Province in South Africa

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Abstract

Wastewater reuse is a significant means to increasing water supplies, improving water quality, and reducing the discharge of wastewater into the environment. Reclaiming wastewater through modern wastewater treatment plants is a sustainable strategic water management approach, and yet it is underutilized, particularly in southern Africa. Since the reuse of wastewater is often driven by public perceptions, more so than as a result of scientific risk assessments, the major drawback to its reuse is the lack of public acceptance. This study assesses public perceptions on wastewater reuse in Thabazimbi. The study adopted a qualitative method approach: public perceptions were captured using questionnaires and structured interviews. A sample size of 171 was selected using the convenient sampling method on a diverse community. The results show that for health reasons, 36% of the respondents are concerned about the prospect of reusing wastewater. The residents are of the opinion that treated water is not clean enough for drinking purposes. Moreover, residents indicated a lack of trust in the treatment process and the ability of local governments to provide clean drinking water. Therefore, these perceptions on using wastewater for domestic purposes may lead to the rejection by the public of any wastewater reuse initiatives that might be introduced. The reuse of wastewater for activities where minimal personal contact is involved (e.g. for irrigation, fire fighting) is the preferred option. The study concluded that there is a need for wastewater reuse in Thabazimbi and that public participation should be implemented by involving all affected stakeholders in the early stages of the project. Five themes were identified as critical to building and maintaining public confidence in water resource management and in decision-making in respect of water reuse, namely, managing information for all stakeholders; maintaining individual motivation and demonstrating organizational commitment; promoting communication and public dialogue; ensuring a fair and sound decision-making process and outcome; and building and maintaining trust.

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In the more practical sphere, the study offers guidelines for water resource professionals, with a strategy for assessing the community context and developing a principle-based approach to public outreach programs, education and participation in addressing the public concerns regarding wastewater.

Keywords: Wastewater reuse; water scarcity; wastewater.

1. Introduction

Globally, water scarcity remains one of the greatest challenges to the human population and the natural environment. The main contributing factors to water scarcity are rapid urbanization, population growth, climate change, desertification, and the uneven distribution of water resources in some parts of the world. These challenges have plunged the world into a water crisis [1,2]. The scarcity of water resources affects the economic growth, social justice, and ecological integrity of regions in both the Global North and South [3]. According to the author in [4], Africa is one of the driest continents and has limited renewable water resources to support its population. Hence, the demand for water is greater than the supply which, of necessity, results in water shortages. It is critical to note that the water crisis on the continent is being made worse through inadequacies in the treatment of wastewater.

South Africa is a water-scarce country with the demand for water in certain cities already exceeding the supply [5]. The South African water sector faces numerous challenges, such as increased water deficits, water pollution and declines in the quality of the water that not only affect the availability of water in the country but also impact negatively on human health and the wastewater infrastructure [6]. Moreover, the country's limited supply of water is unevenly distributed on both the social and economic levels, thereby creating a vital need for the reuse of wastewater in the country [7]. Currently, some of the residents in South Africa are facing water restrictions and are spending days without water. Owing to the high consumption of water and the shortages in the supply of water, local municipalities are implementing water restrictions. For instance, in 2017, the City of Cape Town implemented Level 7 water restrictions, whereby the municipal water supply was largely switched off and residents were without water for weeks. On the other hand, Johannesburg municipality implemented Level 1 water restrictions, with residents prohibited from watering and irrigating their gardens between 6am in the morning and 6pm in the evening. Nevertheless, municipalities are still not reusing their wastewater as a conservation method. Treating wastewater through modern wastewater treatment plants is a sustainable approach to water management, and yet this method is underutilized, particularly in Southern Africa [8]. However, the South African Department of Water and Sanitation, which is the national custodian of water resources, acknowledges wastewater reuse as one of the best strategic approaches to supplement the water supply [9]. Wastewater reuse assists in closing the gap between the supply of water and the disposal of wastewater, the latter being essential for water conservation. On the other hand, wastewater reuse projects are often rejected by the public on account of their health concerns, especially in cases where wastewater is reused for potable or domestic purposes. Therefore, for wastewater reuse projects to be successful, careful attention should be directed to addressing all the concerns and opinions on wastewater reuse expressed by the public. In this paper, we argue that wastewater reuse has to be considered as a water conservation method in order to reduce the abstraction rate of fresh groundwater.

Positive perceptions by the public and their eager acceptance of the practice of reusing water are acknowledged as key factors in the successful introduction of wastewater reuse projects [10,11]. Health concerns, trust in water authorities and stakeholders and knowledge regarding wastewater reuse are some of the factors that affect the perceptions of the public on the reuse of wastewater. Residents are willing to reuse wastewater for purposes that require limited personal contact, such as the watering of the garden, fire fighting, and lawn irrigation, but, owing to health concerns, are unwilling to accept treated wastewater for purposes that require high levels of personal contact, such as for drinking or cooking. A study by [7] in Durban, South Africa, revealed that owing to health reasons, the public is not comfortable with reusing wastewater for potable purposes. Hence, the preference is for such water to be used by industries rather than by households. On the other hand, a study by the author in [11] found that despite some concerns about the poor quality of reused water and its effects on the soil, crop yields, human health and the environment, farmers in the Bottelary catchment in the Western Cape were willing to use treated effluent for irrigation. The benefits to the environment of reusing wastewater impact on the public's perceptions of wastewater reuse. They tend to positively perceive wastewater reuse when they become aware of the environmental benefits of reusing wastewater and the dire state of water scarcity in the country. Research suggests that the reuse of treated wastewater in high income communities would be highly acceptable as long as this measure tackles environmental and water conservation issues, and a high level of public awareness prevails [12]. In the case of South Africa, a study by [13] assessed the perceptions of University of Pretoria and University of Cape Town students on wastewater reuse. The conclusion reached was that the practice of reusing wastewater is widely acceptable provided that the protection of the environment emanates as a definite advantage from its treatment, and that the treated wastewater be reused.

Should consultations with the public regarding the wastewater reuse projects be limited, the rejection of such projects by the public would be a matter of course. Therefore, for wastewater reuse projects to be successful, the public and all affected parties must be involved - from the planning to the execution stage. This position is supported by [14] who conducted a study on the solution to the problem, attributing the former to the successful acceptance of wastewater reuse by the community. In fact, these authors found that the community is extremely volatile on issues associated with wastewater reuse, and public opinion might often shift dramatically on the basis of only a small change in the information supplied. Thus, the public should be involved at all levels of decision-making. In fact, public participation in water resource management is the key factor in improving and restoring the quality of degraded water resources. A study by [10] revealed that the awareness of respondents on actual water scarcity issues, as well as their previous experience with water restrictions, would increase the likelihood that they would accept the practice of wastewater reuse. Such awareness would assist in equipping the communities with knowledge regarding water issues in the country, this knowledge also including the strategies to address them. Thus, there would be an increased chance of public acceptance in respect of such projects. Furthermore, the levels of knowledge that the public acquire on wastewater reuse could influence their perceptions regarding the reuse of wastewater. A study by [15] revealed that people who are more knowledgeable about wastewater are generally more accepting of wastewater reuse projects. Therefore, it is important for stakeholders to assess the level of public knowledge and the prevailing attitudes regarding wastewater reuse in order to assist them in developing and implementing management systems that are acceptable to the public [16]. Thus, it is the purpose of this study to assess public knowledge in order to

determine whether it will lead to public support in respect of wastewater reuse projects.

Previous studies have concluded that trust in the water authority concerned is one of the factors that affects public perceptions on wastewater reuse. In Australia, community members were receptive to wastewater reuse as they perceived that the water authority could provide them with a constant supply of good quality water. They were, therefore, open to applying fair procedures, such as embarking on consultations with the stakeholders and in disseminating information to the public [17]. This same scenario can be quoted in the case of Arizona, USA, where the public's acceptance of treated wastewater reuse proved to be contingent on their trust of the authorities, who influence the design of the associated sociotechnical systems, such as the water and wastewater utilities, consultants, academics, local officials, and regulators [18]. It is in fact the public's trust in the water authority responsible for the wastewater reuse projects that actually contributes to the success of such projects. In the case of South Africa, trust in the water authority is extremely important. This is in the light of the fact that the municipalities are currently providing water services to the communities but that their ineffectual service delivery and the high level of corruption in the municipalities severely impact upon the perceptions of the public on the reuse of wastewater. This paper covers public knowledge on the issue of wastewater reuse, public concerns regarding the practice and trust in the process- when endorsed by certain stakeholders-, and the strategies for gaining public acceptance on future wastewater reuse projects.

2. Methodology

2.1. Study area

Thabazimbi, meaning 'Mountain of Iron', was named after an iron-ore reef discovered in the region. It falls under the jurisdiction of the Thabazimbi local municipality in the Waterberg region of the Limpopo province and its geographical coordinates are 24° 36' 00" E and 27° 24' 00" S. According to [19], Thabazimbi has a population of 28 847 and the area is dominated by black Africans, with the majority being Tswana-speaking people. According to the water risk filter of the World Wildlife Fund, Thabazimbi appears as one of the water-stressed areas of South Africa. In 2019, Mayor John Fischer declared Thabazimbi's water supply situation as a major crisis. The municipality has a wastewater treatment plant but, incongruously, because the treatment plant is not capable of treating wastewater for reuse by people specifically, the municipality does not promote the reuse of wastewater. Instead, the municipality depends on two boreholes and the Magalies' Vaalkop Water Treatment Plant to supply it with water that it then distributes for consumption by the residents. Should the reuse of wastewater be implemented as a worthwhile water conservation measure, it would reduce the abstraction rate of freshwater from the boreholes and lead to a reduction in the cost of the water supplied by the Magalies plant to the municipality's residents.

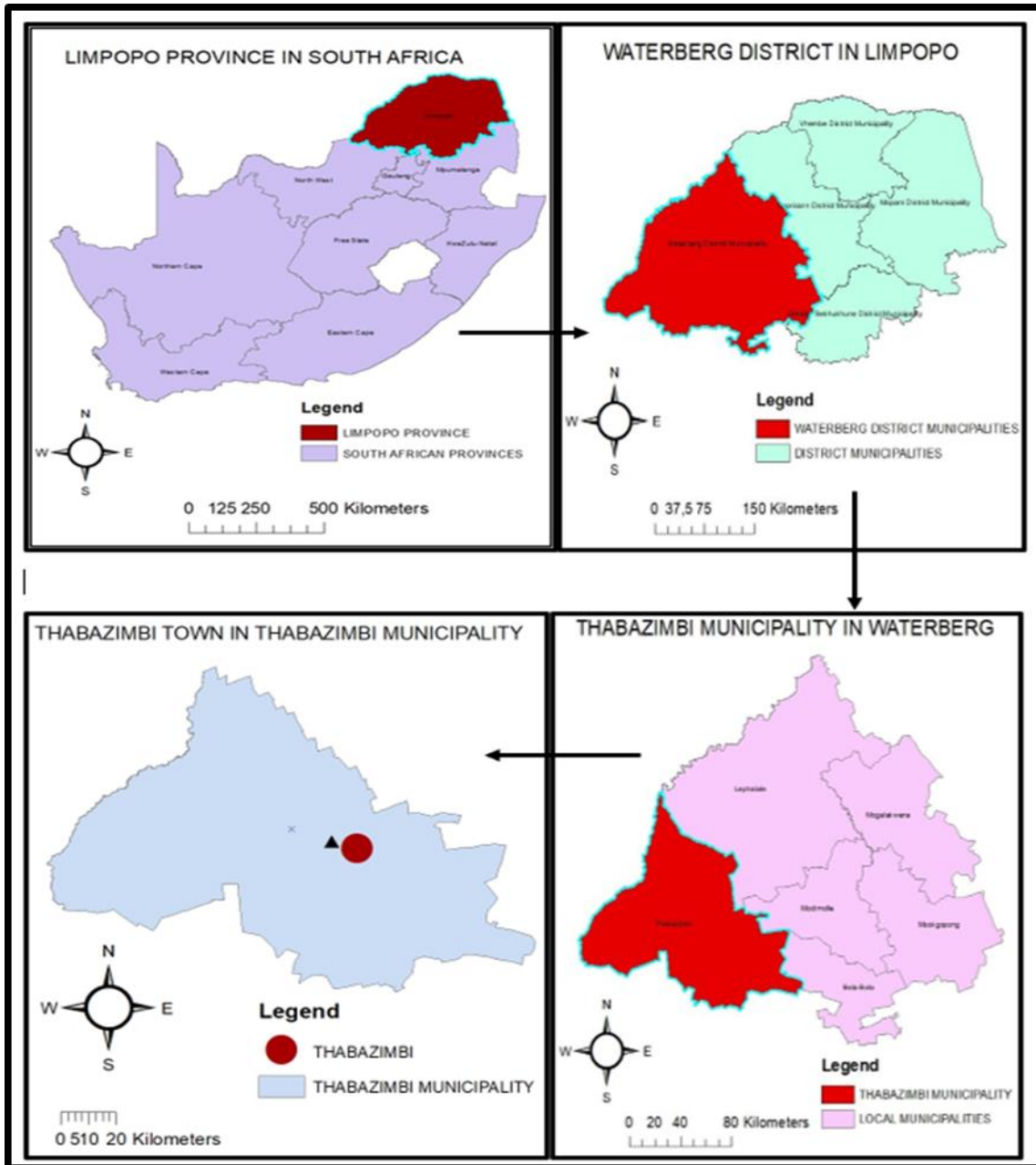


Figure 1: Location of Thabazimbi in Limpopo province, South Africa.

2.2. Sampling techniques

The research design used for this study is qualitative. Qualitative research was deemed suitable for this research project as the purpose of this study was to explore public perceptions on wastewater reuse. A sample size of 171 respondents was selected for this study. This is in the range of other studies of this nature, such as those conducted by [20] with a sample size of 115 and [18] with a sample size of 250. By using the convenience sampling technique, non-probability sampling was used to select the respondents for the study. In that this method allows for a quick understanding of certain trends [21], it was considered to be the preferred technique. The sampling frame embraced municipal officials, the staff of the wastewater treatment plant, and the residents of Thabazimbi. The above-mentioned stakeholders were selected for retrieving the information for this research

project for the following reasons: the municipality is the water authority in question, the wastewater treatment plant staff have the required knowledge as to how the wastewater is treated, and the residents are the end users of the water.

2.3. Data collection methods

Primary data were collected using questionnaires and on the basis of information gathered through observations and interviews. A total of 165 questionnaires were distributed to the community members and administered by the researcher. The questionnaire covered demographic characteristics and public knowledge on wastewater reuse. Moreover, six interview sessions were conducted; three were with municipal officials, while the other three were with wastewater treatment staff. The data were manually coded on the basis of similar or related responses in order to generalize on the responses and to ultimately develop suggestions and recommendations.

2.4. Limitation of the study

The study was conducted during the corona virus (Covid-19) pandemic. Hence, some of the residents in the study area were not willing to participate in the study for fear of contracting the virus. The questionnaires were available in English, whereas most of the participants were Tswana speaking. This may, therefore, have had an influence on the interpretation of some of the questions. It was found that the published literature on public perceptions on wastewater reuse in South Africa was limited.

3. Results and discussion

3.1. Demographic characteristics

The respondents for the study were both male (48%) and female (52%). The age group comprising the largest proportion (27%) of the respondents was the 18 - 29 age group, followed by the 30 - 39 age group (26%). The other age groups, namely the 40 - 49 (19%), 50 - 59 (15%), and 60 and older (13%), constituting the rest of the sample, proved to be less significant to this research. The Number of young people (youth) that participated in the study was large, since, owing to the lack of employment, many were available during the day. According to [22], the youth unemployment rate in South Africa is high, at a record level of 64.40%.

Table 1 below indicates that the majority of the respondents (67%) were black, 21%, white, 5%, coloured, and 6%, Indian, while “others” comprised only 1% of the sample. Most of the blacks were Tswana people because Thabazimbi is adjacent to Botswana. Hence, many migrate to the area in search of jobs on the mines. Furthermore, the majority of the respondents (59%) were employed, 23%, self-employed, 10%, unemployed and 8%, either students or retired.

Table 1: Demographic characteristics of the respondents.

		%
Gender	Male	48
	Female	52
Age(years)	18-29	27
	30-39	26
	40-49	19
	50-59	15
	60 and older	13
Ethnicity	Black	67
	White	21
	Coloured	5
	Indian	6
Qualification	Below matric	22
	Matric	41
	Diploma	30
	Postgraduate	7
Employment	Employed	59
	Self employed	23
	Not employed	10
	Others	8

3.2. Public perception on wastewater reuse

3.2.1. Wastewater reuse options

Figure 2 below presents the distribution of the responses in respect of the options that the respondents would be willing to adopt in their reuse of wastewater. Such information serves to provide valuable insights to project developers in identifying which specific option would yield positive results.

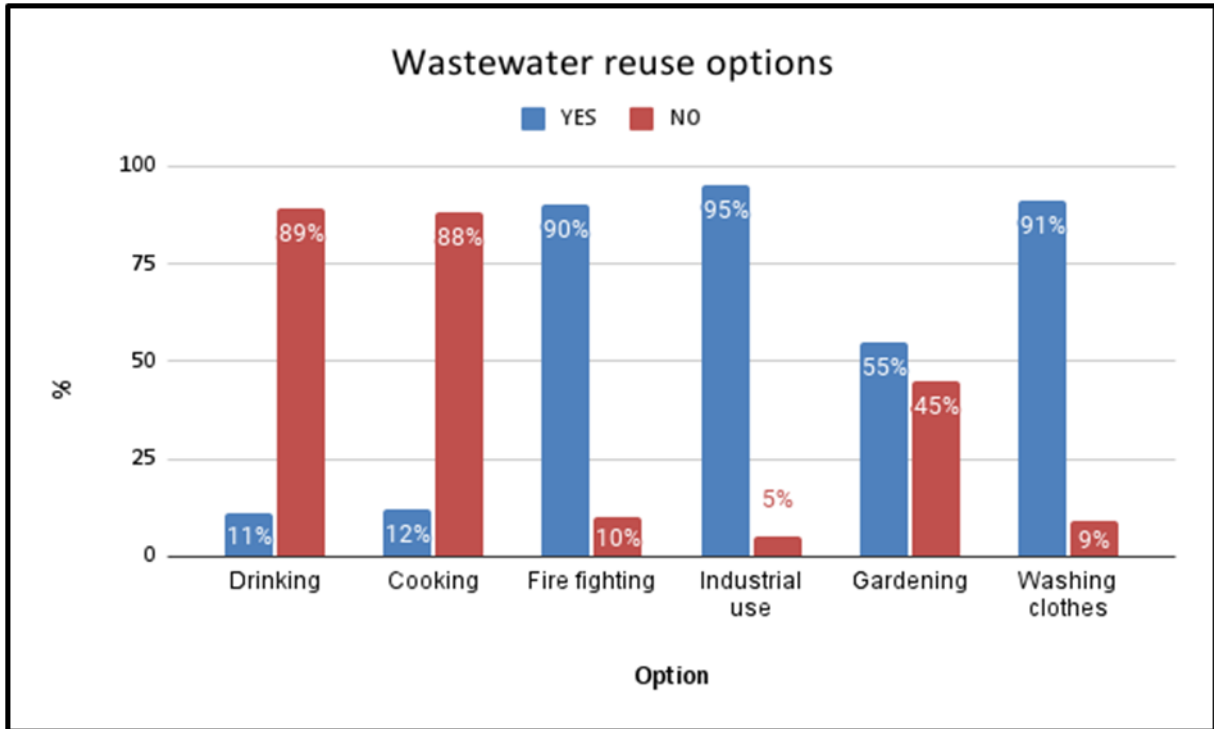


Figure 2: Wastewater reuse options.

The research revealed that most of the respondents (89%) are not willing to reuse wastewater for drinking purposes because they are of the opinion that even though it has been treated, the water is not clean enough. Also, 88% of the respondents are not willing to reuse wastewater for cooking because the water is still considered to be polluted, regardless of the fact that the pollutants have been removed from the water. Furthermore, it was observed that 11% and 12% of the respondents are willing to reuse wastewater for drinking and cooking purposes respectively. Also, respondents are willing to reuse wastewater for fire fighting (90%) and industrial uses (95%). The results imply that the willingness to reuse wastewater is associated with water uses involving limited human contact. Thus, these results agree with those of previous studies that show that people are willing to reuse wastewater for activities with limited personal contact [23,7]. Therefore, when planning wastewater projects, the responsible authority should consider public participation by all affected stakeholders, such as communities and business owners. This would assist in determining the best viable option that the community would be willing to accept, which would in turn lead to higher success rates for projects in respect of the reuse of wastewater.

3.2.2. Wastewater reuse concerns

The reuse of wastewater reuse is strongly influenced by public concern, which influences the perceptions of respondents regarding wastewater reuse. Hence, the respective concerns of the public must be addressed before the commencement of any wastewater reuse project. Figure 3 below illustrates the concerns that the public have regarding the reuse of wastewater in future projects.

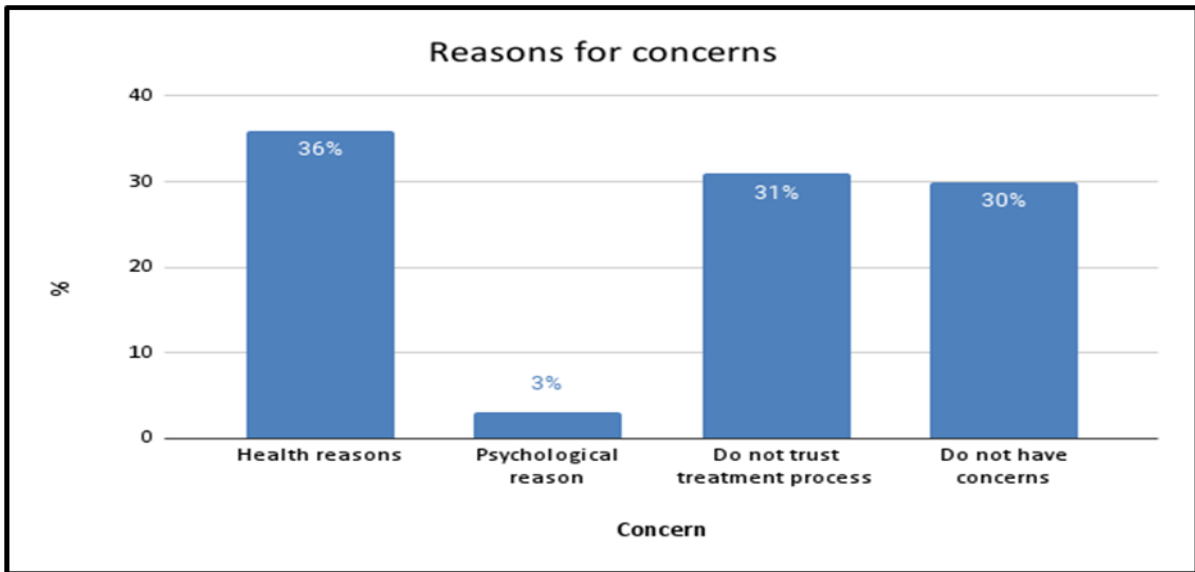


Figure 3: Reasons for concerns about wastewater reuse.

The greatest cause for concern regarding wastewater reuse is the health issue (36%), followed by lack of trust in the treatment process (31%) and psychological reasons (3%). Moreover, the respondents with concerns in the psychological arena perceive that wastewater is sewage water regardless of whether it has been treated. They therefore posed the question as to who would want to consume such water. A study by [24] revealed that most of the participants who had health concerns were mainly afraid of the pathogens and toxic substances present in the wastewater, which could result in diseases, such as cholera, typhoid and diarrhea. Some of the respondents (31%) do not trust the processes used to treat the wastewater because they perceive that the water is not totally clean and suitable for reuse. It is worth mentioning that 30% of the respondents had no concerns regarding the reuse of wastewater. Since the above-mentioned factors influence public perceptions on the reuse of wastewater, public awareness campaigns and measures to involve the public would assist the project developers in providing the public with reliable information on the reuse of wastewater and address the concerns they have.

3.2.3. Trust in the stakeholders involved in wastewater reuse projects



Figure 4: Trust in Water authorities.

The aspect, trust, was examined since to hold trust in the different stakeholders involved in wastewater reuse is a major determinant in accepting the practice, wastewater reuse [25]. Figure 4 below shows the level of public trust held by the respondents in respect of the respective stakeholders.

The majority of the participants (55%) trust the practice of reusing wastewater as long as it is endorsed by professors and experts. Lagging behind this category, are the respective proportions of respondents expressing trust in the Department of Water Affairs (39%) and in the local municipality (6%). When the endorsement is carried out by the Department of Water and Sanitation (DWS), trust is greater than that held in respect of the local municipality since the department is the national custodian of water resources in the country. It is responsible for ensuring that the municipality acts as the responsible water authority on the local level in providing good quality water to the residents through Blue Drop certification. The Blue Drop Certification programme is the regulation tool introduced by DWS with the aim of restoring the trust of the general public in the quality of tap water. In fact, it seeks to certify the quality of the water supplied by a municipality [26]. In general, trust in local government is closely tied up with its performance in providing other key services. As such, the dismal performance in its current provision of electricity and health services has contributed to the local municipality being the least trusted authority on water. For future wastewater reuse projects to be successful, different water authorities should be involved from the initial stage of the project.

3.3. Public knowledge on wastewater reuse

The level of knowledge the respondents have on wastewater reuse is presented in Figure 5 below.

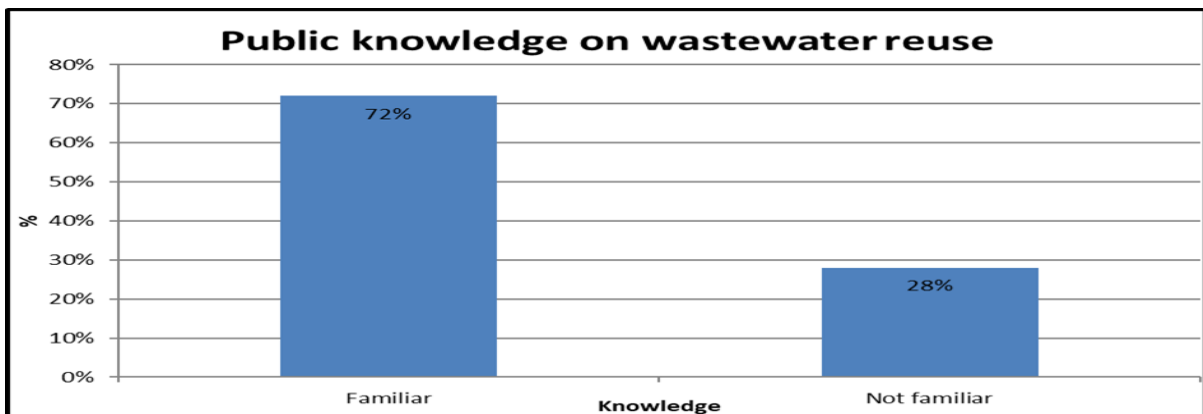


Figure 5: Knowledge on wastewater reuse.

Because they were able to describe the wastewater treatment process, it was clear to the researcher that many of the respondents (72%) are familiar with the reuse of wastewater. They highlighted the process whereby their wastewater is transferred to the treatment plant, where chemicals are used to purify the water. Once the water is clean, it is transferred back to their homes. Therefore, these respondents showed their inclination to accept the reuse of wastewater but only under certain conditions (options). The other respondents (28%) indicated that they know about the term, wastewater reuse, only through the newspapers, television and social media. The results are in line with previous research findings that show that the increase in a person’s knowledge regarding the

wastewater reuse process increases their level of acceptance of this process [27,25]. Therefore, public awareness campaigns should be implemented in the affected communities to provide reliable information regarding wastewater reuse and issues regarding water. Public awareness in this area can be achieved by providing training sessions to the community members about water-saving measures and the importance of wastewater reuse. Pamphlets and posters about wastewater reuse could also be distributed around the community.

4. Conclusion

Thabazimbi is definitely suffering a water shortage, which has been caused by different factors. With the level at which the world, including South Africa, is experiencing water shortages, communities will suffer more in the future than they are at present. This applies particularly to the Thabazimbi community. Hence, there is a need to implement the reuse of treated wastewater in the area. This will assist in supplying the community and the businesses in the area with treated wastewater while conserving the limited fresh water resources currently available. In this research, the public's acceptance of the practice of wastewater reuse was found to be greater under conditions where participants have the knowledge about it, when a wastewater reuse project is endorsed by professors and experts and the Department of Water and Sanitation, and when the level of human contact in using the treated wastewater is minimal. On the other hand, there is a negative attitude towards the reuse of wastewater on account of health concerns and when trust in the local municipality as a water authority, and also knowledge on wastewater reuse, is minimal. Therefore, in order for future wastewater reuse projects to be successful, community participation around them is essential.

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