


Evaluating public perceptions, attitudes and participation in water resource management: The case of an urban township in South Africa

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Abstract

Public participation in water resource management is crucial for community development and resource sustainability. Many studies on water resource management have been done on urban river systems, focusing on water quality, and concentrating mainly on the physical, chemical and biological parameters, while neglecting the social impacts. An example of this is seen in the Kaalspruit, a highly polluted river in the township of Tembisa. After the confluence with the Olifantspruit River, the Kaalspruit runs through the residential and highly industrialised areas of Clayville, Tembisa and Ivory Park in Johannesburg, South Africa. The aim of the study is to evaluate public perception, participation and attitudes towards water resource management in the Kaalspruit River, and to aid with a related community management plan. This was achieved by purposive and random sampling of relevant stakeholders and the public. Community knowledge was used to increase water quality awareness. The study revealed that those surveyed are discontented with the river's current state but are interested in rehabilitating it. Their participation highlighted the need for a community-based management plan for the river.

Key words: community engagement, IWRM, kaalspruit, tembisa

INTRODUCTION

Public participation in water resource management is the key factor in improving and restoring the quality of degraded water resources (Ananga 2015). Integrated water resource management (IWRM) is heavily promoted in the water sector because it is known to provide holistic ideas. IWRM's definition must be understood as that determines how it is implemented (Rouillard *et al.* 2014). The key element is public participation, which is highly important in urban areas due to the population density. Any changes in the urban pattern affect the population at a larger scale (Apipalaku *et al.* 2015). With South Africa's increasing water crisis, an integrated approach that takes into account all physical, biological, chemical and social parameters in water resource management, is essential to promote the sustainability of resources (Carr & Bloschl 2012; Apipalaku *et al.* 2015).

According to Apipalaku *et al.* (2015), empowerment and participation enhancement with knowledge, capability strengthening and awareness encouragement are important for water resource management decision-making, balancing conservation with the short- and long-term beneficial use by stakeholders (Euler & Heldt 2018). The role of public participation in water resource management, especially in river systems, is often neglected because the focus has been more on assessing water quality, identifying pollution sources, and placing the responsibility for maintenance and rehabilitation on government, without involving those that benefit (Coetzee *et al.* 2016).

Some places have implemented IWRM with positive outcomes but also highlighted the challenges that come with this kind of approach (Tantoh & Simatele 2017). The purpose of this study was to use community participation as an IWRM strategy in the Kaalspruit River. The study was concentrated

mainly on the local community, to evaluate their perceptions, participation and attitudes towards water resource management in the river, and assist the development of a community management plan for it.

The study's anticipated outcomes include a well-evaluated perception of the community, and their opinions and concerns regarding the Kaalspruit's water quality. The results are also expected to show a definite interest from the community in rehabilitating the river.

MATERIALS AND METHODS

Study area

The Kaalspruit River is one of the most highly polluted river systems in South Africa. It lies east of Johannesburg in Tembisa (Bega 2017) and joins the northern part of the Olifantspruit River near the Midstream Estate. It flows through two municipalities, the City of Johannesburg and Ekurhuleni. Tembisa is a township in the East of Johannesburg, and six localities near the river were selected (Figure 1), three sites are within the City of Johannesburg (Kaalfontein, Ebony Park and Ivory Park) and three within Ekurhuleni (Midstream Estate, Clayville and Tembisa).

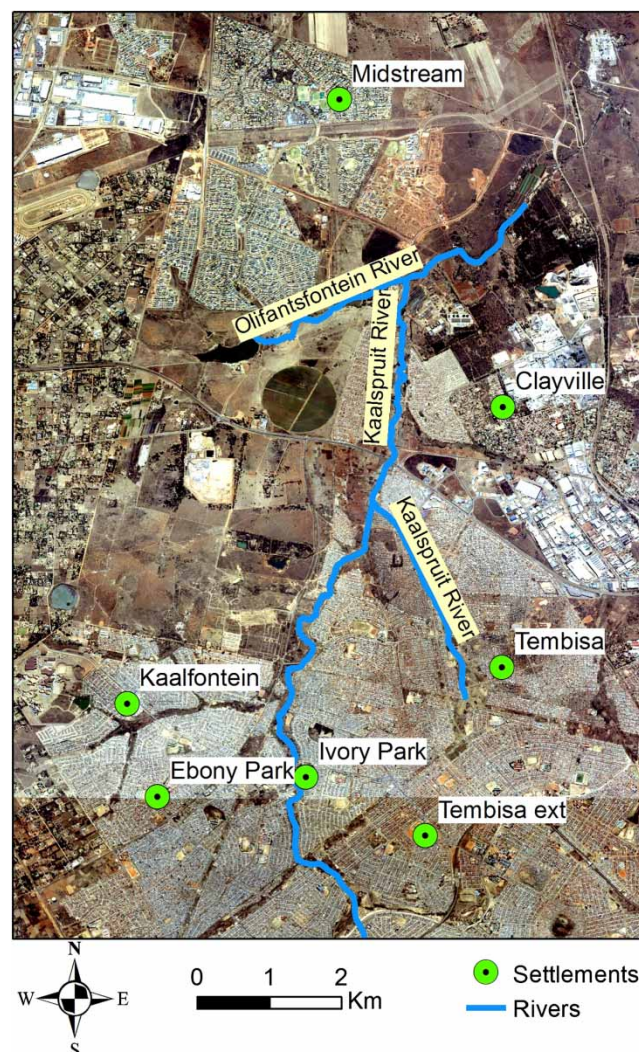


Figure 1 | Kaalspruit River and surrounding communities.

Data collection

The data were collected through field surveys entailing face-to-face interviews in the six townships surrounding the river system and with online questionnaires. The latter were distributed on media platforms – e.g., Twitter, LinkedIn, Facebook, and WhatsApp – and by email, with the aim of reaching the mobile population of the study area. Surveys were hand-distributed in the townships to reach those without access to electronic devices. The face-to-face interviews were conducted to accommodate members of the community who could neither read nor fill in the questionnaire on their own. The questions asked were variously open-ended, fixed and range, examples of the types of questions asked are presented in Table 1. One hundred (100) participants were interviewed from the community. Although these demographics might indicate that the survey population is unlikely to represent the population as a whole this was not a factor as the aim was to tap into the group(s) most likely to help drive improvements like IWRM forward.

Table 1 | Examples of key questions posed to participants

Section	Examples
Demographics	<ul style="list-style-type: none"> • Age, gender, occupation, level of education, how long have you lived in the area, etc
Perceptions on the Kaalspruit	<ul style="list-style-type: none"> • Awareness of the current state of the river • Personal value of the river to participants • Should the community be involved in rehabilitating the river • Personal interest in rehabilitating the river • Recommendations to aid in the rehabilitation

Data analysis

The online questionnaire was created using Google Forms (Google Forms 2018, <https://www.google.com/forms>) so that the data collected could be encoded automatically into a Microsoft Excel spreadsheet. All data were analysed in R (R Development Core Team 2017). To test for the correlation between two variables, a simple linear regression model was fitted to the data when the predictor and response variables are continuous. These variables are log-transformed to meet the assumption of normal error structure. However, when the predictor variable is categorical and the response is continuous, a simple Analysis of Variance (ANOVA) test was run. The significance level of relationships between variables was tested based on the p value: $P > 0.05$ implies no significant relationship whereas $P < 0.05$ means significant relationship between two variables.

RESULTS

The demographic details can be summarized as –

More male than female participants were interviewed and the dominant age group was 18 to 24 year olds; and,

The majority of participants possess a tertiary degree and have resided in the community for over 6 years. Although the survey population does not represent the population as a whole, it is a representation of the groups most likely to assist in driving IWRM initiatives forward.

The survey results showed that more than half (63%) feel that their daily activities are affected by the river and the majority are aware of the river's current state. However, far fewer – around 47% – acknowledge their role in rehabilitating the river. The statistical analysis showed a positive correlation

between potential role awareness and biographical variables such as age, gender, level of education and occupation, as well as the degree to which changes in the river system might affect participants' daily lives (Table 2).

Table 2 | Results from the statistical analysis to determine whether awareness of the river's current state depends on these variables

Variables	Estimates	Awareness			Relationship
		Standard error	Z value	p-value	
Age	0.07	0.02	2.55	0.01*	Yes
Gender	0.88	0.38	2.32	0.02*	Yes
Level of education	-0.74	0.33	-2.25	0.02*	Yes
Occupation	0.46	0.23	2.03	0.04*	Yes
Number of years residing in the area	0.06	0.19	0.32	0.75	No
Household size	-0.10	0.23	-0.43	0.66	No
River condition affects daily lives	1.57	0.46	3.37	0.000739**	Yes

*Significant; **Highly significant.

Local people can provide detailed information and knowledge on local natural resources that are unknown to administrators and/or scientists (Tantoh & Simatele 2017). Indigenous knowledge from the communities surrounding the Kaalspruit River is essential for successful river management implementation. Some community members have lived in the area for as long as 11 years, and therefore know the socio-ecological paradigms of the river sufficiently well.

The study revealed that the community around the Kaalspruit River is generally aware of its current state and willing to participate in rehabilitation efforts. This level of awareness of natural resources is essential for communities, because, as noted by Hudson (2001), environmental education and awareness are important aspects of environmental management. Communities must, therefore, be educated about their environments. Environmental education not only improves environmental knowledge but affects people's attitudes towards the environment (Lieflander & Bogner 2006).

To achieve the study's second objective the perception of the public as role players in sustaining the river was further used to determine whether it depended on the demographic variables of the respondents – perception was used as the response and the demographic variables as the predictor. Analysis revealed no significant relationships between perception of the community as role players and their demographics. Most respondents (51%) are aware of the changes taking place in the river, including its deterioration. The factors of concern ranged from environmental (water quality degradation and habitat loss), to social (increased crime and no clean rivers to perform rituals) and economic (deteriorating aesthetic qualities impact surrounding businesses).

The level of awareness was also assessed against the study's demographics. This showed that older people are more aware of changes in the river's state than younger people. This is cause for concern because younger people have the potential to be active in river rehabilitation, if the opportunity arises. This is supported by Grimmette (2014) who asserts that youth respond well to environmental awareness programmes, which can change their perceptions of the environment and encourage them to be more involved in environmental/resource management. Tantoh & Simatele (2017) further support the notion and feel that there is potential for youth to be dynamic development tools within their communities.

The final analysis in the study was based on participants' interest in rehabilitating the river and their demography. The response about willingness to rehabilitate the river was used as a response variable in the R software to determine whether it depended on the respondent's demographics. Statistical analysis revealed no significant relationships between interest in rehabilitating the river

and peoples' demographics. This feedback is useful as willingness to rehabilitate these water resources is crucial – government rehabilitation efforts will be futile without the community (Rapholo & Pepu 2018). This implies that although they do not believe that river conservation and management are their primary responsibility, they are willing assist in the rehabilitation of the Kaalspruit should the government make the initiative and request them to do so. Similar results were found by Jingling *et al.* (2010) when evaluating the willingness of respondents to participate in environmental management. Their respondents expressed interest in resource management but their level of willingness did not translate into the same level of participation. Another participation assessment indicated that communities are mostly interested in resource management (Braun & Shoeb 2011).

The general decrease in awareness with increase in the level of education was unexpected. It had been expected that those who attended formal schooling would be more environmentally aware than those with less education. This is because environmental education is included in the curriculum and is not elective, at both primary and high school levels, and both internationally (Razzino 2003; Arslan 2012; Stanisic & Maksic 2014) and nationally (Cowie 1997; Le Grange 2002; Mokhele 2011). However, the assumption in this study is negated by an investigation of public perceptions of water shortages and conservation behaviour, which showed that educated people are less environmentally aware than those who are uneducated (Garcia-Cuerva *et al.* 2016).

Environmental awareness of the river's state was higher amongst employed than unemployed respondents. This could be explained by the fact that the unemployed spend most of their time at home and around the river. Thus, their lack of awareness of the river could imply either that they are ignorant or that they do not generally care about the river's state. Their state of unemployment could also make them feel as though they have nothing to offer in relation to the river's 'quality', and that their views and opinions might be rejected.

Slightly less than half of the participants – some 47% – acknowledged their responsibility in rehabilitating the river. This is concerning as it signifies that the people living near the river, who are affected by its bad state and who might be contributing to its deterioration, are not keen to take responsibility for its restoration. It might be that they believe the municipality holds the primary responsibility in river rehabilitation. This sort of perception must change for progress in resource management to be attained, as local communities interact directly with natural resources and so should acknowledge responsibility in such efforts (Agrawal & Gibson 1999).

Several studies have promoted public participation in water resource management (Carr & Bloschl 2012; Carr *et al.* 2014; Tantoh & Simatele 2017). Carr *et al.* (2014) asserted that the role of public participation is to improve resource management so as to achieve efficiency and efficacy (Carr *et al.* 2014). Resource management is a way of achieving sustainable development and, as such, stakeholder engagement can be used as a vehicle for its accomplishment (Day 2009). Although it is important to bear in mind that stakeholder engagement and public participation are by no means always the same thing, stakeholder engagement can also result in community empowerment and thus enhance community development (Tantoh & Simatele 2017). Not only can it result in effective resource management, it can be used as a tool to build trust and communication among communities, authorities and other stakeholders, helping to strengthen stakeholder interactions and networks (Carr *et al.* 2014).

CONCLUSIONS

The community's willingness to participate in rehabilitating the river is a crucial step towards achieving community-based water resource management. This should be coupled with willingness by the river management authorities to involve local communities. If the approach is implemented properly, it will be the foundation for effective rehabilitation and management of the Kaalspruit River.

A management plan involving public participation is required for the Kaalspruit River's rehabilitation and future management.

REFERENCES

- Agrawal, A. & Gibson, C. 1999 *Enchantment and disenchantment: the role of community in natural resource conservation*. *World Development* 27(4), 629–649.
- Ananga, E. O. 2015 *The Role of Community Participation in Water Production and Management: Lessons From Sustainable Aid in Africa International Sponsored Water Schemes in Kisumu, Kenya*. Graduate Theses and Dissertations, pp. 1–215.
- Apipalaluk, C., Wirojangudb, W. & Ngang, T. 2015 Development of community participation on water resource conflict management. *Procedia – Social and Behavioral Sciences* 186, 325–330.
- Arslan, A. 2012 Predictive power of the sources of primary school student's self efficacy beliefs on their self efficacy belief for learning and performance. *Educational Sciences Theory & Practice* 12(3), 1915–1920.
- Bega, S. 2017 *Landfill Monster Choking its Neighbours*. Available from: <https://www.iol.co.za/news/south-africa/landfill-monster-choking-its-neighbours-8142595> (accessed 06 September 2018).
- Braun, B. & Shoeb, A. Z. 2011 Ecological rehabilitation and public participation: general considerations and empirical evidence from a creek rehabilitation scheme near Cologne, Germany. *Journal of Life Earth Science* 6, 1–11.
- Carr, G. & Blöschl, G. 2012 *Evaluating participation in water resource management: a review*. *Water Resources Research* 48, 1–17.
- Carr, G., Blöschl, G. & Loucks, D. 2014 Developing a dynamic framework to examine the interplay between environmental stress, stakeholder participation processes and hydrological systems. In: *Evolving Water Resources Systems: Understanding, Predicting and Managing Water–Society Interactions Proceedings of ICWRS2014*, June 2014, Bologna, Italy. (IAHS Publ. 364, 2014).
- Coetzee, H., Nell, W. & Bezuidenhout, C. 2016 *An assessment of perceptions, sources and uses of water among six African communities in the North West Province*. *Water SA* 42(3), 432–441.
- Cowie, T. L. 1997 *The Role Played by Environmental Education in Secondary School Geography Syllabus in A Future South Africa*. PhD thesis, University of Natal, South Africa.
- Day, S. J. 2009 Community-based water resources management. *Waterlines* 28(1), 47–62.
- Euler, J. & Heldt, S. 2018 From information to participation and self-organization: visions for European river basin management. *Science of the Total Environment* 621, 905–914.
- Garcia-Cuerva, L., Berglund, E. Z. & Binder, A. R. 2016 *Public perceptions of water shortages, conservation behaviors, and support for water reuse in the US*. *Resources, Conservation and Recycling* 113, 106–115.
- Google forms 2018 Available from: <https://docs.google.com/forms/d/e/1FAIpQLScu1F1MNBMGux90xBc-18e2MtakvDi6pFNyguA87yVowjAVxg/viewform> (accessed 30 July 2018).
- Grimmette, K. A. 2014 *The Impacts of Environmental Education on Youth and Their Environmental Awareness*. Lincoln: Digital Commons University of Nebraska, USA.
- Hudson, J. 2001 *Challenges for environmental education: issues and ideas for the 21st century*. *Bioscience* 51(4), 283–288.
- Jingling, L., Yun, L., Liya, L. & Zhiguo, S. 2010 *Public participation in water resources management of Haihe river basin, China: the analysis and evaluation of status quo*. *Procedia Environmental Sciences* 2, 1750–1758.
- Le Grange, L. 2002 Towards a 'language of probability' for environmental education in South Africa. *South Africa Journal of Education* 22(2), 83–87.
- Lieflander, A. K. & Bogner, F. X. 2006 Educational impact on the relationship of environmental knowledge and attitudes. *Environmental Education Research* 24(4), 611–624.
- Mokhele, M. L. 2011 *Integrated Environmental Teaching in South Africa: An Impossible Dream?*. Master's dissertation, University of Free State, South Africa.
- Rapholo, G. & Pepu, M. 2018 Sustainable water service delivery in rural areas: Outcomes evaluation report DST 04/2017-18 outcomes evaluation of accelerated sustainable water service delivery (ASWSD) project. Available from: https://www.dst.gov.za/images/2018/02/EVALUATION_-REPORT.pdf
- Razzino, M. P. 2003 *Environmental Education in Mexico: A Content Analysis of Primary School Textbooks*. Virginia, tech. Available from: <http://www.vtechworks.lib.vt.edu>.
- R Core Team 2017 *R: A Language and Environment for Statistical Computing*. Available from: <https://www.R-project.org/>
- Rouillard, J., Benson, J. & Gain, A. 2014 Evaluating IWRM implementation success: are water policies in Bangladesh enhancing adaptive capacity to climate change impacts. *International Journal of Water Resources Development* 30(3), 1–13.
- Stanisic, J. & Maksic, S. 2014 *Environmental education in Serbian primary schools: challenges and changes in curriculum, pedagogy, and teacher training*. *The Journal of Environmental Education* 45(2), 118–131.
- Tantoh, H. B. & Simatele, D. 2017 Community-based water resource management in North-west Cameroon: the role of potable water supply in community development. *South African Geographical Journal* 99(2), 116–183.