MONASH University

# CITIZEN SCIENCE AND MOTIVATION: A STUDY OF WATER RESOURCE MANAGEMENT IN MPOPHOMENI, KWAZULU-NATAL, SOUTH AFRICA


*By*

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## ABSTRACT

The use of Citizen Science (CS), which can be regarded as the involvement of ordinary individuals to address real-world problems through scientific data gathering and analysis, has gained momentum globally particularly in natural resource management. Citizen Science as a practice has been applauded for its numerous benefits such as educational benefits, skills gain and raising citizen awareness on the subject under investigation. Though the uptake of CS in the water sector has been rather slower in comparison to other natural resource sectors , there are numerous projects that have since engaged the use of citizen volunteers in water resource management particularly water quality monitoring.

In South Africa CS has mainly been adopted in the township areas which are characterised by inadequate service delivery and declining water quality. Furthermore, within the South African context, there is limited understanding of what motivates and sustains the participation of volunteers in CS. It can be suggested that initial participation can be motivated by the prospects of self-enhancement through learning and skills gain enabled by the projects, which does not bring betterment for the collective. However, the success of these projects hinge on understanding volunteer motivation, as it determines the quantity and quality of volunteers and ultimately how to motivate collective action. This study thus is aimed to explore whether CS could be used as an instrument to motivate, raise awareness, and sustain participation of the public in water resource management.

This design of the study was qualitative. A case study approach was used with a case selection of Mpophomeni township, KwaZulu-Natal, South Africa. The selected location was characterised by declining water quality which had resulted in a Citizen Science initiative – the 'Save Midmar Dam Project'. Data was collected using semi-structured in-depth interviews, document analysis and field observation. The interviews were conducted with fifteen participants. The participants were drawn from the active Non-Governmental Organisations (NGOs) running the 'Save Midmar Dam Project' in the Mpophomeni community. These included the Duzi-uMngeni Conservation Trust (DUCT), and the Wildlife and Environmental Society of South Africa (WESSA). The study also drew participants from the pool of Enviro Champs (ECs) involved in CS, community volunteers in the Save Midmar Dam Project and residents that had resided in Mpophomeni for at least five years. Data was also gathered during the study using of field observations with the author accompanying the Enviro-Champs as they carried out their door-to-door campaigns. Pictures of the processes such as fixing of water leaks were also captured during field observation. The document analysed in the study

constituted of the reports to the uMgungundlovu municipality (UMDM), meeting minutes of the ECs and a review of the Enviro-Champs project. Data was analysed manually using five steps of preparing the data, familiarisation, inducing themes, coding and interpretation.

The study findings showed that CS was able to motivate the initial participation of volunteers through its perceived incentives which offered prospects to better one's own welfare. However, for sustained participation in CS, there is a need to transform the volunteers into "agents of change" who could later be deployed into the community to motivate change towards better water resource management. To this end, the study showed that transformation can be achieved through capacity building which enables skills-gain. In this case this resulted in the volunteers developing a group and social identity which shifted the motive towards the betterment of the collective. This enabled them to influence the emergence of a new social norm of better water resource management in Mpophomeni.

Sustainable change will be achieved when the residents realise that they can resolve the problem of declining water quality through behavioural changes and conforming to the new emerging social norm of better water resource management. These findings provide a platform for a follow up study to assess whether the behaviour changes that were starting to be evident in the community towards water resource management are self-sustaining.

**Key words:** Citizen Science, Motivation, Water resource management

## DECLARATION

I, Tinashe Patience Rimau, declare that this thesis submitted for the degree of Master of Philosophy in Integrated Water Management at Monash University contains no material accepted for an award of any other degree or diploma in any university or other institution. To the best of my knowledge, it contains no material previously published or written by another person except where due reference is made in the text of this thesis.

Tinashe P. Rimau 18 July 2018

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## DEDICATION

This thesis is dedicated to

**MR C. RIMAU** – my late father

I really wish you could have seen me complete this journey, I was almost there. Despite your pain you cheered me on and believed in me. I know you are watching me from heaven and you are proud of me. I love you always and forever.

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| | |
|---|---|
| **CS** | **Citizen Science** |
| **DEA** | **Department of Environmental Affairs** |
| **DUCT** | **Duzi-uMngeni Conservation Trust** |
| **DWAF** | **Department of Water Affairs and Forestry** |
| **ECs** | **Enviro-Champs** |
| **miniSASS** | **mini South African Scoring System** |
| **MUHREC** | **Monash University Human Research Ethics Committee** |
| **NGO** | **Non-Governmental Organisation** |
| **SARMCOL** | **South African Rubber Manufacturing Company Limited** |
| **SDT** | **Self-determination theory** |
| **UMDM** | **uMgungundlovu District municipality** |
| **WESSA** | **Wildlife and Environment Society of South Africa** |
| **WRC** | **Water Research Commission** |
| **WWF-SA** | **World Wildlife Fund – South Africa** |

In this study though it is referred to as the Department of Water Affairs and Forestry (DWAF) in relation to the sources used, it is now currently referred to as the Department of Water and Sanitation (DWS).

# CHAPTER ONE

## INTRODUCTION

The value of water to human existence cannot be fully quantified (Morgan & Orr, 2015). It poses greater challenges when the sources of water dwindle because of mismanagement evident through declining water quality, resulting in most African countries being regarded as water stressed (Asmal 2002, UN–Water, 2007). However, despite this irrevocable truth, there remains a gap in the understanding of how to motivate individuals to become accountable collectively for their use of water. When individuals use water without considering how their actions impact on the other users or the environment, they may be understood to be acting in a manner of self-interest (Munnik, Molose, Moore, Tempelhoff, Gouws, Motloung, Sibiya, Van Zyl, Malapela, Buang, Mbambo, Khoadi, Mhlambi, Morotolo, Mazibuko, Mlambo, Moeketsi, Qamakwane, Kumalo & Tsotetsi, 2011). However, arguably the use of water without consideration of the repercussion it has on other users and ultimately the environment can also be due to lack of awareness (Murthy & Tiwari, 2016).

Citizen Science (CS) has been thought to provide solutions through its perceived benefits such as raising public awareness on environmental issues, the promotion of; pro-environmental behaviour, the development of social capital and collective action (Overdevest, Orr, & Stepenuck, 2004; Bonney, Cooper, Dickinson, Kelling, Phillip, Ronsenberg, & Shirk 2009). Citizen Science provides a platform for multiple stakeholders to work collectively towards addressing a mutual challenge (Cohn, 2008; Bowser & Shanley, 2013; Shirk & Bonney, 2015). It also provides opportunities for learning and skills gain which can motivate the initial participation of some of the volunteers (Rotman, Preece, Hammock, Procita, Hansen, Parr, Lewis & Jacobs, 2012). Understanding the motives of the different stakeholders is crucial in such projects as it not only determines the success of the project but also the retention of the volunteers (Nerbonne & Nelson, 2004; Shirk & Bonney, 2015). The retention of volunteers in CS is important, this is because the projects are powered by the work of the volunteers, who provide the data for analysis and in some cases are involved in the data analysis process (Morais, Raddick & dos Santos, 2013).

The relationship between CS and motivation thus becomes symbiotic meaning that whilst CS can motivate stakeholders to work collectively, there is also need for motivation to sustain

participation in CS. On this understanding, this study explored whether CS could be used as an instrument to motivate, raise awareness and sustain participation of the public in water resource management. The scope of the study was limited to Mpophomeni township in KwaZulu-Natal, South Africa as a case study area.

### 1.1. Background of the study

South Africa has been ranked 30th amongst the world's driest countries (McDonald & Pape, 2002). According to Kamara and Sally (2004) two thirds of South Africa is characterised by arid or semi-arid conditions. According to Eales, Forster and Du Mhango (2005) the semi-arid conditions make the country vulnerable to floods and droughts due to variable rainfall. These semi-arid conditions and drought periods, which South Africa has experienced for the past few years, have contributed to the dwindling amount of available water resources.

In addition to the impact of climate variability on available water resources, South Africa is facing challenges in managing the distribution of treated municipal water. This can be attributed to inadequate services and the maintenance of the water distribution infrastructure; as such the quantity of available water is lessened through water leaks, which account for up to 37% of loss, which occurs in most of the municipalities (WWF-SA, 2016).

In addition to the losses experienced in the distribution of treated municipal water, deteriorating water quality is a major water challenge in South Africa (Nkhata, Breen & Hay, 2014). According to James (2008), the declining water quality diminishes the economic use of water and poses a threat to the health of human and other aquatic life. In addition, it exacerbates the water challenges, as declining water quality compromises the use of water, lessening the available quantity (Peter & Meybeck, 2000).

According to Batson (1994) social problems such as declining water quality are a result of failure to act for the public good, with individuals only acting in their self-interest and not focusing on the needs of others. Acting for the public good as defined by Batson (1994), is when one acts to better the welfare for someone other than one's self and thereby improving the welfare of the community. It becomes imperative to motivate individuals towards collective action for water resources to ensure water security, which is the availability of an acceptable quantity and quality of water (Grey & Sadoff, 2007).

Collective action has been referred to as the voluntary action that is taken by individuals to attain a mutual goal (Meinzen–Dick, DiGregorio & McCarthy, 2004). Acknowledging the value of collective action, the South African government put in place Policies and Acts that

promote public participation in water resource management. For example, the National Water Act No. 36 of 1998 (DWAF, 1998) facilitated democracy in water management by acknowledging the public as the owner of water resources and the government as the custodian. It also mandated participation of the public in water management, with special focus on the disadvantaged and marginalised groups.

Chapter 14 of the National Water Act No.36 of 1998 of South Africa also acknowledges the need for water quality monitoring (DWAF, 1998). Water quality monitoring has been defined as constituting two concepts which are data acquisition and management, and storage of data relating to the quality of water resources (DWAF, 2004). The need to protect water quality within South Africa is also advocated by the Water for Growth and Development Framework (DWA, 2009).

Despite, the intentions of the South African government to promote collective action in water resource management, individuals are not motivated to participate, particularly those from previously challenged communities (Boakye & Akpor, 2012). Thus, understanding how to motivate individuals to participate in collective action is of utmost importance for the wise use of water resources.

Arguably, human action in some cases is motivated by self-interest, as a result one's participation might also be due to the anticipated outcome which gratifies this self-interest (Rotman et al., 2012). Self-interest however, has detrimental effects on water resources as early indicated by Batson (1994), thus there is need for self-interested individuals to become collectively motivated towards collective action. Early works by Hardin (1968) and Olson (1971) sought to explain how self-interested individuals achieve collective actions outcomes. The cardinal rule of Hardin (1977:27) was "never to ask a person to act against his own self - interest". Olson (1971) emphasised that collective action can be only achieved by using coercion, selective punishments and incentives. Other studies, for example Stroebe and Frey (1982) and Sandler and Hartley (2001) have been rooted in microeconomic theory and paid little attention to social circumstances that motivate participation in collective action.

Deci and Ryan (1985) argued that social contextual conditions are important as they can either facilitate or hinder motivation. When individuals live in conditions of inadequate service provision, such as the case of many townships in South Africa, the likelihood for motivation towards collective action for a public good would be relatively low. These townships are residential areas that were developed during the Apartheid era to promote racial segregation

and exclusion. Consequently, they are challenged by inadequate service provision, marginal economic opportunities and high unemployment rates (Pernegger & Godenhart, 2007; Sibiya, 2012). Despite, the transition from apartheid to post–apartheid, there are still challenges in services provision to these areas (Pretorius & Schurink, 2007). WWF-SA (2016) has also highlighted that municipalities are faced with challenges of maintaining the existing and ageing infrastructure. It is these social conditions that hinder self-motivation as residents become apathetic towards collective action in water resource management.

As earlier indicated the South African government has put in place acts and policies, such as the National Water Act No. 36 of 1998 to motivate the participation of marginalised groups in water resource management. The weakness in this approach is that it fails to account for the limited capacity of the individuals to meaningfully participate in the process (Faysse, 2005). It can thus be assumed from the argument posed by Faysse (2005), that lack of participation in water resource management for individuals in challenged communities could be viewed as apathy. In their earlier work, Starkstein, Mayberg, Preziosi, Andrezejewski, Leiguarda and Robinson (1992) regarded apathy as the "absence of motivation and diminished goal-directed behaviour". However, lack of participation is also because of lack awareness of the policy and the legislation.

According to Munnik et al. (2011) the lack of awareness could be because of the Apartheid era where the public was marginalised from the management process. The authors stated that due to this background there is need to raise awareness on the need for participation in water management, as well as an understanding of water quality issues (Munnik et al., 2011). Murthy and Tiwari (2016) supported the views of Munnik et al. (2011) arguing that meaningful participation in natural resource management only occurs when awareness is raised on the state of the resources and of the causes of the changes within those resources. To develop awareness on the environmental challenges, Jingling, Yuna, Liyaa, Zhiguoa and Baoqiang (2010) argued that the best approach was for the public to have personal experience, which can be facilitated through collective action. Citizen Science (CS) could be a solution in such a context.

Cohn (2008) defined CS as scientific research in which ordinary individuals are involved to address real-world problems. Citizen science has been acclaimed as a way of bringing participation of the public (Conrad & Hilchey, 2011). It also provides a platform for multiple stakeholders to work collectively towards addressing a mutual challenge (Cohn, 2008; Bowser & Shanley, 2013; Shirk & Bonney, 2015). Other key advantages of CS are that it can raise

awareness and facilitate learning outcomes such as behaviour change, an increase in social capital which results in skills gain and increase in content knowledge (Bonney et al., 2009). These highlighted benefits can be assumed to motivate the initial participation of some volunteers to engage in water resource management as they offer prospects to better one's welfare (Rotman et al., 2012). This study explores the potential of CS as an instrument to motivate, raise awareness and sustain participation of the public in water resource management.

### 1.2. Research Problem

Water is a common pool resource which requires collective action for sustainable use. However, individuals are mostly motivated by self-interest which has detrimental effects on water resources, such as declining water quality. Therefore, the challenge for achieving successful water resource management hinges on being able to shift individual motivation from self-interest towards collective motivation. CS has been commended for its ability to raise public awareness, promote development of social capital and collective action (Overdevest et al., 2004; Bonney et al., 2009). Though there is a growing uptake in the use of CS in water resource management within the South African context (Kolbe, 2014; Cele, 2015), these studies have been limited to understanding its learning outcomes and perceptions of the participants on their engagement. Furthermore, Geoghegan, Dyke, Pateman, West and Everett (2016) highlighted that there was a gap in the understanding of the relationship between CS and motivation due to various methodologies used. Consequently, there is a need to develop understanding of the potential of CS as an in instrument to motivate, raise awareness and sustain participation of the public in water resource management in the South African context, with focus on marginalised townships.

### 1.3. Research Objectives

The main objective of this study was to explore whether CS could be used as an instrument to motivate, raise awareness and sustain participation of the public in water resource management.

**Specific Objectives:**

- To develop an understanding of how CS affected motivation of the public to participate in water resource management.
- To determine the approaches used to raise awareness on water resource management.
- To assess what sustains participation of the public in water resource management.
- To assess the lessons that emerged from the relationship between CS and motivation in water resource management.

### 1.4. Structure of the thesis

The thesis has been structured into six chapters. Chapter one - the introduction of the thesis - provides the background of the study, outlines the problem statement, and research objectives.

Chapter two provides the theoretical framework which guided the study. It provides a review of literature on CS and motivation as well as establishing the relationship of the two concepts. The last section of the chapter provides a conceptual framework that guided the study. Consequently this influenced the methodology and research design adopted for the study.

Chapter three outlines the methodology and research design used within the study. The process of data collection and analysis are explained. Of importance in this chapter is the case study selection and justification outlining why Mpophomeni and the Save Midmar Dam project meet the requirements for the research.

Chapter four presents the results in relation to the conceptual framework of the study. A discussion of the results is presented in Chapter five and Chapter six presents the conclusions and recommendations for future research.

# CHAPTER TWO

# LITERATURE REVIEW

The purpose of this chapter is to set the scene as to why the use of Citizen Science and motivation in water resource management is important, particularly within the South African context. In this chapter the concepts of CS and motivation are explored. A conceptual framework is presented to illustrate how CS could be used as an instrument to motivate, raise awareness and sustain participation of the public in water resource management.

## 2.1. Water quality challenges within South Africa

South Africa is characterised by a rapidly increasing population and rapid urbanisation. According to Watkins (2006) human settlements contribute greatly to the decline of water quality. The contribution of the human settlement to the decline in water quality is exacerbated by the settlement proximity in relation to the water resource. An increase in population places a strain on the infrastructure such as the sanitation system. Novotny (2003) postulated that with every new addition of an individual there is an increase in human waste that place pressure on the sanitation system commonly translating to dysfunctional systems as the systems were designed to service specific numbers.

In addition, the sanitation system is further compromised by maintenance challenges. It is estimated that there are 986 operating sewage treatment plants within South Africa, most of which are dysfunctional because of poor maintenance of infrastructure and equipment (Snyman, Van Niekerk & Rajasakran, 2006). Dysfunctional sanitation systems contribute greatly to declining water quality as the partially treated and untreated waste water is often disposed into the local water courses.

In the Emfuleni district, for instance, in 2003 there was a court case between the Save Our Vaal Environment (SAVE) and Emfuleni municipality over dysfunctional wastewater treatment works (Tempelhoff, Van Zyl, Van Riet, Gouws, Hardy, Jordaan, Ludick, Motloung, Schlemmer, Venter, Van Greuning & Van Wyk, 2008). In this regard, collective action is necessary to address declining water quality arising from abuse of the sewerage system and uncontrolled discharge into water courses. Acknowledging the role for citizens in mitigating water pollution focuses attention on CS as an instrument to motivate, raise awareness and sustain participation in water resource management.

Population growth not only strains the sanitation system; it also results in an increase in solid waste output further affecting solid waste management. It has been estimated that the increase in population correlates to an increment of 2 to 3 percent per annum in solid waste (South Africa, 2008). In 2011, the Department of Environmental Affairs, National Waste Information Base Report stated that South Africa produced an estimated 108 million tonnes of waste with approximately 98 million tonnes being disposed of in landfills (DEA, 2012). There is a discrepancy between the waste produced and the waste that is disposed of through formal processes. This accounts for mushrooming illegal dumpsites and solid waste disposal on roadways and waterways which further compromise water quality (Kolbe, 2014; Hay, 2017).

The growing population also pressurises the agricultural sector to increase productivity, increasing the reliance on fertilizers and pesticides (Shabalala & Combrink 2012). Declining water quality in South Africa was not only due to agricultural run-off which constituted of fertilizers and pesticides but also erosion and sediment pollution (Lee, Smyth & Boutin, 2004). Livestock also contributes to agricultural pollution through faecal contamination as it is rich in nitrogen and phosphorous (Monaghan, Wilcock, Smith, Tikkisetty, Thorrold & Costal, 2007). Another source of water pollution is mining. The process of mining increases soil erosion as it loosens the soil structure increasing run-off and sedimentation of rivers (Naidoo, 2013). According to Dallas and Day (2004) water quality is further deteriorated through acid mine drainage.

This study was situated in the Umgeni Catchment of KwaZulu-Natal. The Water Research Commission (WRC) in 2012 established that the uMngeni River, which supplies water to most important economic sector of KwaZulu-Natal, was highly contaminated (Lin, Ganesh & Singh, 2012). The declining water quality in the uMngeni River was attributed to factors such as population growth, proliferation of informal settlements, ageing infrastructure, agricultural run-off, poor solid waste disposal and industrial effluent (Graham, 2004; Naidoo, 2005; Gebremedhin, 2009; Van Deventer, 2012; Colvin, Cartwright, McKenzie, Dent, Maherry & Mhlongo, 2015).

Moreover, the decline of water quality within the uMngeni Catchment was because of human behaviour. In most cases, individuals use water without considering how their actions impact on other users or the environment, acting thus in a manner of self-interest (Munnik et al., 2011). The authors argued that raising awareness and implementing accountability measures would result in a change of attitudes and behaviours (Munnik et al., 2011). This notion is supported

by Morgan and Orr (2015) who asserted that to protect and instil value in water sources there is need for interaction and exchange of information and knowledge amongst stakeholders.

Thus, in such a context of deteriorating water quality, collective action will only be possible if individuals are motivated and aware of the challenges and consequences of the choices they make.

## 2.2. Citizen Science

### 2.2.1. The concept of Citizen Science

Citizen Science is a concept that can be traced within the literature to the earlier works of Lewis Mumford (1938). Mumford (1938) advocated for an approach where citizens, through interaction with scientists, could learn about their natural environment. Even though not specifically referred to as CS, such a suggested approach embodies the very essence of CS. Miller-Rushing Primack and Bonney (2012) considered that the history of CS is most prominent in ecology and environmental monitoring. One of the earlier uses of the term CS was by Alan Irwin (1995) in his description of the existence of skills that ordinary individuals possess. The concept of CS over the past few decades has become more distinct in practice, particularly in natural scientific research (Silvertown, 2009; Bonney et al., 2009).

However, according to Everett and Geoghegan (2016), there is still limited peer-reviewed academic literature on CS. Despite this, the prominence of CS projects remains, and the term has since evolved and received many definitions which have been grouped in Table 2.1 below. These definitions have mostly been focused on the roles which are ascribed to the volunteers which in most cases is limited to data collection and in a few instances data analysis as depicted in Table 2.1.

**Table 2.1:** Definitions of Citizen Science in literature

| **DEFINITIONS OF CITIZEN SCIENCE IN LITERATURE** |
|---|
| Citizen Science has been defined by Silvertown (2009) as a process where the citizen scientist is involved in the process of collecting and or processing data as part of scientific inquiry. |
| Citizen Science are projects in which public collect, categorize, transcribe or analyse scientific data (Bonney et al., 2014). |

| |
|---|
| Cohn (2008) defined CS as scientific research in which ordinary individuals become involved to address real-world problems. He further stated that the volunteers were only involved in data collection. |
| Citizen Science had also been defined as a process where participants collect data following outlined protocols and submit the data to a central location where it is then analysed by the researcher who then publicizes the results (Bhattacharjee, 2005). |
| The European Commission (2013) gave a broader definition of CS referring to it as a process where the public is involved in the scientific research either through their intellectual effort, surrounding knowledge or their tools. |

In this study, CS is regarded as the involvement of ordinary individuals to address real-world problems through scientific data gathering and analyses. In this particular case the 'real-world' problem is the declining water quality. The case for CS is made apparent where a community does not appreciate its role in the 'real-world problem' of declining water quality and is consequently, not motivated to implement remedial measures.

As seen from the definitions indicated in Table 2.1, the role of ordinary individuals in CS varies due to the project design. Citizen Science projects can be distinguished into three models of involvement for the public: contribution, collaboration and co-creation (Bonney et al., 2009) (see Figure 2.1 below). The first model, contributory projects, is where the public only contributes data and professional scientists carry out the rest of the work (Bonney et al. 2009). This approach is however, quite popular in many CS projects and has been referred to as the "traditional CS" (Grossberndt & Liu, 2016).

Contributory projects, the second model, is where the public is delegated more roles, for example, the public can be involved in project design, analysis and disseminating the results (Bonney et al. 2009; Grossberndt & Liu, 2016). The last model has been referred to as co-creation. As the term implies a bottom-up approach is implemented and the public is involved at all stages of the project from initiation of projects (Bonney et al., 2009, Grossberndt & Liu, 2016). This approach – of co-creation – is supported by Wiggins and Crowston (2011), who emphasised the need for the involvement of the public in the development and design of the project.

According to Minkman, Van Der Sanden and Rutten (2017), these models of volunteer participation are determined by the objectives set for CS, but the majority are contributory in

nature. These models can be viewed in a hierarchical manner in relation to the role that is given to the volunteers in projects (Figure 2.1).

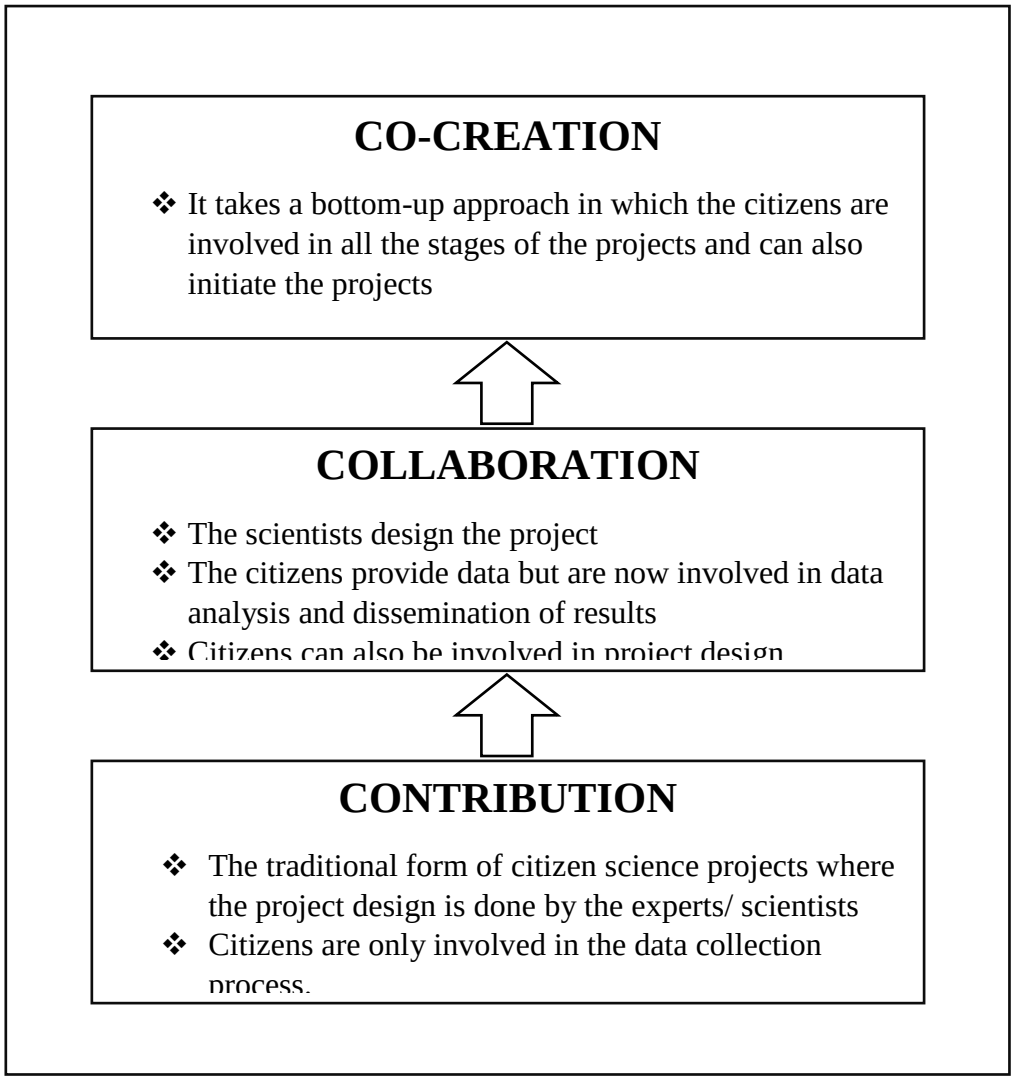


**Figure 2.1:** Model of Citizen Science projects depicting levels of citizen participation *(Adapted from Bonney et al. (2009) and Grossberndt & Liu (2016)).*

The desired outcome of any CS project, irrespective of the model, is that it brings benefits to all the participants (the scientists, volunteers and the community) (Thornhill, Loiselle, Lind & Ophof, 2016). It is against this background that this research proposed that CS could be used as an instrument to motivate, raise awareness, and sustain participation in water resource management.

### 2.2.2. Benefits of Citizen Science

The recent work of the Science Communication Unit (2013) highlighted that one of the benefits of CS is its ability to empower the public to become more engaged in collective action within the society. This view is supported by Overdevest et al. (2004), who stated that CS can facilitate the development of social capital required for collective action. Furthermore, CS has been

praised as an instrument for raising awareness amongst the public concerning environmental issues within their communities, for example the declining water quality in this study.

In their work Tweddle, Robinson, Pocock and Roy (2012) explained that the potential of CS to raise public environmental awareness reflects its ability to bring out challenges in a manner that allows individuals to easily relate and engage. It is because of this ability that some CS projects are developed specifically to capitalise on the potential of raising awareness (Haklay, 2015). A study carried out by Haywood, Parrish and Dolliver (2016) established that individuals involved in a CS project exhibited greater awareness of the environmental challenge being monitored. The public can also become aware of the environmental challenges through the volunteers sharing their experiences with their neighbours and friends (Forrester et al., 2016), an approach that has been viewed to yield better results in motivating public behaviour change (Stepenuck & Green, 2015).

Citizen science not only raises awareness amongst the public, it also brings out context-specific environmental challenges to the attention of responsible authorities. This was revealed in a study by Cele (2015) stating that CS awareness raising capability is not limited to the public only, but the public can also use CS to raise the awareness of the authorities on what is causing challenges affecting their environment. This is supported by Wei (cited in Zheng, Yang, Long & Jing, 2016) who recorded the events of two Chinese residents who managed to bring awareness to illegal dumping in their river from the period of 2004 to 2007 using CS. This draws attention to the value of CS as an instrument of raising awareness to both the residents and the authorities. In relation to this study, one can thus postulate that participating in CS projects related to water quality monitoring could result in greater awareness of water quality issues and of the need for a collective approach to water quality management.

Arguably, participating in CS also creates learning opportunities. Literature on CS has provided evidence that it fosters learning for the participants which can be through both formal training by scientists, and observations and reading of scientific material developed from the data gathered (Blaney, Jones, Philippe &Pocock, 2016; Jennett, Furniss, Iacovides, Wiseman, Gould & Cox, 2014). Learning opportunities in CS arise for all who engage: the volunteers, the communities and the professionals (scientists). Minkman, Van Der Sanden and Rutten (2017) recently noted that during the engagement with volunteers and communities, the professionals also gathered new knowledge.

The learning outcomes of CS have not been limited to an increase in public scientific knowledge (Brossard, Lewenstein & Bonney, 2005; Shirk & Bonney, 2015). Importantly this knowledge can lead to behavioural change for all those involved - individuals and groups - (Toomey & Domroese, 2013). Learning through CS also changes public assumptions and attitudes due to the increase in the understanding of ecological processes (Becker, Agreda, Astudilla, Constantine & Torres, 2005; Ballard, Fernandez-Gimenez & Sturtevant, 2008). Individuals who participate in CS projects also have been documented to exhibit pro-environmental behaviour (Jordan, Gray, Howe, Brooks & Ehrenfeld, 2011; Gommerman & Monroe, 2012) particularly toward the environmental issue that they were monitoring. For example, if individuals were engaged in water quality monitoring they would exhibit preservation behaviour towards water quality. This suggests, as earlier posited, that CS can be an instrument to motivate participation in water resource management. This relationship however, will be expounded further after motivation has been fully explained in the next section.

Citizen Science projects enable extensive data collection at a low cost as it depends on voluntary services. The voluntary nature of CS projects enables for extensive data collection which would have otherwise been time consuming and expensive (Dickinson, Zuckerberg & Bonter, 2010; Tulloch, Possingham, Joseph, Szabo & Martin, 2013). It also allows provision for location specific data and longer temporal data sets (Tulloch et al., 2013; Blaney et al., 2016), which makes monitoring more effective as volunteers tend to be spread out in various geographic locations. However, depending entirely on voluntary engagement for data collection can also result in spatial bias (Blaney et al., 2016) as data is only provided for locations where the volunteers are situated.

Citizen Science should lead to more informed decision-making capacity in those involved in the projects thereby improving environmental governance. According to Danielsen, Pirhofer-Walzl, Adrian, Kapijimpanga, Burgess, Jensen, Bonney, Funder, Landa, Levermann, and Madsen (2014) participating in CS provides the public with an improved understanding of policies and creates opportunity to engage the government to address their environmental issues. As earlier indicated, in all the models of CS projects, the public is engaged in the data collection procedures. With improved understanding of the policies and data at their disposal, the public is empowered to engage in decision-making procedures. The data provided through CS projects can inform policies and conservation measures that can be implemented by

government, municipalities and other organisations (Tulloch et al., 2013; Haywood & Besley, 2014).

However, in their study Conrad and Hilchey (2011) established that data collected through CS did not influence the decision-making process due to factors such as availability to the decision makers and the challenge of its authenticity. In the South African context, such a challenge was highlighted by a study by Cele (2015). She stated that the data collected through CS in river health monitoring had hardly influenced the department's governance structures and decision-making (Cele, 2015).

### 2.2.3. Challenges in Citizen Science

Riesch and Potter (2013) argued that there is need to set realistic goals for CS, as the projects also face challenges such as scientific accreditation. A study by Bonney et al. (2014) asserted that CS as a practice was not considered as a valid approach to scientific research due to the concerns on the data quality. Much of the literature on CS, mainly developed by professional scientists, has been centred on data quality and reliability to alleviate the perceptions on the inferiority of the data collected by citizen scientists (Everett & Geoghegan, 2016; Aceves-Bueno et al., 2017). This perceived inferiority, has resulted in the unwillingness of other scientists in using the data (Crall, Jordan, Holfelder, Newman, Graham & Waller, 2013; Riesch & Potter, 2013).

Cohn (2008) attributed perceptions of data inferiority to a feeling that that CS projects lacked standards, had limited technical capacity and relied on lower-quality equipment. Research on data quality in CS has assessed the data collected by citizens against that of professional scientists. Savan, Morgan and Gore (2003) determined that when evaluated using chemistry measures, an estimate of 40% of the water chemistry variables gathered through the CS program failed to reach the prescribed control checks. Savan et al. (2003) recommended the use of biological measures as better suited for CS projects. When CS projects used biological measures, there was a minimal to no difference in the data gathered by professionals and volunteers (Fore, Paulsen & O'Laughlin, 2001; Canfield, Brown, Bachman & Hoyer, 2002). Besides using biological measures to ensure the quality of the data, Shirk and Bonney (2015) suggested that data quality challenges can be avoided if close attention is given to the project design and realistic goals are set.

Although CS projects have been recommended as being cost-effective, they still require capital investment to be viable. According to Dickinson, Shirk, Bonter, Bonney, Crain, Martin, Phillip

and Purcel (2012), funding is a challenge in most CS projects which hinder the success of some of the projects. The challenge of funding affects the success because it has an influence on volunteer recruitment and sustaining participation (Conrad & Hilchey, 2011; Dickinson et al. 2012). Notwithstanding these challenges, CS remains an instrument that could be used to motivate, raise awareness and sustain participation towards water resource management.

## 2.3. Motivation

### 2.3.1 The concept of motivation

The concept of motivation has been considered ambiguous, so much so that at one point the American Psychological Association considered replacing the word because a search resulted in various meanings thus posing a challenge to its usefulness (Dörnyei, 2001). Dörnyei and Ottó (2002) considered that the study of motivation should be divided in two: how intentions are formed and how they are implemented. This, however, is a challenge when there is no functional definition for the concept of motivation.

There are numerous definitions of motivation. Deci and Ryan (1985:3) defined motivation as the "why of behaviour" providing an understanding of how behaviour is energized and directed. Reeve (2009) also defined motivation as any force that energized and directed behaviour. According to Buelens, Sinding and Waldstrøm (2010) motivation can be defined as the study of why people behave the way they do. The link between motivation and behaviour was also made by Luthans (2011) who defined motivation as being a basic psychological process that triggers behaviour.

Other scholars have refrained from defining motivation with relation to behaviour but have linked it to goals. Batson (1994: 604) defined motives as "goal directed forces". The concept that motive/motivation is goal driven was also supported by other authors. Pintrich and Schunk (cited in Dörnyei, 1998) defined motivation as the process whereby goal-directed activity is initiated and maintained. Goal-directed activities have been defined as when individuals in a certain situation react in a manner due to the anticipated outcome (Zwosta, Ruge &Wolfensteller, 2015). Motivation has been further defined as the force that enables actions and energises people to achieve goals (Allen, O'Toole, Harris & McDonnell, 2008). Motivation however in this study is regarded as goal directed forces which lead to behavioural outcomes. In relation to the study, motivation would lead to behaviour changes towards better water resource management.

Most discussions on motivation direct attention to the juxtaposition of intrinsic and extrinsic motivation. Intrinsic and extrinsic motivations within this study are discussed within the Self-Determination Theory (SDT) by Deci and Ryan (1985).

### 2.3.2. Self–determination Theory (SDT): Intrinsic and Extrinsic motivation

The self-determination theory provides a discussion on a continuum of human motivations, the psychological needs for self-motivation and goals that initiate and direct the action (Deci & Ryan, 1985) (see figure 2.2). The SDT brings into focus a discussion on how external regulations can be internalized and integrated (Deci & Ryan 2000, Gagné & Deci 2005). The process of internalization refers to when an individual "takes in" an originally external regulation and integrates it into a sense of self, allowing the person to behave autonomously (Ryan, Cornell & Deci, 1985; Deci & Ryan, 2000). Discussions on intrinsic and extrinsic motivation within SDT go beyond the causes of the motivation to address issues that provoke and maintain in comparison to those that undermine and reduce the motives (Deci & Ryan, 1985).

#### 2.3.2.1. Intrinsic Motivation

There are many definitions of intrinsic motivation. In 1975, Deci described intrinsic motivation as the behaviour one performed to promote one's sense of competence and self-determination. Later, Ryan, William, Patrick and Deci. (2009) defined intrinsic motivation as carrying out an activity due to the pleasure and satisfaction it provides the individual. Scholars such as Buelens et al. (2010) acknowledged intrinsic motivation as the result of either the pleasure one finds in carrying out the task or a sense of competence. Reiss (2012) simply defined intrinsic motivation as doing something for its own sake. Despite these various definitions, there are elements that remain constant such as the absence of acquisition of incentives to carry out a task, performing a task due to personal satisfaction and the promotion of the sense of competence and self-determination.

Intrinsic motivation, though internally driven, is subject to external forces. According to Ryan et al. (2009) intrinsic motivation varies among individuals, tasks and time. Thus, not all individuals are intrinsically motived towards the same activities at the same time, making it difficult to base a project such as citizen science strictly on intrinsic motivation. The use of external factors such as incentive, however undermine intrinsic motivation as it diminishes autonomy (Ryan & Deci, 1985; Gagné & Deci, 2005).

To fully explore the factors that promote and undermine intrinsic motivation, Deci (1975) developed a sub-theory within the SDT which he referred to as Cognitive Evaluation Theory (CET). The theory explained that intrinsic motivation is affected by the effect of social inputs/ social contextual events on the psychological needs of competence and autonomy (Ryan & Deci 2000; Gagné & Deci 2005; Ryan et al., 2009). Competence in relation to the SDT was regarded as an individual's effectiveness and confidence within the social setting whilst autonomy referred to self-regulation (Ryan et al., 2009).

Simplified, intrinsic motivation increases when an individual feels competent and there is autonomy, which is reaffirmed through communication or positive feedback during the activity (Ryan & Deci, 2000; Ryan et al., 2009). In relation to this study it can thus be assumed that when volunteers receive positive feedback (recognition) there is an increase in intrinsic motivation towards participation in water resource management. But, intrinsic motivation decreases due to negative feedback and to an absence of the sense of competence and autonomy. According to Ryan et al. (2009) although one might be competent if the need for autonomy is not observed intrinsic motivation decreases. Intrinsic motivation can only be promoted in individuals when both the needs of competence and autonomy are observed within the social setting (Ryan & Deci, 2000).

#### 2.3.2.2. Extrinsic Motivation

In the literature, extrinsic motivation is frequently contrasted with intrinsic motivation. As early as 1959, Herzberg was one of the first to juxtapose the motives (Kanungo & Hartwick, 1987). Extrinsic motivation refers to action that is carried out to attain intangible and tangible rewards (Ryan & Deci, 2000). When extrinsically motivated, one carries out an activity because of self-interest and the perceived benefits that one will receive after carrying out an act. In relation to the SDT, extrinsic motivation varies in the degree of autonomy (regulation by self) and controlled motivation (Ryan & Deci, 2000; Gagné & Deci, 2005).

Organismic Integration Theory is a sub-theory within the SDT which addressed the four varying degrees of extrinsic motivation and the factors which promote and undermine them (Deci & Ryan, 1985) (Figure 2.2). As indicated on the continuum (Figure 2.2.), the first degree of extrinsic motivation is externally regulated where action is carried out due to a possibility of reward or punishment (Ryan & Deci, 2000; Gagné & Deci, 2005; Deci & Ryan, 2015). It is generally considered as the basic form of extrinsic motivation and compared to intrinsic

motivation, it is the least autonomous and highly controlled (Ryan & Deci, 2000; Gagné & Deci 2005; Deci & Ryan, 2015).

The second degree is introjected regulation where action is carried out due to contingent self-esteem (internal rewards and punishment), such as ego-enhancement and avoiding guilt or anxiety (Ryan & Deci, 2000; Gagné & Deci, 2005; Deci & Ryan, 2015). It is internally driven but still has similarities to external regulation as both are controlled motivation (Ryan & Deci, 2000; Gagné & Deci, 2005; Deci & Ryan, 2015). The third degree is identified regulation. At this stage internalization would have occurred, aligning the personal goals to the overall agenda (Ryan & Deci, 2000; Gagné & Deci, 2005; Deci & Ryan, 2015). In such instances, action becomes less controlled and more autonomous (Ryan & Deci, 2000; Gagné & Deci, 2005; Deci & Ryan, 2015). The final degree is integrated regulation. This is when individuals have fully accepted the behaviour and the goals into their own sense of self and act autonomously (Ryan & Deci, 2000; Gagné & Deci, 2005; Deci & Ryan, 2015). Integrated regulation has been closely related to intrinsic motivation with the only distinction that action is still carried out with a perceived personal benefit after the task (Ryan & Deci, 2000; Gagné & Deci, 2005; Deci & Ryan, 2015).

In summary, the difference between intrinsic motivation and extrinsic motivation is the source from which the motivation is derived. Intrinsic motivation is derived from internal forces, which other authors have regarded as "psychological rewards" (Buelens et al., 2010), such as a sense of relatedness, competence and autonomy (Ryan & Deci, 2000). Extrinsic motivation is influenced by external forces which regulate the motive such as to attain incentives, receive recognition or avoid punishment (Ryan et al., 2009). Despite, these differences the two motivations are not entirely independent of each other. Arguably, all actions taken by individuals are derived from intrinsic motivation. Extrinsic motivation is only an approach to achieve the intrinsically valued goal (Reiss, 2012).

#### 2.3.2.3. Amotivation

Though the distinction of intrinsic and extrinsic motivation remains vital in their discussion of the SDT, Ryan et al. (2009) acknowledged that not all actions are a result of the two broad motives. They suggested that there are individuals who are neither motivated nor have intentionality to act towards any activity and referred to this state as "amotivation" (Ryan et al., 2009; Deci & Ryan, 2015). As reflected on the continuum (see figure 2.2) amotivation can be attributed to many factors such as the absence/ diminished sense of competence in relation

to the required skill or knowledge, failure to value the outcome and simply having no desire to act towards the activity (Gagné &Deci, 2005; Ryan et al., 2009; Deci & Ryan, 2015).

However, it is imperative, with regards to this study, to distinguish between amotivation and amotivational syndrome. The latter is beyond the scope of this study. Rovai, Maremmani, Pacini, Pani, Rugani, Lamanna, Schiavi, Mautone, Dell'osso and Maremmani (2013) ascribed the amotivational syndrome to the long-term abuse of cannabis, resulting in individuals experiencing loss of motivation, detachment and lack of gratification expect through the use of cannabis, whereas, amotivation is attributed to the perceptions that action will not attain the expected outcomes, despite one's best efforts (Barkoius, Tsorbatzoudis, Grouious & Sideridis, 2008). In such a case, CS could be used as an instrument to overcome amotivation.

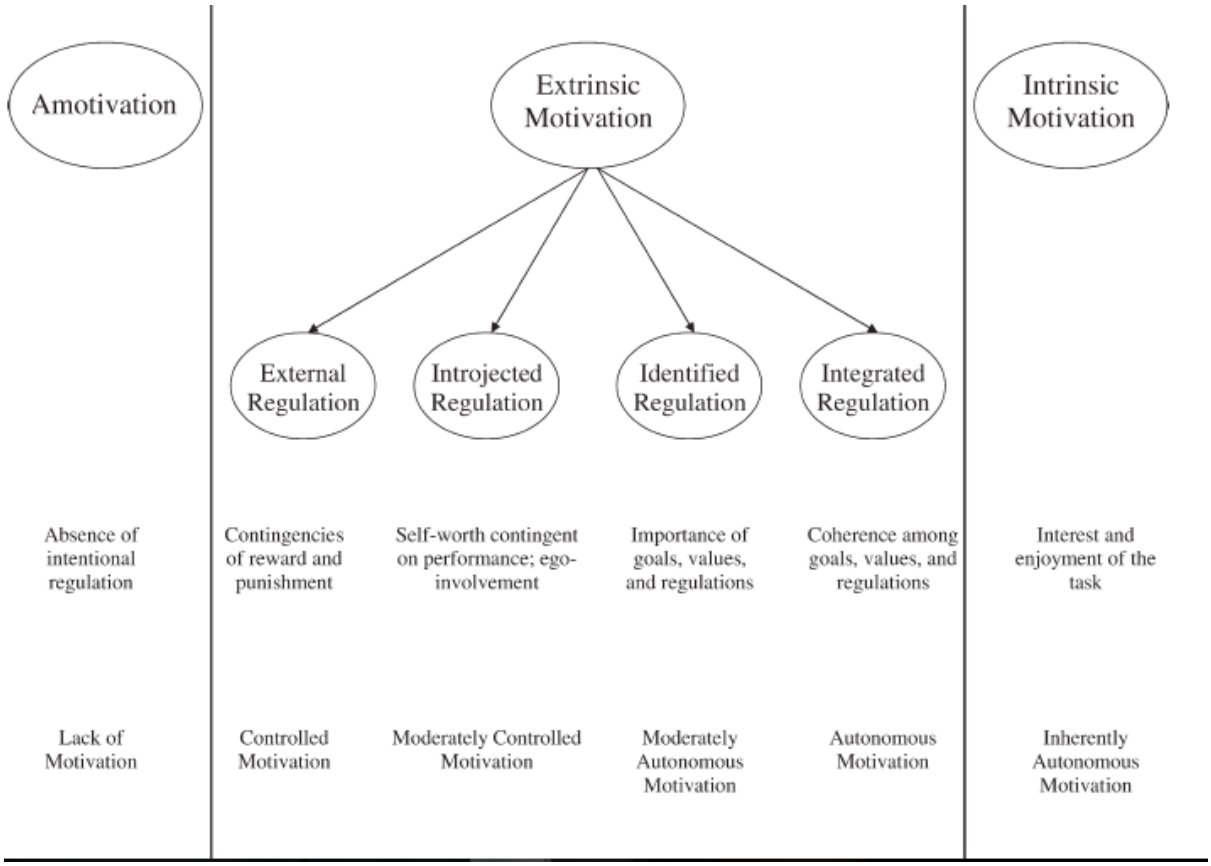


**Figure 2.2:** The self-determinate continuum *(Source: Gagné & Deci [2005 pg. 336])*

Reiss (2012) concurred with Ryan et al. (2009) that not all human motives can be grouped within the two categories of intrinsic and extrinsic motivation. He argues that human motive is too diverse to fit into two categories. Based on this argument, this study explored the concept

of motivation using the categories developed by Batson (1994) which provided a broader explanation on motivation.

### 2.3.3. Four motivation categories by Batson

There are four motives that might drive individuals to act for the public good; egoism, altruism, collectivism and principlism (Batson 1994). These are further explored in the sections below after the explanation of the relationship between motives and goals.

Batson (1994) defined motives as goal–directed forces. The goals were further distinguished with instrumental goals providing the opportunity to reach to other goals (Batson, 1994). Instrumental goals can be understood as being stepping stones towards the ultimate goals (Batson, Ahmad & Tsang, 2002). The instrumental goals can be ignored if the ultimate goal can be reached by other opportunities (Batson et al. 2002). According to Batson (1994) ultimate goals are the end one wishes to attain. These goals are subject to a certain time period, as it is the state (or states) one wishes to attain at a given time (Batson et al., 2002). Unintended consequences can arise during the process of either attaining the instrumental or ultimate goals (Batson et al., 2002). Motives are driven by the ultimate goals and each motive has different ultimate goals.

#### 2.3.3.1. Egoism

As highlighted earlier in the preceding sections, human action is commonly motivated by self-interest. Egoism is a motive with the ultimate goal of improving one's own welfare (Batson et al., 2002). According to Batson (1994), when there is competition between one's self interest and the interest of the public good, individuals will pick self-interest. Batson et al. (2002) suggest that to promote community involvement, it is vital to also consider self-benefits of the participants. Self-benefits can be in the form of material, social and self-rewards such as money, recognition and better self-esteem (Batson, 1994). Self-benefits can also be to avoid self-punishment such as shame (Batson et al., 1999). Self–interest can thus become a threat or a benefit to the public good.

Batson (1994), further explained that there is a state called 'enlightenment' whereby an individual weighs the current benefits with the long-term benefits and realises that in the long term, self-benefits will decrease unless they work for the public good. This remains egoistic because though one works to better the public good the ultimate goal still remains as increasing self-benefits (Batson1994). Self-benefits from working to better the public good can be non-tangible and are often referred to as side payments (Batson 1994). Side payment is when one

acts towards the public good to address social pressures and avoid guilt (Batson, 1994; Batson et al., 2002). The side payments however according to Batson et al. (2002), are not always negative; they can also be self-reward driven whereby one engages in action towards a public good to see one's self as being caring or responsible. These side payments may have a positive effect on the public good but the ultimate goal still remains as egotistic (Batson et al., 2002). In relation to this study, it can be related as an individual volunteering in the citizen science for the social identity to be recognized as being responsible in water resource management.

According to Mill (cited in Batson,1994), it is only when the individual appreciates the external and internal societal sanction that he/ she is enabled to give up egoism. Batson (1994) stated that one's ability to overcome the external and internal sanction will result in 'extreme egoism'.

Egoism as a motive is also subject to benefits and challenges. As a motive to act towards the public good, egoism can be easily evoked, which is of great benefit (Batson, 1994; Batson et al., 2002). Rotman et al. (2012) stated that without egoism as an initial motivation, participation would not occur. However, as a motive to act towards the public good, it is vulnerable as one can easily be tempted to attain self-interest (the ultimate goal) at the expense of the public good (Batson, 1994; Batson et al., 2002). According to Monga (2006), egoism arises from the intrinsic and intangible needs of the ego, as well as the need to improve one's self-esteem.

Batson (1994) dismissed the notion that all action towards the public good was driven by egoism and further discussed other motives such as altruism, collectivism and principlism.

#### 2.3.3.2. Altruism

The concept of altruism was first developed and discussed in a juxtaposition to egoism by Comte (cited in Paul, Miller & Paul, 1993), defining it as motive that has the ultimate goal of increasing the welfare of another (Paul et al., 1993; Batson, 1994; Nelson, 1999). Scholars have questioned the existence of pure altruism, arguing that human action is motivated by prospects of benefit despite how minimal these may be (Rosenhan, 1970; Wallach & Wallach, 1983; Nelson, 1999).

In relation to these perspectives, Rosenhan (1970) considered that altruism can be normative, meaning that it is prompted by social rewards and punishments. Batson (1987) dismissed such insights arguing that the moment rewards and benefits are introduced, the motivation ceases to be altruism and can thus be classified as egoism.

Previous studies have equated altruism to a helping behaviour which brings cost to the individual (Nelson, 1999; Oliner, 2002). However, Batson (1991) suggested that helping is not always entirely based on altruistic motivation. Moreover, helping can be egoistically influenced or constitute both egoism and altruism (Batson et al., 1981). Altruism can be determined by focusing attention on the ultimate goal for action, which is to increase the welfare of another (Batson et al., 1981).

Altruism emanates from empathy which refers to an individual acting because of sympathy or compassion towards another (Batson, 1991; Batson, 1994; Batson et al., 2002). In as much as empathy can be directed to a specific individual, when the individual is part of a group, empathy can also be inclusive (Batson, 1994; Batson et al., 2002). When empathy becomes directed to the group one is part of, action is thus driven to better the group as an unintended consequence (Batson, 1994). This becomes collectivism because of instrumental goals or unintended consequence (Batson, 1994; Batson et al., 2002). However, altruism can be limited to the individual or group to which empathy is directed (Batson, 1994; Batson et al., 2002). Another limitation to altruism is that it cannot be sustained for a long period to drive collective action (Batson et al., 2002).

#### 2.3.3.3. Collectivism

Batson (1994) refers to collectivism as a motive prompted by the ultimate goal of increasing the welfare of a group or a collective. As a motive for action towards a public good, such as water, collectivism can promote sustainable use behaviours because it focuses on benefiting the collective. Batson et al. (2002) suggest that collectivistic motivation has the greatest potential for solving social dilemmas. Ostrom (1998:1) stated that:

> *Social dilemmas occur whenever individuals in independent situations face choices in which maximization of the short-term self-interest yield outcomes leaving all participants worse off than feasible alternative.*

In this study the social dilemmas that arise in securing the supply and quality of shared water resource are indicative of the dominance of egoistic motivation.

Collectivistic motivation also builds on a group identity which promotes action for the betterment of the collective (Batson et al., 2002). Group identity also motivates how individuals participate towards collective action (Nov, Arazy, Lotts &Naberhans, 2013; Antonini, Hogg, Mannettia, Barbieria & Wagoner, 2015). Individuals who relate more to the group identity prioritize the welfare of the group over self-interest and co-operate more (Chen, Wasti &

Triandis, 1998; De Cremer & van Vugt, 1999). Chen and Xin Lin (2009) established that the development of a group identity in an individual also results in an increased self-esteem. In addition, group identity develops into social identities as individuals begin to value their association with the group (Tajfel, 1978). The characteristics of an individual become defined by the objectives of the group, controlling their behaviour and attitudes (Hogg & Abrams, 1988; Chen & Xin Lin, 2009; Abrams & Hogg, 2010). Antonini et al. (2015) further stated that the status of the individual within the group also controlled how group-focused the individual's behaviour became; the higher the position within the group the more likely one acts towards the group. In relation to this study, if a volunteer identifies with the CS project and becomes associated by the defining features of the project within the community, the more likely the volunteer will work towards the betterment of the project. A potential drawback for collectivism, however, is that motivation is limited to the group to which it is directed and it can promote indifference towards external individuals (Batson et al., 2002).

#### 2.3.3.4. Principlism

Principlism refers to motive in which action is taken with the ultimate goal of upholding personal moral principles (Batson, 1994). As an enabling motive principlism has been supported by moral philosophers arguing that action towards the public good can only be because of one's personal principles (Batson, 1994; Batson et al., 2002). However, principlism as a motive is individualistic. As such while an individual may set an example by honouring his/ her principles, it may have little direct influence on those of others. Achieving collective stewardship of shared resources thus requires motives that are more able to direct changes in behaviour and sustain behaviours that are expressions of collectivism.

There are numerous motives that direct individual action, thus this study sought to elucidate how CS could be used as an instrument to motivate participation in water resource management. The following section provides an understanding of the relationship between CS and motivation within literature.

### 2.4. Citizen Science and Motivation

Understanding the different motives of the stakeholders for engaging in CS is of utmost importance for the success of a project as it increases the quantity and quality of participation (Rotman et al., 2012; Shirk, Ballard, Wilderman, Phillips, Wiggins, Jordan, McCallie, Minarchek, Lewenstein, Krasny & Bonney, 2012). Volunteers will continue to participate in CS projects if they are carried out in a manner which satisfies the motives of the volunteers

(Ryan et al., 2001; Measham & Barnett, 2007). However, for researchers, achieving this understanding is challenging as motivation varies according to time, individuals, and projects. An individual can possess diverse motives at a given time (Batson et al., 2002; Grove-White, Waterton, Ellis, Vogel, Stevens & Peacock, 2007; Rotman et al., 2012). Consequently, dynamic motives can result in conflicting goals amongst the stakeholders threatening the success of the project (Weng, 2015). Success of CS projects thus is dependent on understanding the initial motive of participation (Rotman, Hammock, Preece, Hansen, Boston, Bowser & He, 2014).

For most volunteers, the initial motivation for participation in CS is generally considered to be self-interest (Rotman et al., 2012; Rotman et al., 2014). For some volunteers the self-interest is personal advancement through learning opportunities and acquiring new skills (Bowen, 2007; Nov et al., 2014; Raddick, Bracey, Gay, Lintott, Murray, Schawinski, Szalay & Vandenberg, 2010; Gollan., De Bruyn, Reid & Wilkie, 2012). Self-interest for other volunteers is satisfied when they participate for enjoyment and curiosity (Eveleigh, Jennett, Blandford, Brohan & Cox 2014; Jennett et al., 2014). Nevertheless, it is with fault to assume that all initial participation by volunteers is egotistically motivated. Batson et al. (2002) suggested that though self-interest can be dominant, human action can be because of other motives.

However, it is not reasonable to assume that all participation is driven by egoism. In some instances, initial participation can also be motivated by altruism. As such, participation by volunteers can be because of genuine environmental concern and the intention to contribute to conservation (Cohn, 2008; Raddick et al., 2010; Roy, Pocock, Preston, Savage, Tweddle & Robinson 2012). Some volunteers are motivated by the prospects of contributing to the science and imparting previously acquired knowledge (Wiggins & Crowston, 2011; Alender, 2016).

In addition, as indicated earlier, initial motivation is subject to change during engagement (Batson et al., 2002; Grove-White et al., 2007; Rotman et al., 2012). The change can be facilitated by factors such as increasing awareness by consistent feedbacks amongst the stakeholders observing it at individual, group and community levels, and creating opportunities for social learning (Bell, Marzano, Cent, Kobierska, Podjed, Vandiuskaite, Reinert, Armaitien, Grodzinska-Jurczak & Mursic, 2008, Rotman et al., 2012).

The ongoing reframing of motivation contributes to sustaining participation of the volunteers as feedback and acknowledgement on contribution correlates to recognition which can promote an increase in responsibilities (Bell et al., 2008; Gura, 2013; Rotman et al., 2014). In addition,

recognition of skills, efforts and contribution also results in community respect and recommendation (Subbarao & Coury, 2004; Alubbe, 2015). Furthermore, communication can result in the development of relationships amongst the participants, which Overdevest et al. (2004) referred to as personal networks and a feeling of community connectedness, which shape individuals' decision-making (World Bank, 2015). Hence, within such networks, trust becomes of utmost value for sustained participation amongst the participants, especially between the scientist and the volunteers (Buytaert, Zulkafli, Grainger,Acosta, Alemie,Bastiaensen, De Bievre,Bhusal, Clark, Dewulf, Foggin, Hannah,Hrgaren,Isaeva, Karpouzoglou, Pandeya,Pandel, Sharma, Steenhuis, Tilahun, Van Hecken & Zhumanova, 2014; Gharesifard & Wehn , 2016).

Literature on the motivation for participation in CS has been focused on volunteer motivation without taking into consideration the motives of the scientists and professionals. Rotman et al. (2012) note however, that the initial motives for scientists and professionals is like those of the volunteers as they can also be egoistically motivated. These motives can be broadly related to the need for data and career advancement (Rotman et al., 2012; Buytaert et al., 2014). However, in some cases the initial motive can be altruistic or collective in nature, as for example, they seek to educate communities and improve conservation measures (Macknick & Enders, 2012).

A recent study by Weng (2015) noted that there can be areas of potential conflict between the motives of the scientist and the volunteer. Conflict can arise on the preferred timeframe of the project; professionals or scientists preferring long-term engagement whilst the volunteer may prefer short-term, posing a challenge on volunteer retention (Weng, 2015). In addition, there are challenges of power hierarchy between the scientist or professionals and the volunteers which can find expression in the allocation of the duties to the volunteers (Weng, 2015). Despite these challenges, citizen science remains an instrument that could be used to motivate, raise awareness and sustain participation towards water resource management.

### 2.5. Conceptual Framework

According to Babbie (2014) a conceptual framework in research depicts the relationship between concepts and attributes. Acknowledging the symbiotic relationship between CS and motivation, I developed a conceptual framework to depict how CS could be used as an instrument to motivate, raise awareness and sustain participation in water quality monitoring (see figure 2.3).

To some extent, the framework is context specific in the sense that it is structured around a settlement, Mpophomeni, which strongly reflects the political history of South Africa of the segregation of the blacks (uMngeni Municipality Council, 2012; Denis, 2013). In such settlements residents were deprived of adequate services, there are marginal economic opportunities and high unemployment rates (Pernegger & Godenhart, 2007; Sibiya, 2012). While there is a prevailing sense of helplessness, people can be assumed to be desperate for opportunities such as CS (Save Midmar dam project) may be able to provide, such as learning opportunities and financial gain (UMDM, 2017). Arguably, individuals are amotivated to engage in water resource management because of lack of competence in relation to the skills and knowledge of what is required in the management procedure. . The consequence of amotivation on the part of the individuals due to perceived inability to contribute to improved water resource management, in most cases is evident through declining water quality.

Deteriorating water quality is a concern for the scientists and professional water resource managers which motivates their use of instruments such as CS to motivate citizen participation. The amotivated citizens (1) are motived to seek self-improvement. CS provides engagement benefits such as creating opportunities for learning and skills gain (2). Volunteers are arguably, are initially egoistically motivated to participate in the CS projects because of the prospect of self-enhancement through learning and skills gain and, in this case, also the prospect of being employed and financial rewards. Over time engagement in CS increases personal growth and understanding enhancing the competence level of the volunteers (3). During the process of participation, there is feedback and communication between the scientist and the volunteers, increasing recognition and sense of self-worth amongst the volunteers (4). This shifts the motivation of the volunteers towards incorporation of collectivism referring to when they are motivated to improve the welfare of the group or collective (5). It also built on the development of the group identity amongst the volunteers which further develops into a social identity with which they are identified with within the community (5). The shift in motivation towards incorporation of collectivism and the development of a group and social identity, sustains participation amongst the volunteers enabling the transformation into “agents of change” who are deployed into the community to raise awareness of other citizens towards better water resource management (6). The increased awareness of the other citizens fosters competence and motivation to engage water resource management and CS (7).

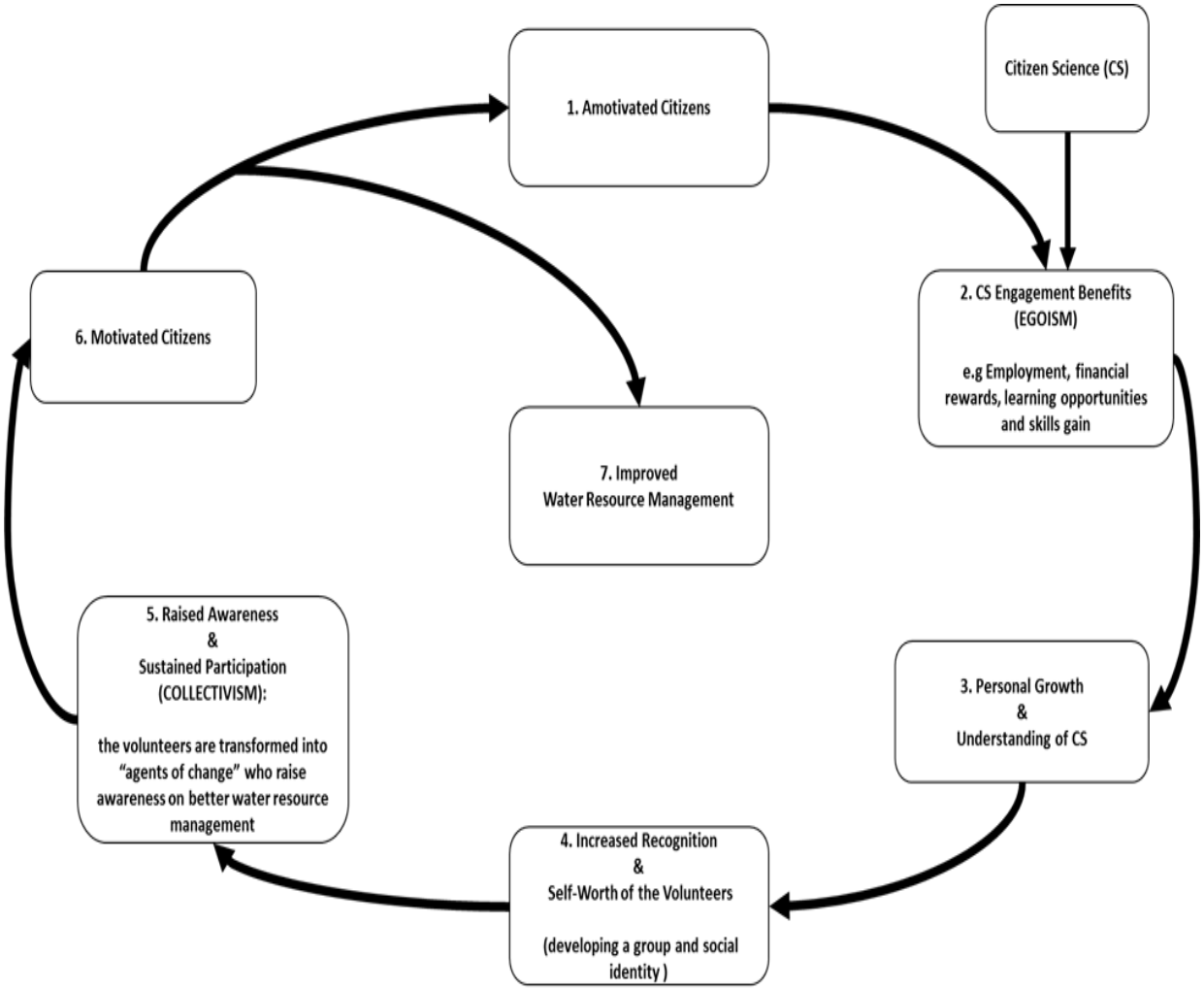


**Figure 2.3:** Conceptual Framework (*Adapted from Batson (1994), Ryan & Deci (2000), Rotman et al. (2012)*)

The conceptual framework has been used in this study as the starting point of understanding how CS could be used as an instrument to motivate, raise awareness and sustain participation in water resource management.

## 2.6. Summary

The evidence from literature suggests that CS can, and has, been used to motivate participation and raise awareness of environmental issues. However, it is likely to be challenged when seeking to sustain participation for long enough to bring behavioural changes that are required for long-term solutions to environmental issues. The challenge arises from the nature of motivation, and from what individuals seek to gain or accomplish through their participation. This would be particularly challenging when the volunteers are drawn from disadvantaged, impoverished communities, such as the case of most South African townships, where

individual circumstances drive self-interest. In this light, the study sought to understand how, in the Mpophomeni Save Midmar Dam project, CS was, or could be used as an instrument to motivate, raise awareness and sustain participation in water resource management.

# CHAPTER THREE

# METHODOLOGY AND STUDY SITE

In this chapter I describe the research methodology that was implemented in this study. Silverman (2006) refers to methodology as the choices a researcher makes about what to study, who to study and how to gather and analyse data within a research study. I outlined the research paradigm, design, data collection and analysis procedures. The chapter also provides the selection and justification of the case study location. The measures taken for trustworthiness were also described as well as the ethical considerations that were observed during this study.

## 3.1. Research Approach

Creswell (2014) defines research approach as the process that the researcher carries out during a research study which includes the selection of a paradigm, research design, data collection procedure and data analysis. A paradigm has been defined as a set of beliefs on the complexities of the real world (Guba & Lincoln, 1994; Patton, 2015). A paradigm is constituted by four assumptions, ontological, epistemological, axiological and methodological which have been summarized in Table 3.1. In this study, I adopted a combination of the interpretivist and social constructivism approach (Creswell, 2014), providing a summary of the assumptions in Table 3.1.

**Table 3.1:** Summary of the assumptions within Interpretive - Social constructivism paradigm (*Adapted from Crotty, 1998*; *Creswell 2013, 2014; Patton, 2015*)

| **INTERPRETIVISM - SOCIAL CONSTRUCTIVISM PARADIGM** |
|---|
| ***ONTOLOGICAL ASSUMPTIONS (NATURE OF REALITY)*** |
| • Believe in multiple realities shared by different groups<br>• The realities are shaped by human interactions and individuals live within their constructed realities<br>• The realities are also influenced by social, historical and cultural backgrounds<br>• Reality changes over time |
| ***EPISTEMOLOGIAL ASSUMPTIONS (HOW REALITY IS KNOWN)*** |
| • Reality is jointly constructed by the researcher and the participants; it is subjective and shaped by the individual's experiences. |
| ***AXIOLOGICAL ASSUMPTIONS (ROLE OF VALUES)*** |
| • It is value-bond, individual values are honoured and negotiated, the researcher is also part of the researched |
| ***METHODOLOGICAL ASSUMPTIONS (APPROACH OF INQUIRY)*** |

- Information is gathered mainly through a qualitative approach using interviews, observations and documentary analysis

According to Du Plooy–Cilliers, Davis and Bezuidenhout (2014), interpretivist approaches seek understanding and describes social action and experiences. The paradigm values the participants' views and their experiences (Creswell, 2003; Yanow& Schwartz-Shea, 2011). It was best suited for my research because I sought to explore how CS could be used as an instrument to motivate, raise awareness and sustain participation in water resource management and hence participant views were of utmost value. The views of the participants are shaped by their social and historical background which creates a social construction of reality (Willis, 2007). This was particularly pertinent in the study; hence I combined the interpretivist paradigm with social constructivism.

The social constructivism paradigm ascribes to the perceptions that reality is shaped by the social, historical and contextual background of the individual placing great value on understanding the contextual background (Crotty, 1998; Creswell, 2014; Patton, 2015). Reality is subjective as it is related to how individuals engage the world and thereby resulting in multiple realities shared by different groups (Crotty, 1998; Willis, 2007; Creswell, 2013; Patton, 2015). Reality in this paradigm is because of shared meaning and agreement amongst a group of individuals and it is subject to change over time (Creswell, 2013; Patton, 2015). These elements of the paradigm are relevant for this study as they account for the value of the social and historical contextual background shaping one's reality, particularly, of individuals residing in townships developed during the Apartheid era. The understanding of the contextual background is important in this study as it affects the self-motivation of the individuals to participate in water resource management. The selected paradigm values the role of shared meaning affecting reality, in relation to this study, the development of a shared meaning for the need for collective action would positively impact the reality of water resource management in Mpophomeni.

### 3.2. Research method

The study was qualitative oriented. Qualitative research enables the deeper understanding of individual meaning or how a group perceives a social or human problem (Creswell, 2014). These elements were best suited for this study as I sought to understand how individuals within the Mpophomeni context perceived the challenge of declining water quality. Denzin and

Lincoln (2000) stated that research carried out with a qualitative approach is conducted in the naturalistic setting with the researcher seeking meaning of phenomena as perceived by the participants. McMillan and Schumacher (2010) asserted that qualitative research allows the acknowledgement of several constructed realities.

Qualitative research however is not without challenges. Patton (2015) asserted that there are challenges in the perfect replication of the analytical thought pattern of the researcher and challenge of a standardized approach to test reliability and validity. In this study these concerns are addressed by the clear outline of both the steps in the data analysis process and how the issues of trustworthiness were addressed.

I selected a case study method within this qualitative research. Yin (2011) stated that because a case study allows for deeper investigation it provides detailed information of phenomenon being assessed. In addition, a case study approach enables the researcher to observe the participants in a real–life context as the event occurs minimising distorted meaning (Cohen & Manion, 1994; Creswell, 2013).

One of the noted challenges however, with the use of a case study is providing a clear rationale on the selection of both the case and the data collection procedure (Creswell, 2013). This challenge is addressed in the following section in which I provide the data collection procedure outlining and justification for the selection of the case study.

### 3.3. Data Collection Approach

Creswell (2013) has outlined seven stages for data collection in a framework called the data collection circle. The first stage was locating the site, a stage at which I made a case selection of the area that was best suited for the study. The second stage was gaining access and rapport. This stage involved seeking permission to carry out the research and contacting the community gatekeepers. Upon getting permission to carry out the research in the chosen area of Mpophomeni I adopted a sampling procedure. Thus, for the third stage during which I made the decision on the participants, the sampling strategy and sample size; I adopted the purposeful sampling procedure. The fourth stage is collecting data. This stage encompasses the selection of the collection tools such as interviews or documents. The fifth stage is recording the data. At this stage I used recording instruments and memos. The sixth stage is field issues. This stage addressed the challenges which can occur in the data collection process such as challenges in securing participants. Finally, the last stage was storing data whereby I outlined how data was kept (Creswell, 2013). Figure 3.1 illustrates the seven stages of the data collection circle by

Creswell (2013). In the succeeding section I provide a description of how I carried out each of these stages within the study.


**Figure 3.1:** The Data Collection Circle by Creswell (2013:146)

### 3.3.1. Locating the site

In this section I explain how I carried out the first stage of the data collection circle with regards to site selection. I provide a background of the study site relating it to the declining water quality in Midmar Dam. I provide the rationale and justification of the study site. I selected the case study approach in my study with the case selection of Mpophomeni. This enabled me to observe participants in their natural setting as they addressed the challenge of water resource management. In the following section I will outline the features within the 'locating the site' that made the case section of Mpophomeni best suited for a deeper understanding of the potential of CS as an instrument in motivating, raising awareness and sustaining participation in water resource management with an interest in the townships.

**Midmar Dam Water Quality**

Midmar Dam is a source of freshwater supplies for the eThekwini, uMgungundlovu and Msunduzi municipalities (Ramnath, 2010). The dam is also one of KwaZulu-Natal's main water resorts providing recreational value such as the annual Midmar Mile swimming race (The Department of Water Affairs and Forestry (DWAF), 2008).

However, the quality of the water in Midmar Dam is said to be deteriorating as evidenced by high levels of *E. coli*, high algal counts and increasing concentrations of nutrients (DWAF, 2008; GroundTruth, 2010a; Umgeni Water, 2011). The source of the *E. coli* was mostly from the uMthinzima stream which has its source in the foothill above Mpophomeni township and passing through the township into Midmar Dam (Figures 3.2, 3.3 and 3.4., van Deventer, 2012).

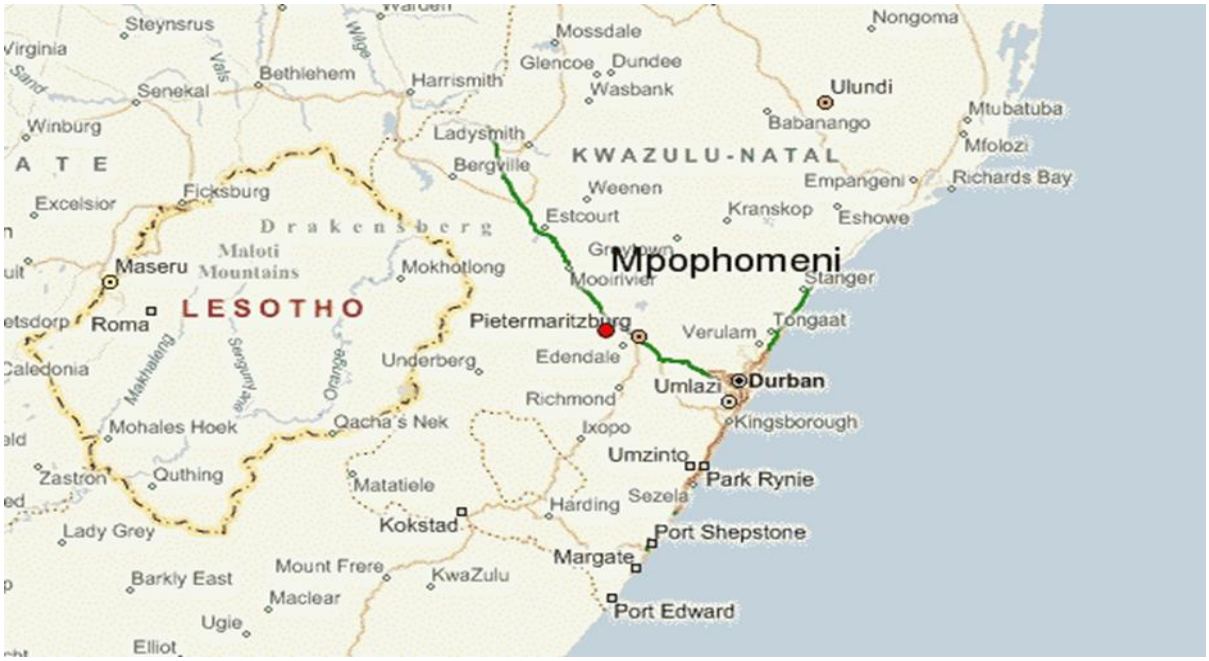


**Figure 3.2**. Showing the overall position of Mpophomeni township within the South Africa (*Source Google Images, 2018*)


**Figure 3.3**: Map showing the proximity of Mpophomeni to Midmar Dam *(Source: Studio 2014 cited in Kolbe, 2014).*

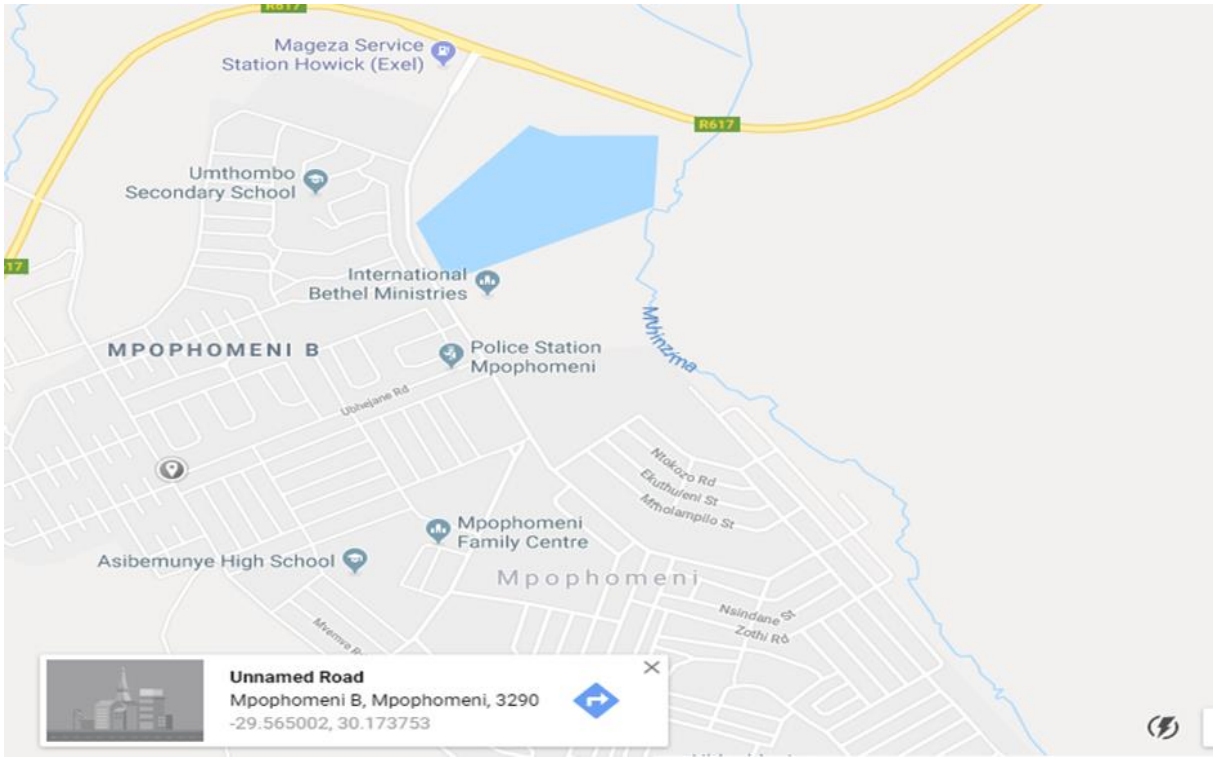


**Figure 3.4:** Map showing the uMthinzima stream and the proximity of the Mpophomeni Township to the stream *(Source: Google Maps, 2018)*

**Research site background**

Mpophomeni is a peri-urban township situated in the KwaZulu-Natal Midlands region of South Africa. Administratively it is within the uMngeni municipality (Baiyegunhi & Makwangudze, 2013; Masibumbane, 2014). It is situated 12km from Howick, 30km from Pietermaritzburg and 120km from Durban (Baiyegunhi & Makwangudze, 2013). It is also positioned in the upper catchment of the uMngeni River and an estimated 4km from Midmar Dam (DUCT, 2013). The name of the township, which translates into 'Waterfall' from isiZulu, was derived from the downstream Howick waterfall (Zulu Mpophomeni Tourism Experience, 2012). According to Frith (2014) an estimated 25,000 people resided in the township in 2011. The population is predominantly black and isiZulu speaking (Frith, 2014).

Mpophomeni township was established in 1968 during the Apartheid era to segregate the black Africans from white-dominated areas (uMngeni municipality Council, 2012; Denis 2013). The history of the struggles and poverty of the Mpophomeni community can be further attributed to the dismissal of most of its work force in 1985. Most of the population within Mpophomeni were employed by the South African Rubber Manufacturing Company Limited (SARMCOL) situated in Howick (Sinomlando, 2012). Conflict between management and the work force resulted in protests from the workforce and the management dismissing and replacing most of the workforce (Sinomlando, 2012; Denis, 2013). The incident created further animosity between Mpophomeni residents and neighbouring communities. residents from neighbouring communities were hired to occupy the vacant positions in SARMCOL whilst many Mpophomeni residents became unemployed (Sinomlando, 2012). The community became characterised by high unemployment rates and marginal economic opportunities.

During the same periods of late 1980's and early 1990's the area witnessed political tension. Political affiliation of the Mpophomeni to the African National Congress (ANC) and its neighbouring communities to Inkatha Freedom Party (IFP) further fuelled the tensions resulting in the death of approximately 120 people (Zulu-Mpophomeni Tourism Experience, 2010). It was only after these deaths in 1993 that there was peace in Mpophomeni (Denis, 2013)

According to Thorstensen (2009) the aftermath of such a history was massive poverty and unemployment in Mpophomeni. residents of Mpophomeni must travel to nearby areas in search of employment (Baiyegunhi & Makwangudze, 2013). The township is characterised by poor living conditions, high unemployment, inadequate services and facilities (Thorstensen 2009).

Inadequate services and facilities are evident in the township's poor sewage disposal (Umgeni Water, 2014).

Mpophomeni township contributes to water pollution in the uMthinzima stream and Midmar Dam. Data collected on pollution in Midmar Dam from the period of 1999 to 2009 indicated that although Mpophomeni constituted 2.4% of the dam's catchment area its *E. coli* input was as high as 50.9% and it accounted for 15% of the phosphorus load (GroundTruth, 2010a). GroundTruth (2010b) assessed the health of the uMthinzima stream for the period from 2003 to 2009 and found that the river had high levels of pollution. A further assessment of *E. coli* levels from the 1st of September to the 23rd of November 2009 in the uMthinzima stream, showed that it failed to meet the required *E. coli* standards as set by the Department of Water Affairs of 130 counts/100ml (maximum) as it was as high as 660 000 counts/100ml (GroundTruth, 2010a). The high *E. coli* levels in the uMthinzima stream pose a health threat to those who would encounter the water through recreational use. Use of water with such high levels of *E. coli* is likely to cause gastrointestinal illnesses (Isikhungusethu Environmental Services, 2012).

The township is serviced by both the uMgungundlovu District municipality (UMDM) and uMngeni local municipality. The former is responsible for the sanitation management and the latter is responsible for the solid waste collection (Taylor, 2013). Also active within the community are non-governmental organisations (NGOs) such as Duzi-uMngeni Conservation Trust (DUCT) and the Wildlife and Environment Society of South Africa (WESSA).

**Sanitation management**

Inadequate sanitation management in Mpophomeni was highlighted as being a major threat to water quality in the uMthinzima stream (Van Deventer, 2012; Kolbe, 2014). The housing structures within the township are characterised by malfunctioning and inadequate sanitation infrastructure that was strained by the growing population (Van Deventer, 2012; Kolbe, 2014). The challenges of the sewage management in Mpophomeni, particularly the waste water treatment plant located adjacent to the uMthinzima stream contributed greatly to the pollution (Douman, 2008; GroundTruth, 2010b; Van Deventer, 2012).

The presence of high *E. coli* levels in the uMthinzima stream suggested that there was faecal contamination because of raw sewage spilling directly into the stream (GroundTruth, 2010b). A study carried out by van Deventer (2012) also confirmed that the uMthinzima stream was characterised by deteriorating water quality and ecological conditions which were because of

point source sewage input from Mpophomeni. In her study Kolbe (2014) attributed the spilling manholes to lack of education and awareness on the proper use of sanitation infrastructure.

**Solid waste management**

Solid waste was also noted as one of the contributory factors to deteriorating water quality in the Midmar Dam. According to Hay (2017) only about 50% of the households in the uMgungundlovu municipality received dependable solid waste collection. The failure of proper management of solid waste results in the residents disposing solid waste in rivers, streams, storm drains and sewage systems (Hay, 2017).

According to the observations of GroundTruth (2010a), Mpophomeni had solid waste that was scattered throughout with some of the solid waste dumped or washed into the watercourse. These observations were supported by Kolbe (2014) who stated that Mpophomeni was characterised by informal dumpsites near the roadways and waterways as well as direct disposal of solid waste contaminating the river. To address the challenges of declining water quality because of poor sanitation and solid waste management within the Mpophomeni community, the Save Midmar Dam project was initiated which adopted a CS approach (UMDM, 2017).

The selected location was considered to provide a good case study because it was characterised by a water resource management issue of declining water quality, which affected the lives of the citizens. The gravity of the declining water quality was such that it brought focused attention and prospect for support from the authorities and NGOs, facilitating a CS initiative, the Save Midmar Dam project. However, the nature of the water resource management issue was such that action by the citizens could bring about a much needed change. These attributes made it an appropriate location in which to carry out the study.

### 3.3.2. Gaining Access and Rapport

I carried out an initial field scoping exercise of the study area in November 2016 with the assistance of the Monash Water Research Node. This process is the second stage in the data collection circle whereby the researcher gains access and builds rapport (Creswell, 2013). Due to previous existing relations of the Water Research Node within the KwaZulu-Natal region it was easy to gain access into the community. I was introduced to the members of the non-governmental organisations DUCT and WESSA that oversaw implementing the project.

I built rapport with the members from DUCT, who then acted as the community gatekeepers in this study and provided access into the Mpophomeni community. I made the initial contact with the prospective participants from the Enviro-champs citizen science volunteers during one of their Tuesday meetings at the local community hall in Mpophomeni. I was introduced to the group and I explained my study to the group stating the purpose of the study, the timeframe I would require from the participants and how the findings would be used. I interacted with the volunteers and received an opportunity to be shown around the community areas where they were working. During this process, I also identified prospective participants that would contribute to the study. I then planned the interviews and refined data collection procedure which I carried out in May 2017.

### 3.3.3. Purposeful Sampling

Patton (1990) defined purposeful sampling as an approach of selecting information-rich participants that enable the researcher to answer the purpose of the research. Purposive sampling has also been referred to as judgemental sampling (Etikan, Musa & Alkassim, 2016). It depends on the discretion of the researcher to select the participants who provide the necessary knowledge due to experience (Bernard, 2002). The field scoping revealed different groups of participants in the study area the NGOs (DUCT and WESSA), volunteers the Enviro Champs (ECs) and residents who had resided in Mpophomeni for 5 years and above. The participants for this study were drawn from these three groups as they were considered as information-rich participants that would be able to offer different perspectives on citizen science and motivation as they experience the project on different levels. The NGOs oversaw running the Save Midmar dam project, the ECs were the volunteers who were deployed into the community to influence the change in behaviour towards better water resource management and the residents were the target group.

**Sample size**

Purposive sampling does not have a set number of participants but depends mainly on data saturation (Oppong, 2015; Etikan, Musa & Alkassim, 2016). Suri (2011) stated that data saturation is a point where further interviews will not yield new information. Data saturation for this study was reached after 15 participants were interviewed. The 15 participants constituted of three participants from the NGO category, eight participants from ECs and four residents. The justification for the selection of more participants within the ECs category is that

they provided rich information for understanding motivation for public participation in water resource management.

### 3.3.4. Collecting Data

Within the qualitative approach in this study, I selected and collected data using three approaches, interviews, documentary analysis and field observations.

**Interviews**

Purposive sampling requires data collection methods that allow for intensive gathering of information such as semi-structured in-depth interviews, which was implement in this study (Curtis, Gesler, Smith &Washburn, 2000) (Appendix IV). The interviews were carried out using open-ended questions which enabled for further probing allowing me to explore deeper into detail (Lewis, 2003). According to Creswell (2013, 2014), this approach also allows the researcher to listen to the participants as they construct their own meanings to their daily relationships with others.

I made appointments with the participants from DUCT and WESSA prior to returning to the field for data collection. I emailed them the explanatory statement, interview guide and consent forms (as shown in the appendices). We agreed on the times, date and location of the interviews according to their work schedules.

After carrying out my interview with the participant from DUCT, who oversaw the daily management of the volunteers, it was suggested that the best approach for contacting the ECs was to attend their weekly Tuesday meetings. I was referred to those ECs who were perceived to be well informed about the project and who would be in the position to engage in the study. I attended a Tuesday meeting and set appointments with the identified volunteers.

The community was predominately Zulu speaking; hence I sought the assistance of a translator who was aware of the area and the concepts under investigation. This helped me with communication and interpretation with the participants. During the interviewing process some of the residents attempted to teach me the Zulu language lessening the ‘distance’ between the participants and myself.

The interviews lasted approximately 45 to 90 minutes although some were longer. This was because of the open-ended questions allowing for further probing and formulation of the other questions deepening my understanding of the participants’ reality. Topics that were discussed

were broadly related to how citizen science had been used to motivate, raise awareness and sustain participation in water resource management within the community.

**Document Analysis**

Information was also collected through document analysis because documents also reveal specific social realities (Bryman, 2008; Flick, 2009). Other authors, however, refute these perceptions arguing that documents are purposefully written and should not be considered as reflecting reality (Atkinson & Coffey, 2004). Despite these varied perceptions, documents provide a researcher with contextual benefits such as the historical and cultural background which gives an ability to further the research (May, 2001; Flick; 2009). During the data collection procedure, I also collected secondary data from DUCT that was charged with the daily management of the Save Midmar Dam project. They provided documents which included the uMgungundlovu District municipality (UMDM) reports, meeting minutes and the review of the Enviro-Champ project (Ward, 2016).

**Field Observations**

Creswell (2013) identified observation as one approach of gathering data concerned with the interaction of individuals within a context. According to Schuh and Upcraft (2001) field observations enable to the researcher to gather rich information as they observe what individuals say or do within their natural setting. DeWalt and DeWalt (2002) stated that field observation also ensures the trustworthiness of the research as it allows the research to derive a deeper understanding of the phenomenon under study.

In this study I practised open observation whereby I accompanied the ECs whilst they carried out their door-to-door campaign. Field observations enabled for a first-hand experience of the changes of skills amongst the ECs, images of the processes such as fixing of water leaks (Figure 4.3.) were also captured during field observation. The intention was that these observations would enable me to make meaning of the realities of the participants (Creswell, 2013).

### 3.3.5. Recording Information

I carried out this stage concurrently with the data collection. Before every interview I sought consent from the participant to audio record the proceedings. This enabled the conversation to be replayed and allowed me to search for deeper understanding of the meanings of the participants' realities (Creswell, 2013). According to Lofland and Lofland (1995) there are diverse field notes such as mental notes, jotted notes and full field notes. During the interviews

I jotted notes which I then developed into further questions to probe as I used open ended questions.

I carried a field journal in which I noted my observations of the daily activities of the participants. These would be jotted down during the interview. At the end of each day these would be expanded into full field notes in which I also reflected on non-verbal actions (e.g. body language) of the participants during interviews as they expressed their opinions. This helped to account for events as they occurred and for deeper interpretation of meaning. According to Patton (2015) it is this human ability to interpret meaning that gives strength to qualitative research.

### 3.3.6. Field Issues

Creswell (2013) draws attention to challenges a researcher experiences during data collection. In my study I faced challenges with some of the residents. After the interviews some of the residents were seeking references to be recommended to become part of the ECs. They assumed that since I was carrying out research with the members of the NGOs I would be in the position to recommend them so that they would also become volunteers. However, although I managed to correct the misconception by redirecting their attention to the explanatory statement which explained my role, their intention to use the opportunity to seek employment may have conditioned their responses. Some of the referred residents were also not eager to be part of the study for personal reasons so other prospective participants were sought. Despite having a translator, some of the residents questioned why I was not able to speak a South African language if I had studied in South Africa for such a period. However, some of the residents were willing to teach me the basic words which lightened the moment when I could not pronounce the words well lessening the distance between the residents and myself.

### 3.3.7. Storing Data

The final stage of the data collection circle is storing data. During this stage it is recommended to have back-up copies (Creswell, 2013; Patton, 2015). I made back-ups of the field recordings keeping copies locked under password on my computer, stored on my Google Drive, saved on a memory stick, other copies were also kept by my supervisor in a safe as per Monash protocol. To protect the confidentiality and anonymity of the participants, the participants were only referred to using the randomly allocated participant identification numbers.

### 3.4. Data Analysis

After data collection I proceeded to the data analysis stage. Babbie (2013) refers to data analysis as a process through which the researcher explores the patterns within the data that indicate the theoretical understanding of life. It has also been considered a process in which data is transformed into findings though the rigorous sifting of trivial material to produce a framework of what is found in data (Patton, 2015). There are different approaches to carry out the data analysis process. There are many approaches that can be adopted at this stage in the research, whilst some choose to use software such as QSR NVivo, data analysis for this study was done manually due to the challenges posed in mastering the software in the limited timeframe. Below I outline the steps I took in the data analysis procedure.

#### 3.4.1. Preparing the data

The first step for data analysis was preparing the data (Braun & Clarke, 2013; Bezuidenhout & Cronje, 2014). All the recorded interviews were transcribed verbatim to preserve meaning from the participants although non-sematic words were not included (Braun & Clarke, 2013). An example below shows how data was transcribed verbatim:

> TPR: What has been your experience during this process?
>
> EC6: At first it was hard because you come across a person who doesn't have time for you. They just say talk talk; I don't have time for all this. Sometimes when we pitch up they close the door and it is painful. The thing is I am not just there to bother and ask for money, but I am there to feed them with information so that they also know what is wrong with the environment. There is nothing much I can do with those people.

Despite the data being transcribed verbatim, for the anonymity and confidentiality of the participants I masked their identity by randomly allocating participant identification numbers. For instance, if the participants were from the professional category I referred to them as NGO 1, 2 etc., the volunteers were EC 1, 2 etc. and the residents as MR1, 2 etc. Such abbreviation enables the reader to understand the category to which each participant belongs but does not reveal a name. For example, an interview with one participant where they referred to themself by first name.

> "Being one of the members of the committee, I could see that for the community members to most of them I was a pillar, that they say if we see EC8 definitely he will solve this for us". (Interviewee EC8)

### 3.4.2. Familiarisation

After preparing the data, the second stage of data analysis was familiarization with the data. Familiarisation involves the process where the researcher immerses oneself into the data, reading it numerous times looking for meanings and patterns (Braun & Clarke 2006). As recommended by Babbie (2013), I continuously read the transcripts, making memos of the concepts that were prominent from the interviews, documentary analysis and observation notes. I developed an understanding of the dominant themes and the emerging idea in the findings in relation to the conceptual framework.

### 3.4.3. Inducting themes

Patton (2015) referred to this stage as inductive analysis in which patterns, theme and categories are discovered. Within a case study, Yin (2009) suggests that analysis can be carried out focusing on the theoretical proposition. I had constructed the interview questions on the predetermined themes from the proposition of the study on how citizen science could be used as an instrument to motivate, raise awareness and sustain participation in water resource management. According to Bezuidenhout and Cronje (2014) data should then be disaggregated into categories which will be compared for similarities, differences and relation. I then created files which organized the data into groups according to the most noticeable categories.

### 3.4.4. Coding

Babbie (2013) regarded coding as the classification and categorizing of data, whilst, Braun and Clarke (2013) defined coding as the process of identifying data that relates to the research questions. I regarded coding as a process of classifying and categorizing data in relation to my research questions. I used the pre-determined themes from the proposition on how citizen science could be used as an instrument to motivate, raise awareness and sustain participation in water resource management. I also used concept mapping to depict the concepts and their interrelation (Babbie 2013) as reflected in the results chapter section (Figures 4.2. and 4.3.).

### 3.4.5. Interpretation

The final stage of data analysis was interpretation. At this point I sought to make sense of the findings from the data by interpreting the relationships. According to Bezuidenhout and Cronje (2014) interpretation is whereby the researcher compares the research findings to literature and considers other factors that can affect understanding. Data was also interpreted using the theoretical framework in chapter two, where interpretation could not be related to this

theoretical framework additional literature was included. The following statement depicts how interpretation of the field findings was related to literature:

> "I started in February 2015 to attend the training, and X said we can start getting paid in October, but we didn't get paid until November" (Interviewee EC 1)"

During his evaluation of the ECs project, Ward (2016) stated that the project manager was reluctant to provide the volunteers with any monetary incentive prior to establishing their commitment to the project which brings clarity to the delay in payment. It can thus be interpreted as reflecting that the initial motivation for participation for some of the volunteer was driven by prospect of financial reward.

The step carried out during the data analysis procedure are summarised in figure 3.5.

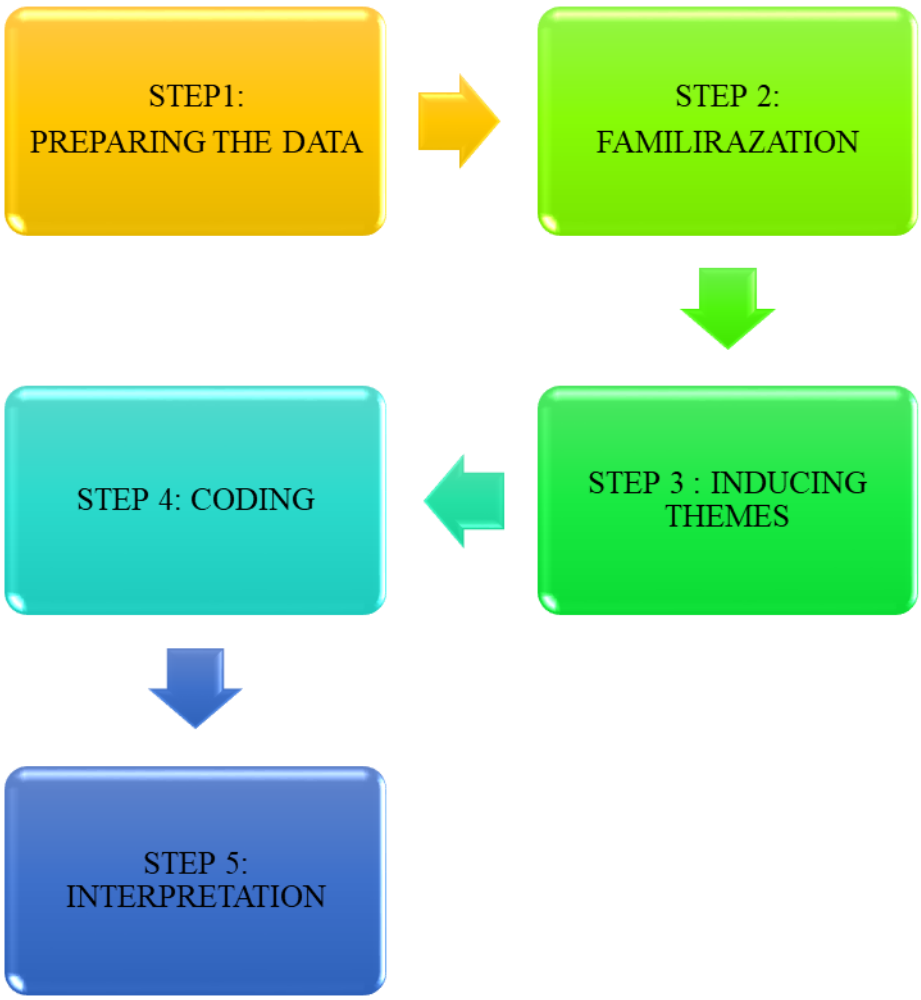


**Figure 3.5:** Summary of the steps taken for the data analysis process **(***Adapted from Babbie (2013), Braun & Clarke (2013) and Bezuidenhout & Cronje (2014)*).

### 3.5. Trustworthiness

According to Collier-Reed, Ingerman and Berglund (2009) can be understood as the process through which the value and effect of a research can be measured. It also ensures rigour in qualitative research (Schwandt, Lincoln, & Guba, 2007). The concept of trustworthiness is discussed in relation to the concepts of credibility, dependability, transferability and confirmability (Lincoln and Guba, 1985). The justification for the use of the four concepts is in line with the work of Guba (1981) who states these categories ensures trustworthiness within qualitative research.

**Credibility:**

Macnee and McCabe (2008) defined credibility as the confidence that can be given to the research findings as being true. In this study I used different data collection methods, interviews, document analysis, and field observations. The use of different tools was to foil any shortcomings of one approach and exploited on the strength of the other. I also recorded and referenced to the participants verbatim so that meaning was preserved (Seale, 1999; Silverman, 2006).

**Dependability:**

The concept of dependability has been referred to as the quality in the process of integrating the data collection methods, data analysis and theory as to attain meaning from data (Koonin, 2014). In this study I carried out rigorous data analysis and interpretation. I also provided an outline of the case study and participant's selection which were clearly justified.

**Transferability:**

Transferability is the degree to which a different individual, in a different context can carry out the study with other participants and still obtain similar results (Bitsch, 2005). In this study I observed clear description of the methodological procedure providing steps as recommended by Silverman (2006).

**Confirmability:**

According to Tobin and Begley (2004) confirmability focuses on whether the data and interpretation are representative of the data and not manipulated by the researcher. I used an approach of peer debriefing (Creswell, 2014), to verify that data represented the perspectives

of participants. However, the supervisors in this case, occupied the position of the peer due to ethical considerations.

### 3.6. Ethical Considerations

Research involves interaction of the researcher and the participants and a code of ethics regulates these relations (Flick, 2009). Prior to any engagement with the participants, approval was granted by the Monash University Human Research Ethics Committee (MUHREC) (approval number 7944 see Appendix I).

Research ethics stipulates that no harm should come to the participant (Bryman, 2008; Flick, 2009; Babbie, 2013). The harm has been explained to entail factors such as stress, lessening self-esteem or affecting participant's development (Bryman 2008). According to the guidelines by the MUHREC, this research posed no harm to the participants and was classified as a low-risk.

All participation in this study was voluntary and the participants were free to disengage at any point of the research. All the participants were above the consenting age. According to Flick (2009) consent can only be given by those that are competent, in this study all participants were above 18 years. The participants were provided with two documents –the explanatory statement and the consent form – to help them in making a decision to participate (or not) in the study. The explanatory statement (Appendix II) outlined the purpose of the study, the expectations of the participants and the use of the study. This was to ensure that the participant had informed consent before signing the consent form (Appendix III).

In addition, anonymity and confidentiality of the participants was emphasised prior to and after the engagement (Silverman, 2006; Babbie, 2013). In all the documents I masked the identity of the participants using randomly allocated participant identification numbers. No unauthorized personnel were allowed access to the research data. During the analysis and reporting of the data I refrained from referring to the participants in a way that was judgemental and tried to discuss the finding only as reflected in the data. In the same procedure I also observed honesty and openness (Babbie, 2013), indicating the challenges I faced during the procedure as indicated earlier (see section 3.4.6. on field issues).

I avoided the pitfall of deception in which the researcher deceives the participants of their real intentions (Babbie, 2013). I managed this by clearly stating the purpose of my presence in the community, the purpose of the study and the requirements of the willing participants.

## 3.7. Limitations of the study

Some of the challenges that were faced in this study were earlier mentioned in section 3.4.6. One limitation of study was not including the municipality members as part of the participants for this study as they also have a key role in the success of CS motivating participation in water resource management. This was mainly due to the time constraint associated with receiving informed consent from such stakeholders. Though their participation would have provided valuable insight, the primary focus of understanding motivation for participation in water resource management in this study were the ECs from which I drew the highest number of participants.

## 3.8. Summary

The chapter outlined the research methodology of the study and provided the background and justification for the selection of the study site. An outline of the data collection and analysis procedures was also provided and the discussion of the ethical considerations. In the following chapter I present the results.

# CHAPTER FOUR

# RESULTS

This chapter focuses on establishing how CS was used as an instrument to motivate, raise awareness and sustain participation in water resource management in Mpophomeni. A brief background is provided of the Save Midmar Dam project with a conceptual model to indicate my understanding of the project in relation to the above stated study proposition. The results are presented in relation to the conceptual framework that was developed in Figure 2.3 of Chapter 2. The results are ordered under headings of amotivation and declining water quality, egoism as the initial motivation for volunteer participation, recognition of the increased competence amongst the volunteers, shift towards incorporation of collectivism amongst volunteers, raising awareness towards water resource management and perceived success as motivation for sustained participation. A summary is provided at the end of the chapter.

## 4.1. Background of the Save Midmar Dam project

Mpophomeni is serviced by two municipalities (A in Figure 4.1), the uMgungundlovu District municipality (UMDM) and uMngeni local municipality. The "Save Midmar Dam" project was implemented from October 2015 to April 2017. During the project two non-governmental organisations (NGOs); the Duzi-uMngeni Conservation Trust (DUCT) (B in Figure 4.1) and Wildlife and Environment Society of South Africa (WESSA) (C in Figure 4.1) worked actively within the community. DUCT was the implementing agent in charge of the daily project management of the Save Midmar Dam project and WESSA provided accredited training on CS tools and the use thereof, for the volunteers in the project. These NGOs provided the scientists within the CS project. The Enviro-champs (ECs) (D in Figure 4.1) were resident volunteers from the various wards within the community who actively participated in the Save Midmar Dam project. While the ECs were the primary target for raising awareness in water quality monitoring and management, the Mpophomeni Residents (E in Figure 4.1) were the secondary target. The ECs and Residents are the citizens within the Save Midmar Dam project.

I developed the following description of the Save Midmar Dam project to indicate my understanding of the project in relation to the study proposition that CS could be used an instrument to motivate, raise awareness and sustain participation in water resource management.

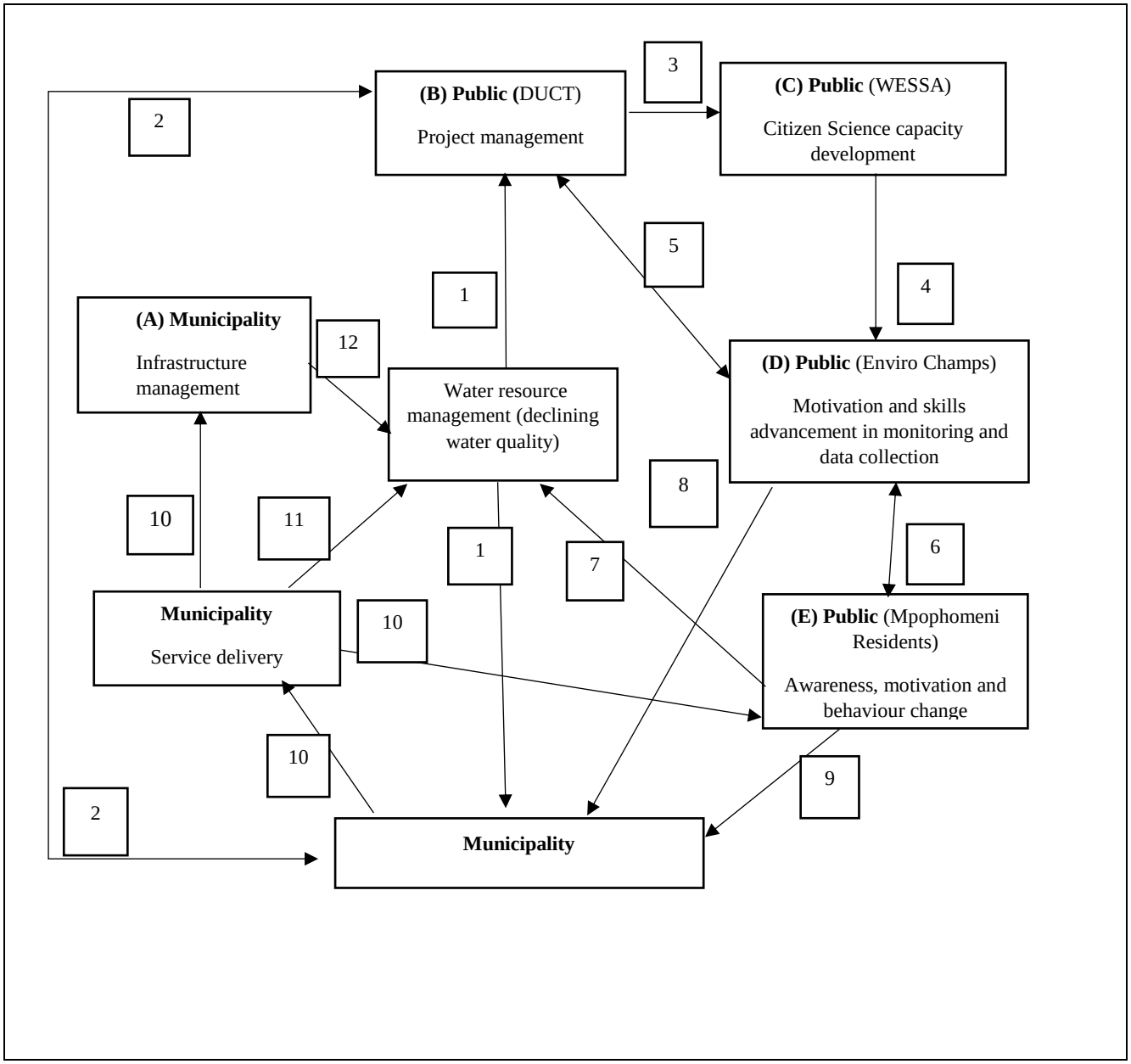


**Figure 4.1:** Conceptual model of the role of CS in the Save Midmar Dam project

As depicted in Figure 4.1, water resources management (1) prompts interaction of diverse stakeholders particularly, when declining water quality poses a threat to water security.

The degradation of water quality within the tributary streams of the uMthinzima stream, which runs through Mpophomeni Township and flows into Midmar Dam, provided a context within which a CS project could be used as an instrument to motivate, raise awareness and sustain participation in water resource management. A partnership was established between the uMgungundlovu municipality (UMDM) and DUCT (2) with funding from the Expanded Public Works Programme (EPWP) to launch the Save Midmar Dam project (UMDM, 2017). Though the participants were considered as volunteers, the project recruitment process was

carried out under the EPWP employee regulations, with stipulated benefits for the participants allowing them to be awarded a monthly stipend:

> *Employment of participants was guided by the basic conditions of employment as stipulated in the Ministerial Determination 2014 and Code of Good Practice for Expanded Public Works Programmes both from the Department of Labour. The service provider (DUCT) signed contracts with participants and ensured that the participants are covered under Compensation for Occupational Injuries and Diseases Act, 1993 (COIDA) and the Unemployment Insurance Fund (UIF) (UMDM, 2017).*

The project was implemented using a collaborative CS model (Bonney et al., 2009). According to Minkman, Van Der Sanden and Rutten (2017), CS projects assist in addressing public knowledge and awareness gaps. The focus of the Save Midmar project was educating and raising awareness on water and waste management, vocational education and capacity building with volunteers (the ECs) being the primary "agents of change'' (UMDM , 2017).

The Duzi-uMngeni Conservation Trust (DUCT), as the implementing agent within the project, partnered with WESSA (3) another civic organization to provide capacity building in CS tools and the use thereof, for water quality monitoring and data collection to the ECs (4). WESSA provided training on ecological infrastructure specifically through the Environmental Practices Skills Programme, National Qualifications Framework (NQF) Level 2 covering module 1, 2, 3, 6 and 7 (UMDM, 2017). The capacity building from WESSA (4) increased the competence of the ECs to participate in water quality monitoring and data collection and analysis. This is consistent with the understanding that CS enables ordinary individuals to be involved in scientific research to solve real-world problems (Cohn, 2008).

Participation in water resource management, however, is motivated by different goals. According to Shirk and Bonney (2015) understanding and appreciating the motive and goals for participation in the CS project is important to ensure continued participation. A two-way arrow has been placed at (5) between DUCT and the ECs to show a complementary interest in the water quality monitoring and data collection process.

According to Rotman et al (2012), personal motivation changes with an increase in personal knowledge. It is postulated that with the increase in knowledge and competence a change in motivation occurred in the ECs which influenced them to share their acquired knowledge with other residents to develop a shared understanding (6). Improved understanding would result in

the residents communicating challenges for example, surcharging manholes and leaks, thereby aiding the monitoring and data collection process; hence the two-way arrow (6). The goal was to influence progressive behaviour towards water and waste management improving the state of water resources (7).

The data gathered by the ECs pertaining to water quality within the community is also passed to the municipality (8). The increased awareness of the residents is thought to result in an informed engagement between the residents and the municipality especially in terms of service provision requests (9). The flow of data and information from the ECs and the residents at large (8 and 9) is expected to improve service delivery (10). The provision of location specific data in terms of surcharging manholes allows for effective infrastructure maintenance (10). The improved service delivery will also positively affect the behaviour of the residents towards better water and waste management (10). The improvement on service delivery and effective infrastructure management will then lead to improvement in the state of the water resources (11 and 12) especially due to a decrease in sewer surcharges

This section provides a background of the Save Midmar Dam project highlighting some of the opportunities that the project provided within the Mpophomeni community. My conclusion is the funding from the EPWP created employment opportunities and the partnership with WESSA created educational and skills opportunities which can be assumed to be motivational factors for the initial participation in the Save Midmar Dam project.

In the following section I discuss the results in relation to the conceptual framework developed in Chapter 2 (see Figure 2.3). I start with a discussion of the conditions within Mpophomeni prior to the establishment of the Save Midmar Dam project.

### 4.2. Amotivation and declining water quality

In their earlier work, Deci and Ryan (1985) stated that contextual conditions can hinder motivation. Arguably the residents of Mpophomeni can be assumed to have lacked the motivation to engage in water resource management because of their apartheid experiences and recent experiences of poor service delivery (Thorstensen, 2009; Umngeni Water, 2014). Mpophomeni was established as a dormitory township in the 1960s where the black work force was forced to live (Ward, 2016). Over the years the population had grown but few infrastructural adjustments have been made to support the growing community posing threats to sanitation management. Mpophomeni has thus suffered with continually surcharging manholes for over twenty years (UMDM, 2017):

*"There used to be an average of 10 sewers a day spilling" (Interviewee NGO 2)*

**Figure 4.2:** Spilling manhole and illegal dumpsite in Mpophomeni *(photograph from Kolbe 2014 cited in Ward, 2016).*

The above image depicts a spilling manhole with the wastewater flowing into the uMthinzima stream (Ward, 2016). This affected the water quality of the stream and subsequently affected the water quality of Midmar Dam.

The occurrence of surcharging manholes can be assumed to have been as a result of numerous factors amongst which are ageing and inadequate infrastructure:

> *The only problem is the line near Mpophomeni high school, opposite the library those are the only manholes that are spilling. Even for them they haven't been spilling that much they would spill week after week but now they can spill after a month. It is the infrastructure; the manholes were built to accommodate a few number of people but now the community has grown large there are more houses (Interviewee EC 7).*

*The residents were complaining of the permanent spilling manholes which was as result of poor and old infrastructure (Workshop, 2017)*

These observations reflected by the statements above by both residents and ECs that the infrastructure could no longer service their population mirrored comments by a plumber interviewed by Ward (2016) who reported that:

*"The pipes are too small. They are 110mm and should have been 120mm pipes".*

Because of these prevailing conditions, the residents arguably felt amotivated with perceptions that despite their best efforts their conditions would not change (Barkouis et al., 2008). In part, this reflected their poor understanding of the sewer system and how it functions. The sense of helplessness and lack of awareness lead to the residents apportioning blame on service delivery:

*"Mpophomeni was quite a small area, but people came, and more houses were built but in terms of the sewer line infrastructure it was never replaced or upgraded it remained the same. So, people would say "you can't say that you have a family of eight you buy one bread and when your family doubles to sixteen you still buy one bread". That is a problem so that is what people have been saying in Mpophomeni'' (Interviewee EC3)*

When a community is characterised by inadequate sanitation infrastructure some of the residents tend to blame all the problems on the inadequate infrastructure and d not account for how their own behaviours contribute to the problem. This was the challenge with some of the residents in Mpophomeni. However, due to the vigilant work of the ECs recording all the material removed from the spilling manholes they were able to raise awareness about the detrimental effects of residents' behaviour:

*"With those graphs and reports we have been getting from the Enviro-champs, it shows that in this particular area people are putting wrong things. We then share that information with the people and we say yes, we are understanding what you are saying about infrastructure but if we look at this particular manhole especially that one which is close to them we say this one in particular its spilling is as a result of what'' (Interviewee EC3).*

The findings of this study affirm the conclusion of Kolbe (2014), who suggested that the cause of spilling manholes within the Mpophomeni community was because of lack of knowledge and awareness on the proper use of infrastructure.

The challenge of solid waste management posed a different challenge within the community. Whilst the sewers provide continuous collection and removal of sewage, solid waste management is dependent on provision of an effective waste removal service by the municipality. Without such service residents may not be motivated to manage disposal of household waste:

> *"We have been telling the councillors that the problem is with the trucks, at times they do not come to collect the rubbish and people do not want to keep the rubbish in their houses. They take the rubbish to illegal dump sites and the dogs and goats spread the rubbish everywhere." (Interviewee EC 2)*

> *"They are issues of solid waste littering in Mpophomeni, at times the solid collection trucks do not come. The fact that uMngeni doesn't come to collect regularly has an impact on what is thrown into the toilets, ladies then opt to flush their pads instead of having them laying around which affects the sewage system." (Interviewee NGO 1)*

> *"Also, some people put their waste together but if the municipality doesn't come no one comes to say that is my waste I have come to take it back, so it will stay there. If the rains come it will go to the river. So those are the problems that we have in Mpophomeni in terms of waste and water pollution" (Interviewee EC3)*

> *"So, we came across the problem that the municipality used to give the community plastic bags but now they have stopped giving them. This is what is causing the people to just dump anywhere" (Interviewee EC1)*

> *"I am going to talk about the black bags, the community has been saying that they are polluting because they do not have black bags to throw their waste. Our municipality used to provide these black bags, but they do not any more the community was complaining that this is the reason why there are illegal dumpsite because they cannot afford black bags." (Interviewee EC5)*

The residents seemed to have little control over refuse collection services and thus until regular service is provided, residents can be goal-directed but only insofar as getting the waste out of their homes to a local unauthorised dumpsite. The situation seemed to have been aggravated by the municipality which established a precedent when it provided residents with bags for solid waste. By providing bags residents were encouraged to manage solid waste making it

easier to collect. When bags were no longer provided without providing an alternative it seemed residents went back to disposing of their solid waste anywhere that is convenient resulting in the declining water quality in the uMthinzima stream:

> *"There were not that many people in the community that were worried about the situation, they knew that there was some kind of problem by the river and they tell their children not to go play there but it was not high priority on the local community's list" (Interviewee NGO 1)*

Arguably, the residents in Mpophomeni were amotivated to engage in solid waste management because they perceived that despite their best efforts there would not be any changes. Earlier, EC3 stated that people put their waste together for collection but the municipality still failed to collect. Thus, their primary concern was to dispose the solid waste from their households and not from the township as a whole.

Amotivation, amongst the residents in Mpophomeni, to engage in water resource management can be assumed to be due to the perception that despite their best effort their action would not yield any changes. The effects of amotivation were the numerous surcharging manholes and illegal dumpsites which resulted in the declining water quality of Mthinzima stream and Midmar Dam. It was amidst such conditions that the Save Midmar project was initiated to mitigate these conditions. In the following section I explore the initial motivation for volunteer participation in the CS project.

### 4.3. Egoism as the initial motivation for volunteer participation

The initial motivation for some volunteer participation in CS projects has been perceived to be driven by egoism, which is the ultimate goal of bettering one's welfare. Arguably, the same can be assumed to have motivated the initial participation for some of the volunteers in the Save Midmar Dam project. The project created opportunities for employment and financial reward, educational advancement and skills gain.

#### 4.3.1. Employment and Financial Reward

Mpophomeni, like many townships, was characterised by unemployment and marginal economic opportunities. It can thus be assumed that the initial motivation, for some of the volunteers, to participate in the Save Midmar Dam project were the prospects of employment and financial rewards as the volunteers received a monthly stipend. The following statements yield insights into what motivated the initial participation of some of the volunteers:

*"You get volunteers that volunteer for the stipend model because generally you come, and volunteer and you get a small stipend and that is your work. You volunteer so that you get work" (Interviewee NGO 3)*

*"I am getting something at the end of the month" (Interviewee EC 7)*

*"At first, I came to this work just for money" (Interviewee EC 6)*

These statements suggest that self-interest (egoism) provided the initial motivation for participation as some of the ECs were seeking employment and financial return. Understandably, perhaps under the prevailing socio-economic conditions of the Mpophomeni community and the need to improve one's own welfare, the initial motivation for participation was generally due to egoism. According to Batson et al. (2002) egoism is a motive with the ultimate goal of improving one's own welfare. The prospect for financial reward as a motivation for participation was emphasised in this statement of one of the participant s:

*"I started in February 2015 to attend the training, and X said we can start getting paid in October, but we didn't get paid until November" (Interviewee EC 1)*

Despite the delay in receiving financial reward participant EC.1 continued to serve the project as a volunteer. This behaviour can be interpreted as indicating the importance of personal income as a motivating factor. Such motivation for personal advantage suggests egoism. During his evaluation of the ECs project, Ward (2016) stated that the project manager was reluctant to provide the volunteers with any monetary incentive prior to establishing their commitment to the project which brings clarity to the delay in payment. It also suggests that there was awareness that participation could be promoted by the prospects of financial reward.

Furthermore, the importance of employment and personal income as a motivating factor for participation can also be sought in responses that reflect on how others perceived the volunteers as initially there was animosity from residents:

*"Some are not happy they say because now you have a job you think you are better than us. When we knock at the doors when we are doing door to door they will say it is you people because you have got work we want work go away. They insult the Enviro-champs'' (Interviewee EC 8)*

*"Well people are not the same, some respond well some don't. At certain times people tell you that if we don't litter you lose the job" (Interviewee EC.5)*

However, because of the socio-economic challenges within Mpophomeni, the opportunity of employment and prospects of financial reward would sustain volunteer motivation despite the hardship and abuse that they experienced at the start.

These findings suggest that due to the stipend model used in the project, the initial motivation for participation can be assumed to be the prospect of employment and financial reward for the volunteers providing an avenue for self-enhancement. And perhaps because of these prospects the volunteers were able to endure the initial challenges they faced engaging with the residents.

### 4.3.2. Educational Advancement

Furthermore, CS projects have been applauded for their educational benefits for the volunteers who participate and the Save Midmar Dam project was no exception. Educational advancement was noted for some of the volunteers fostered through the ecological infrastructure trainings by WESSA. Some of the volunteers acknowledged the educational advancement stating that:

> *"Now as an Enviro-champ, I now have a qualification in the ecological infrastructure, I am just waiting for the statement of understanding'' (Interviewee EC6)*

> *"I finished school long time back, I wanted to do something like medicine, but I couldn't qualify because of the points that were needed as a requirement. Then I decided rather than stay at home I would do anything I qualify for. Then I went for environmental stuff" (Interviewee EC3)*

The improvement in the personal educational status also positively impacted the families of the ECs as it enabled them to assist their children in their school work. It is these personal benefits that can be assumed to have initially motivated some of the ECs to continue participating in CS. In an evaluation carried out by Ward (2016) during a group interview one of the ECs stated that:

> *"Some of us have children and now we are able to help them with their homework which is more important. We are getting power because we have more knowledge. This is one of the reasons we stay with Enviro Champs."*

These findings suggest that the initial participation for some of the volunteers can be assumed to be as a result of the educational benefits that were enabled through the Save Midmar Dam project. This reinforces the perceptions CS offers educational benefits for the volunteers and

that the initial participation for some of the participants was egoistically driven as their ultimate goal was to improve their personal educational status.

### 4.3.3. Skills Advancement

Citizen Science was used as the instrument through which ECs could learn skills, while at the same time developing understanding of how water quality issues were affecting their lives. The ECs received training weekly on Tuesdays from professionals (UMDM, 2017). The intention was that new skills and understanding would, in time, expand motivation to include service for the public good i.e. would encourage collectivism. Establishing the links between skills, water quality and community well-being was thus important. The following statements illustrate how participants related these links:

> *"We are learning about the tools that are used in the environment. Now I can use the clarity tube, velocity plank and also the miniSASS" (Interviewee EC1)*

> *"Yes, I have learnt a lot of citizen science tools such as the velocity plank to measure the speed of the river, miniSASS to measure whether the river is clean and riparian tool how to take care of the wetlands and how the wetlands help the river." (Interviewee EC5)*

> *"I grew up in Mpophomeni we just used the sense of smell or colour, if you see that the river is not clear we assumed that it is polluted. If it was clear also we would assume that it's clean. If it was smelling or not smelling, we also assume whether it is polluted or not. But doing the miniSASS, I also found out some things in the miniSASS that ok fine, I can go in a river and if there are chemicals, some chemicals will not change the clearness of the river. The colour will stay the same, but the river will be in a poor condition in terms of naturally" (Interviewee EC 8)*

> *"The first skill I gained as an Enviro-champ was using excel. It was my first time using excel, I met with a guy from Germany he had come to do his study with UKZN, and so he assisted me. That was the first thing and he showed me how to look after this data base and I have been working on it. I am now able to see when there is a problem and fix it. I collect the data for the manholes for all the groups and I load it onto the excel sheet and I formulate graphs of that information so that it can show the changes" (Interviewee EC 3)*

Citizen Science developed skills and raised awareness amongst the ECs through water quality and river health monitoring. Because the skills advancement of the ECs was not limited to data collection, but also included data analysis, it enabled interpretation that facilitated appreciation for environmental change. The statement by participant EC3 shows that the ECs were also in charge of data analysis and presentation, thereby encouraging accountability and ownership of both information and interpretation for the project. Also, evident in this statement, is that the project used a collaborative model of CS. In collaborative projects, the public can be involved in the analysis and dissemination of the results (Bonney et al., 2009; Grossberndt& Liu 2016).

One of the thrusts of the Save Midmar project was minimising wastage of water through early detection and repair of leaking pipes. The ECs were trained to repair leaks. I accompanied two of the ECs who went to fix a leak that was reported within the community. Their first task was to measure and record how much water was leaking and for how long the pipe had been leaking. This was to enable them to assemble data on how much water was saved through their actions. Three stages of repair are shown in the following photographs:

**Figure 4.3a:** The reported water leak with water being collected to estimate the amount of water that was being lost (*source author*)

**Figure 4.3b:** The procedure of fixing a water leak (*source author*)

**Figure 4.3c:** The fixed water leak (*source author*)

**Figure 4.3:** Images a, b and c showing the procedure of fixing a water leak

In conclusion, the socio-economic conditions within Mpophomeni can be perceived to have influenced the initial motivation for the ECs. In a community characterised by a high unemployment rate and marginal economic opportunities, the initial participation of some of

ECs can be assumed to have been egoistically motivated. Despite, the initial motivation for participation suggesting to be as a result of employment opportunities and educational advancement, there was skills advancement amongst the ECs. There was a deeper understanding of water resource management amongst the ECs with regard to water quality and quantity conservation. The skills enabled the ECs to be responsible and accountable for gathering and interpreting data. It also promoted an emerging motivation to serve the community such as fixing leaking pipes. This was helpful to the community as it lead residents to conserve water.

### 4.4. Recognition of the increased competence amongst the volunteers.

Recognition has been cited by numerous authors as a motivational factor for volunteer participation in CS projects (Bell et al., 2008; Gura, 2013; Rotman et al. 2014). In their earlier work, Fisher and Ackerman (1998), defined recognition as the process by which the work of the volunteers is appreciated by external members resulting in prestige and status amongst those appreciated. Merrill (2005) further grouped recognition into extrinsic recognition – which is when volunteers are offered physical objects such as ribbons, certificates and badges – and intrinsic recognition, which is intangible – such personal sense of achievement, sense of pride and purpose. As mentioned in the literature review (Chapter 2 section 2.4), recognition of skills in volunteers' increase responsibility, community respect and social status as was the case of the ECs in the Save Midmar Dam project.

**Involvement in the decision- making procedures: Participation in War Rooms**

Arguably, with the increase in skills of the EC, there was also a growing involvement in local decision-making.. The ECs were now able to participate in the local decision- making forums which were referred to as "War Rooms". One of the participants described the meetings as:

> *War room meetings are attended by councillors and different stakeholders and people from department of health, people from social grant development. All departments coming in one place to just report back about what has been happening for the past month so, we discuss on it and will then do the interventions. We can also attend these meetings and the Enviro-champs are able to share what they have been working on (Interviewee EC3)*

Ward (2016) further inferred that the War Room was a platform that facilitated multi-stakeholder engagement within the community for the betterment of the community through

integrated service delivery. The involvement of the ECs in such meetings suggests that there was recognition of the volunteers by the government. One of the participants said:

> *"We now have the voice; they now recognize us in the municipality we are now able to communicate with the municipality members. We are able to talk to the councillors there was this meeting that the councillors talked about our work, these are the new councillors we were introducing our work so that they know what is happening in their areas"(Interviewee EC 6).*

It is such sentiments as depicted in the statements above from EC 6, "we now have a voice", that suggest that prior to the recognition of the increase in competence and participation in the Save Midmar Dam project ordinary residents were not included in the decision- making procedure.

Attending the War Rooms could also have further enabled recognition, positive feedback and praise from government officials. Arguably, the intention of enabling participation could also have been to increase government awareness of the work of ECs while also exposing them to a wider range of issues affecting the community:

> *"I have attended the War Rooms and it was great because we got a chance to introduce ourselves and our work. After we introduced ourselves we talked about what we are doing in the community and if there are people that need our work they will tell us where there are problems and we go there. When you go to these meeting there is awareness that there are people doing this kind of work and you are acknowledged and known." (Interviewee EC 7)*

> *"We did attend the war room only to find that when we attend we find that there are different kinds of problems here in our community and we are able to reach the people that we had missed on our door to door when they come to the War Rooms. It is interesting that other people are interested in our work. The War Rooms also make us interact with different people and allows us to also help out with some of the problems being faced in our community" (Interviewee EC5)*

> *"War room were the other key thing, because we could find that there are people that were wasting water because they didn't know about us that we can help them save water. The war room made it spread so that people know about us even when*

*I am passing by people approach me and tell me their water problems". (Interviewee EC 8)*

Involvement in the decision -making process was not only limited to the War Rooms, amongst the ECs there was a development of an executive committee which was also being involved in some of the group's decision -making:

*"Recently they have established an executive committee for the running of the group and that is trying to give more of the responsibility over to the Enviro-champs themselves to take on a stronger governance role and a stronger decision -making capacity for the project and for themselves. So, they are becoming more included in the decision- making process definitely, you know its baby steps" (Interviewee NGO 3)*

Recognition of the competence of the ECs resulted in the allocation of more duties and responsibility. This also suggests growing recognition of ECs' decision-making capacity. Ryan et al. (2009) referred to competence as an individual's effectiveness and confidence within the social setting. With skills development and growing understanding, the ECs became more confident and effective. Recognition of the increased competence of the ECs was also evidenced by the support provided to the volunteers so that they could attend scientific meetings such as those related to fracking (UMDM, 2017).

Although a growing recognition can strongly reinforce egoism, when it is contextualised within community welfare, it could reinforce motivation to consider and act for the common good. This is particularly evident in interviewee EC 8's statement suggesting both, that recognition of the volunteers was also spreading within the community, and there was a growing intention among ECs to serve the community.

**Recognition from the community: Community respect and social status**

In the longer term, the success of the project would be determined by how strongly motivated the ECs are to act for the common good and by the willingness of the residents to acknowledge and draw from the skills and capabilities of the volunteers. Within the community, the ECs received recognition for their skills, their ability to fix water leaks (Figure 4. 3):

*"They are reporting water leaks and we go there and we check that maybe it's a rubber and we try to fix it" (Interviewee EC1)*

*"The water leaks, people are calling us to say we have a leak here and we go there and fix it on time." (Interviewee EC7)*

These quotes suggest that the ECs were being summoned to different households to fix leaks. It also suggests that there was an increase in the responsibility of the ECs as the residents became aware that they could address the gap in the inadequate service delivery within the Mpophomeni community.

Amongst the ECs, recognition could also be suggested by the growing community respect and social status which increased a sense of pride and self–worth:

*"Being one of the members of the committee, I could see that for the community members to most of them I was a pillar, that they say if we see EC8 definitely he will solve this for us". (Interviewee EC8)*

*"Being an Enviro-champ has changed me when I walk on the road I put my head up high because I am known" (Interviewee EC7)*

*"Before I became an Enviro-champ, I was nothing but now when people see me they say here comes the water police'' (Interviewee EC1)*

Not only was there an increase in sense of self-worth (particularly the sentiments of EC7 and EC1), there was also a strong suggestion that through participation in the project the ECs had developed an identity founded on recognition within and external to the community, their acquired skills and knowledge, and growth in self-confidence. This is particularly strongly expressed by EC8 referring to himself as a pillar to the residents and having the ability to assist in their water challenges.

It can thus be argued that increased competence associated with opportunity to participate in various forums and growing recognition of the ECs increased intrinsic motivation (see also Ryan and Deci, 2000; Ryan et al., 2009), thus shifting their motivation from egoism towards incorporation of collectivism.

### 4.5. Shift towards incorporation of collectivism amongst volunteers

As suggested in the previous section, with the growing recognition of the ECs, there was suggestion of a growing community respect and social status. The ECs became recognized by the characteristics of the group as can be insinuated from the quote of interviewee EC 1, in the previous section, who stated that when the residents saw her they referred to her as the "water

police"; residents were associating her with the group and the work it carries out. Arguably, individuals who relate more to the group identity prioritize the welfare of the group over self-interest (Chen et al., 1998; De Cremer & van Vugt, 1999). This characteristic was used to measure group identity amongst the ECs and ultimately suggest incorporation of collectivism:

> *"I stay next to the stream our contract expired but since then I do patrols along the stream to see that there is nothing wrong with the stream." (Interviewee EC5)*

> *"At first I came to this work just for money but as I worked I developed love for the environment now I don't want even anyone to mess with the environment I will just die". (Interviewee EC 6)*

> *"I went back to my area and said yes, I have been learning a lot from X now am I going to impact and feed my community all this information (Interviewee EC 2)"*

The shift towards incorporation of collectivism as being contributed by group identity can be insinuated from the continued monitoring (Interviewee EC 5) despite no longer receiving a stipend. This suggests that motivation was now also driven by the ultimate need to better the welfare of the wider collective as much as to receive personal benefits. The statement of participant EC 6 also suggests a shift in motivation from egoism where the ultimate goal was to receive a stipend, to interest in improving the environment and ultimately the benefit of the collective.

The growing group identity amongst the ECs could also be viewed as having evolved into a social identity and status which controlled the behaviour of the volunteers, arguably promoting action towards the betterment of the community:

> *"We are the link between the community and the municipality, monitoring at grass root level what I can say is we are the 'eye and the ears'" (Interviewee EC 5)*

> *"When we are wearing this t-shirt, we are representing 'the eyes and ears' of the community and municipality" (Interviewee EC4)*

The development of a group identity and perhaps also a social identity amongst the ECs is also evident when the ECs referred to themselves as a collective by preferring to use the term "we" instead of "I". This further suggests that the individualism that characterised the start of the project was being conditioned by the emerging motivation to serve the common good. These findings suggest a synergistic relationship between development of a group identity and

collective action: as a group develops and consolidates its identity, so the members become motivated to act for the good of the collective and this in turn, strengthens the collective identity (see Batson et al., 2002; Batson, 2014). The strength of the social identity of the ECs also positions them to act for the common good of the community as they became intermediaries between the community and the local government. One of the participants explained why they referred to themselves as the "eyes and ears" stating that:

> *"So, there is a gap between the municipality authorities and the community in terms of understanding each other. So, we share information between the municipality authority and local people from the community so that they can understand each other and try to work out what can be the solution. We represent 'the eyes and ears' of the community and municipality" (Interviewee EC3)*

The findings could suggest two roles for the social identity in motivation:

- It serves to encourage ECs to act for the good of their collective and, by enabling them to be identified by the community at large.
- It motivates the ECs to also act for the good of people and organisations outside of their group.

Through these actions the identity of the ECs could be viewed as strengthened, and their motivation is sustained. Implied in this interpretation is that collectivism could have played a significant role in sustaining the efforts of the ECs.

These findings support those of Batson et al. (2002) who considered that collectivism has the potential for solving social dilemmas. But for this to happen public awareness of the declining water quality would be required and that it is perceived as a social dilemma, the solution of which requires collective action. The quote from participant EC2;

> *"I went back to my area and said yes, I have been learning a lot from X now am I going to impact and feed my community all this information."*

Suggests that awareness-raising was included in the approach that the volunteers used to help residents understand their roles in water resource management and thereby to enable them to better the welfare of the wider collective.

### 4.6. Raising awareness towards water resource management

Citizen Science was used as an instrument to raise the public awareness on water resource management in the Mpophomeni community. The ECs used several approaches to achieve this amongst the residents. Below are some of the predominant methods used.

#### 4.6.1. Door to Door Campaign

One approach that was used to raise awareness within the Save Midmar Dam project was the door-to- door campaign, which was an educational approach. It was explained by one of the participants in this way:

> *The door-to-door is environmental education; we visit the homes and have discussions on environmental issues" (Interviewee EC4)*

The door- to-door campaign covered topics which affect water quality including care and use of toilets to prevent blockages, the effects of blocked toilets and pipes, illegal dumping, and scheduled days for refuse collection and recycling (UMDM, 2017). In relation to refuse disposal, ECs also used the door to door campaign as an opportunity to distribute black bags (sponsored by UMDM) to the community for refuse collection (Workshop 2017). One participant explained:

> *"As the Enviro-champs we started provided black bags to the community four bags for each household a month" (Interviewee EC5)*

The ECs also provided the residents with flyers identifying items which could cause blockages to the sanitation system. These included items such as plastics, condoms, newspaper, sanitary pads, nappies, food items, rags and cardboard (See Appendix V).

The process of carrying out the door-to-door campaign was characterised by diverse experiences. Some of the ECs faced challenges of apathetic residents whilst some residents were receptive to the initiative:

> *"At first it was hard because you come across a person who doesn't have time for you. They just say talk talk; I don't have time for all this. Sometimes when we pitch up they close the door and it is painful. The thing is I am not just there to bother and ask for money, but I am there to feed them with information so that they also know what is wrong with the environment. There is nothing much I can do with those people'' (Interviewee EC6).*

*"When I do the door-to-door it depends, some houses you go, and you find that they are not interested so it will be like 15 minutes others you get there they are interested, and you sit down it can take up to an hour just talking to them." (Interviewee EC 7)*

*"When you got to someone's house they would say no no; we can't talk to you because municipality has done this. Because they are now confusing us with the municipality. They say that you keep making promises you cannot keep because the municipality has promised them. When we go there they keep saying you keep on making promises which you can't keep" (Interviewee EC5).*

*"It becomes easy to work with the people that you live with, we have helped, and they know us which makes a good working relationship with the community." (Interviewee EC8)*

The Save Midmar Dam project ran for a period of 18 months it started from October 2015 to April 2017 and within that period approximately 6 811 households were visited and 1052 follow-ups for the door-to-door were conducted (UMDM, 2017). While the negative responses to the approaches by the EC may not be surprising, they illustrate both the need for developing awareness and the importance of a collective identity that sustains commitment to public engagement.

### 4.6.2. Street Theatre

In addition to the door to door engagement, awareness was raised using street theatre which has the advantages of not having to engage with individuals directly. And importantly, it enables the acting out of scenes with which residents are familiar. In this way it can be assumed that the awareness message becomes immediately relevant to those watching.

A drama group was established amongst the ECs and one of the group members described their experience in the following way:

*"We use the street theatre to raise awareness in the community on what is happening in the community. If there are public meetings we are called to do our dramas on the environment. They are responding very well, even the schools call us to perform drama as well on the environment activities. Even the children when you are walking in the street they know that this is the person doing environmental*

*drama and some of them call me and say 'Malume we know what is going into the toilet'." (Interviewee EC4)*

As an approach of raising awareness street theatre can be assumed to have been effective within the Mpophomeni community particularly with children. The children were able to memorize the things that were not supposed to be placed within the toilet, promoting proper use of the sanitation infrastructure. The drama group had different plays on water and sanitation which included how to properly use different types of toilets, littering and recycling (Ward, 2016).

**Figure 4.4:** Image of drama group members in action at a school (photograph from Ward, 2016)

Because of the success of the use of street theatre as an approach of raising public awareness in Mpophomeni, the drama group has become quite popular. After the interview with the leader of the drama group, he was approach by members of another NGO seeking his assistance on developing a play for their organization. It is this further recognition that reinforces a sense of competence amongst the ECs and promoting sustained participation in water resource management.

### 4.6.3. Youth and Children Clubs

Awareness amongst the residents was also raised by the start of Friday Youth Clubs and the Saturday "Mpops Kids club". The topics covered included the use of the miniSASS, recycling, monitoring illegal dumping, and reporting repeat offenders (UMDM, 2017). The ECs also used these meetings to raise awareness in youth and children on the proper use of sanitation facilities at school and home, reporting spilling manholes and reporting and fixing leaking taps (UMDM, 2017). One way in which the ECs sought to link cause and effect was to take youths and others to surcharging manholes so that they could see what was causing the spillage:

> *"Sometimes we can take people to the manhole and they can see what has been taken out when the manhole was being fixed so that they know that it is true that they have also been putting wrong things" (Interviewee EC3)*

This approach enabled residents to develop awareness of the materials that cause blockages as they witnessed first-hand what was removed from the manholes. They were encouraged to develop a sense of accountability for their actions.

The ECs kept detailed spreadsheets on all manholes and the material found blocking the manholes was recorded to enable monitoring of the changes (see Appendix VI). These spread sheets were used by the ECs to raise awareness and bring accountability to the residents:

> *"With those graphs and reports we have been getting from the Enviro-champs, it shows that in this particular area people are putting wrong things. We then share that information with the people and we say yes, we are understanding what you are saying about infrastructure but if we look at this particular manhole especially that one which is close to them we say this one in particular its spilling is as a result of what'' (Interviewee EC3).*

Through their "War on Leaks" initiative, carried out every Friday, which focused on reducing incidents of fresh water leaks, the ECs raised awareness on the importance of reporting and fixing fresh water leaks (UMDM, 2017):

> *"I had a water leak and a man from the Enviro-champs came and fixed it for me. In the time before there was Enviro-champs' no one would do anything even if we reported". (Interviewee MR1)*

> *"Since the Enviro-champs came we have been benefiting a lot they come and fix our taps when there are leaking." (Interviewee MR2)*

*"They are helping us a lot most of the houses have leakages and since they have started they have helped us save a lot of water". (Interviewee MR3)*

These quotes suggest that there was a growing awareness amongst the residents on the need for better water resource management as they were drawing on the services of the ECs. This was an important campaign as water leaks accounted for up to 37% of the water loss (WWF-SA, 2016), lessening the available quantity of fresh water.

This section focused on presenting my findings on how CS affected motivation to participate in water resource management. I proposed that CS created opportunities within the Mpophomeni community whose context was defined by poverty and lack of employment opportunities. I showed that self-interest motivated participation as individuals sought financial benefit and skills that might lead to future employment. As the volunteers learned skills and became competent, other parties, particularly water resource professionals and government officials, began to recognise and acknowledge their contribution.

This had two consequences: growth in confidence and sense of self-worth, and emergence of an identity shared by the volunteers. The sense of belonging motivated individuals to align their behaviours with the objectives of the collective. The development of collectivism among the volunteers is shown to be an important factor in achieving recognition and enabling engagement with other parties, particularly in government. Acknowledgement of competence and identity was helpful, perhaps even necessary, for the volunteers to be able to confidently engage wider society.

Once the volunteers were able to demonstrate their competencies and raise awareness they became increasingly motivated to serve the people, and collectivism became more evident. And, as they gained recognition and respect among the residents of Mpophomeni both their motivation to serve and their collective identity were reinforced, to an extent that some volunteers would continue their work even when payment ceased. In Figure 4.5 below I illustrate this self-reinforcing system.

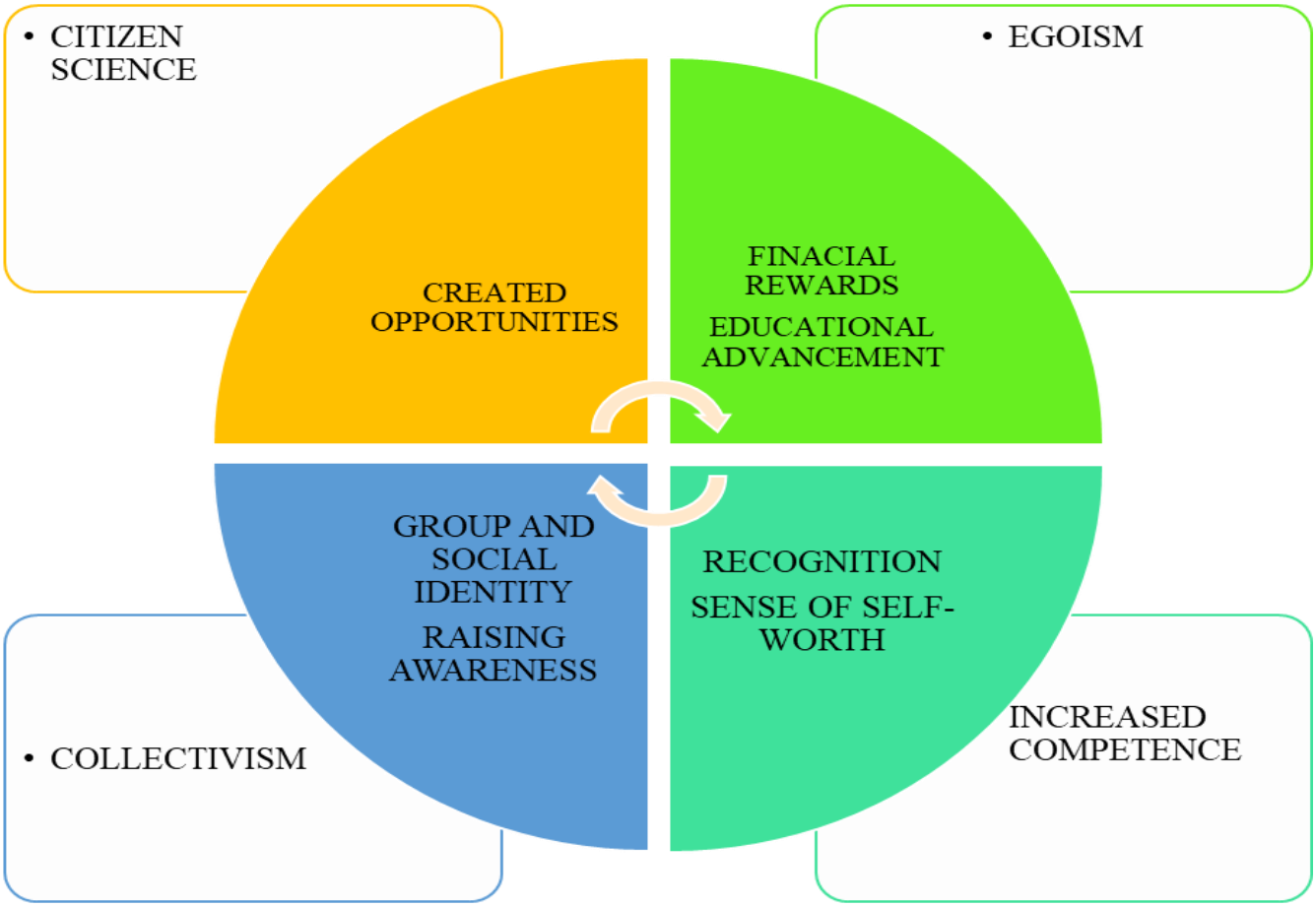


**Figure 4.5:** Conceptual map showing how CS affected motivation to participate in water resource management in Mpophomeni community *(Adapted from Batson, 1994; Ryan et al., 2009 and Haklay, 2015)*

The growing recognition of the ECs (section 4.4) enables them to carry out various approaches to raising awareness (section 4.6) and motivate goal-directed behaviour amongst the residents. The success of the ECs efforts to engage and motivate the residents to participate in water resource management can be assessed by investigating changes in the attitudes and actions of residents, which sustains participation in water resource management.

### 4.7. Perceived success as a motivation for sustained participation

Perceived success sustains motivation, particularly when it has been achieved under difficult circumstances. Mpophomeni has a history of very poor service delivery both during the Apartheid era and since the advent of democracy (Thorstensen, 2009; Umgeni Water,2014). Such conditions can lead to apathy and loss of interest in social issues. Translating engagement by the ECs into community motivation and action in support of water resource management required a shift from amotivation to active support. Perceived success in this study is regarded through two indicators which are changes in attitudes and action towards improved water resource management.

#### 4.7.1. Changes in attitudes towards improved water resource management

Prior to the engagement of the ECs, it can be assumed that the residents of Mpophomeni community were amotivated to engage in water resource management. As suggested in the reflection of participant NGO 1 (section 4.2), water resource management was not a priority maybe due to the perception that their actions would not bring about meaningful change. However, after the engagement with the ECs, arguably residents became aware that they could contribute to the efforts of improved water resource management and also preserve the quality for others:

> *"These projects are valuable because we need to clean these rivers because people in the lower areas using this water should also get it clean". (Interviewee MR3)*

With the increasing awareness and perhaps sense of competence, there was a growing change in the attitudes of the residents. This would suggest that the residents became more goal-directed towards water conservation practices as suggested in the practise of reusing water:

> *"I am saving water, when I do washing I don't throw it away that is water I use for my garden. I am saving water actually where I stay we have a monthly limit of 6000litres which is subsidised by the government, but I don't exceed that I roughly come to 3000litres" (Interviewee MR4)*

> *"I am now able to save water at first, when I was washing I would let the water run and rinse the clothes on itself but now I have learnt that water is life. It is important to save water and keep it clean. If I was bathing I can now reuse that water to do other things like mopping or flushing the toilet" (Interviewee MR 2)*

*"I will only speak of me; other people I am not aware. I try to take water that I was using to water my garden, if I was washing I use it to mop the house. I do not use water from the tap, even when I water my garden I use a bucket instead of a hose pipe" (Interviewee MR1).*

Though it is still in the early stages, it is suggestive that there was a growing expression of the latent motivation of the residents due to the conditions that the ECs had created within the community that enabled the community to engage in water conservation. There was a beginning of a collective responsibility towards better water resource management. In the long term these conservation practices would result in improved water security. The shift in attitudes towards water conservation was not only limited to adults, children were also slowly becoming goal-directed towards the need to conserve water:

*"The kids used to play with hose pipes but now they will tell you it is drinking water we can't play with it" (Interviewee EC 1)*

The reinforcement of the shift in attitudes towards water conservation was also carried out during the Youth and Children Clubs.

The success of the ECs in changing the attitudes of the residents could also be suggested by early adopters (referring to residents within the township that the ECs had first contact with in the door-to-door campaign), who had become goal-oriented, spreading the behaviour change amongst other residents:

*"Some of the residents were telling us that my next door neighbour was using water not the right way and they would come back to us to say I have just told my neighbour that he should not use the hosepipe to wash the car he must use the bucket and they must not use the tap for a long time. This was the feedback for us to say that all the things we are teaching them is working now." (Interviewee EC8)*

The slow progression of the residents beginning to educate each other towards better water resource management could suggest success in the work of the ECs to motivate active engagement of the residents in water resource management. As indicated in the first section (4.2), the residents of Mpophomeni had been amotivated to engage in water resource management, but these results suggest an early shift towards incorporation of collectivism

### 4.7.2. Changes in action in sanitation and solid waste management

In a community that experienced surcharging manholes for over twenty years, the greatest success for the ECs can be perceived through the changes in the number of spilling manholes which they related to the increase in awareness because of the door to door campaign:

> *"The door-to-door started in November 2015 and we have seen the change from November 2015 to 2016 there is a decrease in the spillage reported. It is changing". (Interviewee EC 2)*

> *"Then we started door-to-door and the problems of spilling manholes stopped showing that the environmental education is playing its role.'' (Interviewee EC5)*

> *"There haven't been much spilling manholes right now there are only about two or three there was a time when all the manholes were spilling this is a good change showing we are doing a good job." (Interviewee EC8)*

The change in actions of the residents towards better use of sanitation infrastructure will, in the long run, lead to improved water quality and attainment of the objective of the Save Midmar Dam project. Already there are indications of the improvement of water quality in the Midmar Dam, as Jewitt and Namugize, have reported a lowered nutrient load since December 2015 (UMDM, 2017). This can be viewed as a success for the ECs as it suggests that their efforts were resulting in noticeable change in water resource management.

The purpose of the door-to- door was to enable residents to appreciate that they could resolve the problem through behavioural change. Once they realised this, they were able to become goal-directed and motivated toward a solution of good care and use of the toilets to prevent blockages:

> *"You are not supposed to put pap after washing your pots, clothes, pads, pampers, you shouldn't let young children go the toilet alone" (Interviewee MR 2)*

> *"Hard paper, cloth and cardboard box, basically it is wrong to put things in the toilet that is not toilet paper" (Interviewee MR3)*

> *"The children when they go to the toilet they don't go alone they have to go with an older person to see that the toilet is being used properly and closely monitored" (Interviewee MR1)*

*"Sometimes, when the children play they put bottles and papers that is not allowed which will cause the system not to flow properly." (Interviewee MR4)*

The residents within Mpophomeni not only became aware of proper use of the sanitation facilities, but they also developed the capacity to resolve the problem of surcharging sewers proactively. There was thus a growing progression towards collectivism; they were monitoring their children's use of the toilets as such action would benefit the welfare of the collective. Though the adults had made the shift, there was still need for reinforcement for some children towards behaviour change as earlier indicated by the comments of interviewee MR1, MR2 and MR4. Further reinforcement however, was also being provided through the earlier mentioned children clubs and street theatre.

During the door to door campaign the ECs distributed four refuse bags per household per month (Interviewee EC 5) for proper solid waste disposal. Once the system was established the residents embraced it evidenced by the decline in the numbers of illegal dumpsites:

*"We have been going to talk to people about illegal dumpsites some had illegal dumpsite just in front of their yards and now they have cleared the areas fenced it and made gardens" (Interviewee EC4)*

*"We can see with the illegal dumps that they are decreasing, that is how we see that our projects are being helpful." (Interviewee EC 1)*

Arguably, the residents were motivated to dispose of the solid waste in an appropriate manner; the earlier failure could have been because there was no effective support system, such as that provided through the door-to-door, provision of black bags and awareness of days for refuse collection (UMDM, 2017). Some of the residents were even starting to practise recycling (Workshop, 2017).

Once the residents had the materials, they had a shared goal that was within their reach. Though it was still in its early stages there was a growing progression towards collectivism which would however, require continuous reinforcement from the EC and better service delivery from the local municipality.

### 4.7.3. Success as a motivation for sustained participation for the ECs

Sustained participation in water resource management for some of the ECs could probably have been because of the success they achieved in bringing about changes in the attitudes and actions

of the residents. The ECs related the changes in the community to be because of their actions and this motivated them to continue with their engagement in water resource management:

> *"I am very much encouraged to continue because of people from all walks of life come and learn about the work that we do and even adopt it so that they can change their communities. I am happy about what we have achieved but hope to do much better than before" (Interviewee EC1)*

> *"We are happy with the way we work, they continue to call us if there are problems and we are willing to do for the project so that we will continue to serve the people not only in Mpophomeni but South Africa" (Interviewee EC8)*

> *"It has been a great journey for me to be an Enviro-champ, seeing the community becoming a better place encourages me to do more. There is nothing exciting as seeing good results out of what you are doing. I surely want to do more." (Interviewee EC6)*

> *"The success of our work has encouraged me to participate more, coz of our work, in the community as a whole, councillors and everyone recognize us more and they appreciate our work. I am over the moon with what we have done and still doing'' (Interviewee EC7)*

There is also a suggestion from the ECs, that recognition of their success plays an influential role in sustaining participation as it increases a sense of competence making them also more goal-oriented.

In this section I considered the success achieved by the ECs in their engagement with the residents of Mpophomeni and how this influenced awareness and motivation. Prior to the engagement of the ECs, the residents were amotivated because they perceived themselves to be unable to bring about change within their environmental challenges. Through the efforts of the ECs raising awareness, the residents understood that they could solve the problems through their own action and they were able to act on their latent motivation. The ECs provided an alternative system which enabled the residents' latent motivation to manifest as they were equipped to address the problem.

### 4.8. Summary

In this chapter, I established how CS was used as an instrument to motivate, raise awareness and sustain participation in water resource management. Prior to the Save Midmar Dam project,

residents were assumed to be amotivated to engage in water resource management because they perceived their action as not enough to change the situation. Due to this perception they behaved in a manner which suggested self-interest, when the residents' focus was to dispose solid waste out of their homes without considering the environmental consequences such as declining water quality that would result from the illegal dumpsites. It was amidst these challenges that a CS project, Save Midmar Dam was initiated. Citizen Science created opportunities within the community such as employment and education advancement. These opportunities motivated participation of the volunteers. The results suggest they sought benefits-financial rewards, educational and skills advancement. They were motivated by self-interest. The skills advancement resulted in recognition and an increase in competence. This shifted motivation from egoism towards an incorporation of collectivism as the volunteers developed a group identity and sort to better the condition of the community through raising awareness. The ECs raised awareness and provided a support system for the residents, they were able to express their latent motivation and began to engage in water resource management. In the next chapter I carry out the discussion relating these findings to the existing literature.

# CHAPTER FIVE

# DISCUSSION

This study set out to explore whether CS could be used as an instrument to motivate, raise awareness and sustain participation in water resource management. The results show that while citizen science was used within Mpophomeni, it was carried out within the Save Midmar Dam project which had its own set of objectives which influenced how CS was conceptualised and initiated. In this chapter I bring into focus again what is meant by CS, and then proceed to discuss how it was expanded within this study. I then consider how CS can be understood within modern society.

## 5.1. What is Citizen Science?

In most definitions of CS, the role of the volunteers is restricted mainly to data collection and in some instances data analysis (See Chapter 2, table 2.1.). The data are then handed over to participating scientists or professionals who are assumed to proceed to implement appropriate measures according to the data collected. In this context the volunteers are not responsible for using the data in, for example, implementing remedial action as this becomes the responsibility of other individuals such as the professionals.

It is a result of such definitions of the roles that are given to the volunteers that some scholars have considered that CS mainly benefits the scientists through data collection (Edelson, 2012). The assumption that the data provided though CS results in meaningful measures by participating scientists to remedy or address the challenges revealed in the data was challenged by McKay (2007) who argued that though CS, with a particular reference bird watching, had indicated that there was a decline in some species there was little that had been implemented to remedy or address the causes. This brings into focus one of the challenges in CS, that though data is collected, an increase in knowledge does not automatically translate into appropriate remedial action (Chase & Levine, 2017).

The diffusion of understanding reflects the conscious of effort those who participate in CS to engage wider society. Diffusion refers to the spread of ideas (Green, Ottoson, García, Hiatt & Roditis,2014). In their recent study Fisher, Montambault, Burford, Gopalakrishna, Masuda, Reddy, Reddy and Salcedo (2018) stated that information sharing can either be promoted or hindered by social networks. For CS to lead to the diffusion of understanding it would have to

construct and support networks that extend beyond those who actively engage CS. Thus, CS would have to be conceptualised within a project (the Save Midmar Dam project in this case) that has the stated purpose of improving water resource management through changed behaviour among citizens.

Arguably, had the role for CS been limited as suggested in Chapter 2, Table 2.1, it would have not elicited the behavioural changes in the Mpophomeni community that were required to address the causes of declining water quality in the uMthinzima Stream, and eventually also in Midmar Dam. The challenge within the township of Mpophomeni was that residents were not aware of how their use of the sanitation system was related to the surcharging sewers (Kolbe, 2014). And, consequently, the residents did not appreciate that they could solve the problem through their own actions.

In the narrowly conceived form of CS, the role of the ECs would have been limited to gathering data on spilling manholes, in some cases analysing data, but with no requirement for conscious effort directed at disseminating information and encouraging behavioural change. The information would have been passed on to DUCT, who would then publicize the results and be responsible either directly or indirectly, for intervention. In this form CS, would likely have been too indirect to influence public behaviour and insufficient to bring the change that was required in Mpophomeni, particularly because of its history.

In this context, for CS to have a meaningful impact within the Mpophomeni community it had to engage the residents directly to disseminate information, raise awareness on their detrimental actions towards water resources and motivate for goal–directed behavioural change. This approach reflects the work of Stepenuck and Green (2015), who consider attitude and behaviour change to be as a result of raising awareness within the community. But to accomplish this in the Mpophomeni community, there was a need to first transform the ECs into ‘agents of change’ who have a shared understanding and are motivated collectively to engage, disseminate information and motivate other residents to bring about the change that was necessary. This mirrors the recent suggestions by McKinley,Miller-Rushing , Ballard , Bonney , Brown , Evans , French , Parrish , Phillips , Ryan , Shanley , Shirk , Stepenuck, Weltzin, Wiggins , Boyle , Briggs , Chapin III , Hewitt , Preuss and Soukup(2017) that individuals were more likely to alter their behaviours in relation to the examples that were set by their neighbours and friends.

Engaging with the public requires a motivation to serve together with the required skills and a shared understanding of the envisaged role that was expected of the ECs. The Save Midmar Dam project's focus was educating and raising awareness on water and waste management (UMDM, 2017). This required the ECs to actively engage with the public. A question that can be posed is: "*How was CS expanded in the Save Midmar Dam project?*" I explore this question in the section below.

### 5.2. Developing and motivating the volunteers into "Agents of Change"

For CS to have a meaningful impact within the Mpophomeni community, pertaining to addressing the declining water quality, it had to transform the volunteers into 'agents of change' a process that hinged mostly on motivation. Rotman et al. (2012) observed that understanding the initial motivation of the volunteers was essential for the success of a project. They go on to suggest that the initial motivation for volunteers was mostly related to egoism, which is action that is carried out to improve one's own welfare. This becomes a challenge in a community that is characterised by social and economic hardship such as the case of Mpophomeni (Thorstensen, 2009) when collective action is required. The challenge is exacerbated when the project objectives intentionally prescribe that the potential participants be selected from poor unemployed households in a project that has a stipend model.

Bowen (2007) draws attention to the important role for material incentives in securing participation in projects. Financial reward can be a motivator for participation in community projects, with the volunteers developing loyalty to the organization that provide the financial reward (Kavanagh & Cavanaugh, 2006; Mitra, 2013). In their study Zheng, Yang, Long and Jing (2016), however, specified that though economic incentives can motivate participation this approach is unsustainable. In collective action, incentives are viewed as being selective - whereby there is either a reward for the individuals actively participating, or a punishment towards those that fail to participate in collective action (Oliver, 1980).

In the case of Mpophomeni, the stipend became a selective incentive to reward the ECs who actively participated in water resource management. The results suggest that the reward did become sufficient to motivate and sustain participation by the ECs despite the initial negative response from the residents. However, drawing from my results, I concur with the study by Zheng et al. (2016) that the stipend would likely not sustain participation of the ECs in water resource management if the sense of competence and autonomy were not developed to increase intrinsic motivation (Ryan & Deci, 2000). Rewards can be understood as external regulators

which control individual behaviours (Gagné & Deci, 2005). Thus when individuals are egoistically motivated they may continually search for better rewards rather than commit to serving in an endeavour such as water resource management. This was not the case in Mpophomeni where alternative modes were limited, and any material benefit could be expected to evoke strong egoistic motivation at the expense of fostering collective action. However, progress towards balancing egoism with collectivism requires something more than a material reward. It requires personal growth which in the context of Mpophomeni and the Save Midmar Dam project was achieved by developing a shared understanding for the need of water resource management, increased sense of competence and professionalism of contributing to collective effort among ECs.

Citizen science has been commended for facilitating learning amongst the participants (Jennett et al., 2014; Blaney et al., 2016). When applied with the specific intention of developing shared understanding, professionalism and collective effort CS provides a platform that can enable those who engage to develop motivation to serve the common good (collectivism) while at the same time satisfying the need for personal benefit. Rotman et al. (2012) acknowledged that though egoism can be the primary motive for participation at the start of the project, involvement with time and clear understanding of the project goals and value, motive shifts to include collectivism. In the Save Midmar Dam project, CS provided the platform by developing clear, shared understanding of the need for water resource management through the weekly training sessions on ecological infrastructure (Mutimukuru, Kozanayi & Nyirenda, 2006; UMDM, 2017). A more recent study by Cele (2015) concurred with the finding by Mutimukuru et al. (2006), stating that the participants developed collective meaning-making and a development of a group identity. Arguably, the developed understanding and sense of being part of a 'greater effort' increased confidence among ECs to be able to engage individually and collectively with residents. This created conditions that favoured the emergence of a desire to serve the common good to the extent that motivation began to reflect both egoism and collectivism.

Initially the prospect of a reward (extrinsic motivation) secured participation of ECs. But to achieve the intentions of the Save Midmar Dam project, they would have to develop intrinsic motivation. Ryan et al. (2009) proposed that an increase in the sense competence and recognition increases intrinsic motivation in individuals. Linking CS to advocacy for improved water resource management provided for both development of competence and opportunity to gain recognition and thus be understood to have led to increased intrinsic motivation. This

emergent intrinsic motivation to better the welfare of other residents would have strengthened commitment to develop group cohesiveness and personal orientation toward serving the common good.

The intention of the Save Midmar Dam project was to bring about sustained effort directed toward improved water resource management. Intrinsic motivation and motivation to serve hold important implications for sustaining effort beyond the end of a project. This discussion of factors that motivate ECs in participating in CS raises the question: '*What sustains this participation*?'

### 5.2.1. Sustaining ECs participation in Water resource management

Recognition afforded to the ECs by the professionals (DUCT) resulted in the formation of an Executive Committee amongst the ECs which had delegated authority to engage in some of the decision-making pertaining to the running of the group. This added responsibility suggested an acknowledgement of the increased competence and decision-making capabilities of the ECs and contributed to sustaining active participation of the ECs. The establishment of the Executive Committee can also be viewed as the start of a 'bottom –up' approach, in which the ECs began to exert control in the project, slowly moving the project into a co-created model as suggested by Bonney et al. (2009).

This increase in knowledge and skills advancement amongst the ECs also came with an important outcome. It resulted in ECs being subconsciously promoted to a respected position within the community as evidenced by their inclusion in platforms such as 'War Rooms' which were communal decision-making platforms. The reflection from EC 6 *"now we have a voice, they now recognize us"* suggests prior to the engagement in citizen science, these individuals were not involved in the decision -making neither were they empowered to engage in such platforms. These findings support those of Danielsen, Pirhofer-Walzl Adrian, Kapijimpanga, Burgess, Jensen, Bonney, Funder, Landa, Levermann and Madsen (2014) who observed that participating in CS can provide the public with an improved understanding of policies and creates opportunity to engage the government to address their environmental issues. But, for this to happen, the ECs (in this study) had to be motivated and sufficiently competent to engage.

Cele (2015) concluded that CS enables the citizen to engage authorities in relation to areas causing challenges. Evidence from this study shows that the ECs were encouraged to engage with authorities in their efforts to improve service delivery, particularly in respect of solid waste disposal and illegal dumping. The sense of being a 'voice for the community' was a motivating

factor that kept the ECs working towards the betterment of the community. This is also in line with Brodie,Hughes, Jochum, Millers, Ockenden and Warburton (2011) who stated that individuals continue to participate when they perceive their actions as making an impact. The shift in motivation (extrinsic to incorporate intrinsic) of the ECs allowed for communication with the government, influencing service delivery within the community to improve the state of the water resources. And the resultant improvement (feedback) enhanced the sense of being a 'voice for the community' and strengthened intrinsic motivation.

The recognition from other stakeholders also contributed to a shift in motivation among the ECs towards the inclusion of collectivism. This is particularly indicated by the development of a group identity. They began to refer to themselves as a collective "we are the eyes and ears of the community" motivating sustained active participation supported by a growing sense of self-worth. As the ECs became recognized within the community, for example as the 'water police', their social identity strengthened. This identity conferred by the community motivated sustained participation because it gave them a position of authority within the community and an increasing sense of self-worth among ECs. This is line with Wenger (2000) who suggests that how the world views an individual could motivate a move from initial participation to sustained participation.

Abrams and Hogg (2010) suggest that social identity can regulate the attitudes and actions of individuals in line with the group objectives. Such was the case of the ECs who sustained active participation despite the absence of the stipend which provided the initial motive for participation (EC 5 Chapter 4 section 4.1.3). These findings are in line with those of the World Bank (2015) which stated that recognition (social identity) has the capability to motivate individual participation and in some cases substitute monitory reward. Arguably, in this study, it can thus be said that with the growing collectivism the ECs transformed from being mere volunteers into envisioning themselves as 'agents of change' with the shared vision of motivating better water resource management in Mpophomeni.

Despite the success in shifting away from extrinsic toward intrinsic motivation with the accompanying development of collectivism, there remained a challenge of how CS was going to motivate sustained participation among residents. This is particularly challenging given the history of the Mpophomeni settlement. Earlier, I argued that for CS to have a meaningful impact in wider society it had to directly engage the public and bring awareness of the detrimental effects of their actions on water resources. This is not typically part of CS projects.

However, in the Save Midmar Dam project, after the volunteers were transformed into 'agents of change', it became possible to engage the public with the intention of changing resident motivation towards better water resource management. What was particularly significant in this transformation was leading residents to the realisation that a solution was within their control; changing their behaviour could solve the problem of surcharging sewers. The residents could become goal-directed rather than 'problem-oriented'.

### 5.3. Deploying the volunteers as "Agents of Change" in Mpophomeni

The ultimate goal for deploying the ECs as 'agents of change' into the community was to facilitate a shift in the motivation of the community from self-interest (egoism) towards acting for the common good (collectivism), to bring about a collective responsibility towards water resource management. Understandably, these intentions are challenged when the community is deprived of efficient service delivery and the residents are either oblivious to or unconcerned about the detrimental effects of their actions towards water resource management. However, the results of this study suggest another interpretation, namely that residents might be motivated to remedy the problem but become apathetic when they feel no solution is within their grasp. Lack of knowledge and awareness are considered to contribute to amotivation among stakeholders (Gagné & Deci, 2005) but once they become aware that changing their behaviour could solve the problem their latent motivation manifests. They become goal-directed and through their own actions the problem can be resolved. This interpretation gains support from Ryan et al. (2009) who concluded that there is a decrease in intrinsic motivation if individuals have a diminished sense of competence.

From the reflections of the residents (Chapter 4 section 4.2.2.), with the increase in awareness there was a change in the actions amongst the residents slowly moving toward collectivism. For instance, they started managing their own behaviour and becoming vigilant in monitoring children as they used the sanitation facilities. Though the outcomes of behaviour changes of the residents were still in the early stages, the better use in the sanitation system was translating into fewer spilling manholes. This had an effect of lowering the nutrient load reaching Midmar Dam (UMDM, 2017) and also contributing to an improved living environment.

Arguably, with ongoing reinforcement from the parents, street theatre and youth and children clubs, a shift in behaviour was noticeable amongst the children within the community. They refrained from playing with fresh water and became conscious of the required proper use of the sanitation infrastructure. This indicated a slow progression towards intrinsic motivation

leading to more people conforming to emerging social norms (collectivism). This is in line with Sunstein (1995) who concluded that with new information social norms change as they are based on perceptions about relevant facts. Social norms are regarded as '*rules and standards which a society guides and/or constrain social behaviour without the force of laws'* (Cialdini & Trost, 1998, p. 152; Macionis, 2004). In this study the results suggest that while new information played an important role, the demonstrated success from acting on the information, led people to believe that the solutions were within their grasp if they change their behaviours. Perhaps their latent motivation stemming from a sense of hopelessness became apparent once they were able to see their role in solving the problem.

Through the ECs' engagement with society new norms of behaviour started to become entrenched among residents. This was in line with the conclusion of McLaughlin and Vitak (2011) who stated that social norms developed due to prolonged engagement of individuals. Furthermore, Siu, Shek and Law (2012) attributed social norms to changes in behaviour and decision-making. In this case the ECs became a reference group, because of their developed social identity amongst the residents (Bicchierie, 2006). In this role they provided a standard against which the residents evaluated their own behaviour.

Once the residents were provided with materials and a system for proper solid waste management there were notable changes in solid waste management within the Mpophomeni community; illegal dumpsites were slowly turning into garden patches and slowly residents were beginning to engage in recycling. This indicates the success of the ECs in motivating the residents to conform to the emerging social norm of better solid waste management moving towards collectivism.

There was a growing change from self-interest in the residents within Mpophomeni. Because of the emerging social norm the residents were slowly developing a collective responsibility towards freshwater management. This was evident through the reporting of water leaks to the ECs. Residents that had also engaged in the awareness campaigns facilitated by the ECs were slowly reinforcing water conservation measures to other residents (Chapter 4 section 4.2.3). The reporting of such activities to the ECs also suggests that the residents may also have been seeking approval for conforming to the emerging social norm. Mackie et al. (2015) suggested that social norms are maintained because of either approval or disapproval from the reference group. Though in its early stages, these were signs that there were changes in the group

behavioural norms. The residents within the Mpophomeni community were slowly progressing towards collective action in water resource management.

The emerging social norm towards collectivism within the community was still in the early stages. This prompts the question "*What will sustain participation of the residents in water resource management?*" I explore this question in the section below.

### 5.3.1. The emergence and maintenance of social norms

In the previous section I argued that there was evidence indicating an emerging social norm towards better water resource management within the Mpophomeni community. Arguably, desired behavioural changes within the community will only be self-sustaining if progress toward the emerging social norms continues and expands. This is in line with Reynolds et al. (2014) who stated that sustained behaviour change can only be attained through changes in social norms. Social norms can be broadly categorized within two groups; descriptive norms (where individuals behave as others do) and injunctive norms (where individuals behave as expected by others) (Cialdini& Trost, 1998).

In their later work, Lilleston, Goldmann, Verma and McCleary-Sill (2017) stated that behaviour change can only be achieved if the reference group adopted the desired behaviour thus changing the injunctive norm towards the preferred behaviour. In the case of Mpophomeni, the adoption of better water management practices by the ECs (the reference group) was setting an example thereby shifting the behaviour towards collective action and slowly establishing the injunctive norm within the community. Participation in water resource management would be sustained by residents conforming to the emerging norm due to the perceptions that others would also conform due to the anticipated social rewards or sanctions (Bicchierie, 2006; Mackie, Moneti, Shakya, & Denny, 2015).

However, despite the emerging social norm towards better solid waste management, the efforts of the ECs were undermined by poor service delivery on the part of the local municipality. Mpophomeni is still faced with a challenge of solid waste collection and there were many reports of the municipality failing to collect refuse on the indicated dates and times. This resulted in the residents reverting to illegal dumping. Thus it can be argued that sustaining the emerging social norm was undermined by the service delivery from the municipality. As such, sustaining the participation of the residents required that the ECs also motivate the municipality to improve on the service delivery and for the municipality to conform also to the emerging social norm. However, the process of the municipality conforming to the emerging social

norms might pose a greater challenge as it cannot be easily subjected to the rewards and sanction that individuals are subjected to for conforming or violating social norms (Bicchierie, 2006; Mackie et al., 2015). Arguably, the residents can only sanction municipal members who fail to conform during elections by desisting from voting for them as councillors hence depending on "political sanctions".

### 5.4. Implications for the design and implementation of Citizen Science

The study sought to explore whether CS could be used as an instrument to motivate, raise awareness and sustain participation in water resource management. What the results have shown is that there is a need to shift the understanding and approach in which CS is carried out. There is need to transform the 'volunteers' into professional "agents of change". Such as in the case of Mpophomeni, this can be achieved through capacity building which increases the sense of competence amongst the volunteers. In addition, this can also be achieved by developing opportunities for active participation in promoting behavioural changes. This increases the sense of professionalism and feelings of self-worth thus sustaining participation amongst the volunteers. With the growing skills there is a development of shared understanding amongst the volunteers which evolves into a group identity. Reynolds, Subašić and Tindall (2014) stated that when an individual identifies with a group their actions and behaviours are shaped by the characteristics of the group further sustaining participation amongst the volunteers.

Effort should be focused on enabling latent motivation to manifest within the communities. Most of the residents were amotivated to engage in water resource management because they did not perceive themselves to be competent to contribute to the solutions. However, through the various approaches used to raise awareness, which are required to either develop motivation or enable latent motivation to manifest, the residents became aware that they could also solve problems through behaviour changes. When the residents develop the sense that they are part of the solution it sustains motivation and participation.

Effort should be directed at development and promotion of social norms. From their earliest work Fishbein and Ajzen (1975, 1980) concluded that social norms shape and regulate the willingness of individual behavioural changes. Promoting pro-environmental behavioural social norms will result in behaviour changes that are self-sustaining. This is because when behaviours become accepted as the social norm for the community it provides the ongoing

reference for what is or is not acceptable behaviour and helps to sanction those who do not conform.

There is also need to expand the network and resource base. The ECs need to be understood as part of a larger network. For example, when the solution to a problem requires service from outside agencies (such as municipalities), the ECs need to be able to draw on support that can be used to leverage service delivery. This happened when the uMngeni local municipality, which is in charge of waste collection, failed to provide the residents with 'black bags' (disposable rubbish bins). Instead the ECs provided 'black bags' during their door-to-door campaign which were donated by the UMDM. The network with UMDM provided resources which enabled a support system for the residents to act on their latent motivation of better solid waste management. However, such short term solutions need to lead to more sustainable solutions.

There is also need to sustain gains made through citizen science because it takes time to bring about behavioural change. When viewed as a 'project' CS has limited scope for success. The more CS becomes adopted as a 'main stream' approach to motivating behavioural change, the more likely it is that gains made will become sustainable.

### 5.5. Summary

This study sought to explore whether CS could be used as an instrument to motivate, raise awareness and sustain participation in water resource management. The findings of this study suggest that CS has all this capability when carried out in an expanded form which enables volunteers to be transformed into "agents of change" that are deployed within the community to directly engage with residents and motivate behavioural change. The engagement with the "agents of change" resulted in the residents realizing that they have the competence to contribute to the solution of better water resource management through behavioural changes. Sustained behavioural changes are achieved through an emergence of new social norms to which the residents conform.

# CHAPTER SIX

# CONCLUSION

In this chapter provides a summary of the research findings, contributions of the study and suggestions for further study. The study sought to explore whether CS could be used as an instrument to motivate, raise awareness and sustain participation in water resource management. This study had a particular interest in township communities which had water management challenges such that action by the residents would bring about relief. To this end, Mpophomeni Township in KwaZulu-Natal, South Africa was selected as the case study area of this research. The township was experiencing declining water quality as a result of raw sewage water flowing into the uMthinzima stream. In the Mpophomeni community a CS project, the Save Midmar Dam project, was already active making the area best suited to carry out this study.

## 6.1. Summary of the research findings

. The findings suggest that CS carried out in its typical form, where the volunteers are limited to data collection and in some cases analysis, would not bring about the needed change in behaviour within Mpophomeni to address the challenge of declining water quality. There was a need to directly engage with the residents which meant that there was a need to expand CS and transform the volunteers into more than data collectors.

In the Mpophomeni context, however, CS was carried out within the Save Midmar Dam project. This modified how CS was carried out. For instance, in this context CS was implemented using a stipend model in which volunteers received monetary rewards. This created opportunities which attracted the initial participation (egoism) of some of the ECs. However, the project was also structured in such a way that the volunteers received weekly training in ecological infrastructure and developed skills in water resource management. These skills resulted in recognition from other stakeholders such as the professionals, local government and the residents which developed a sense of self–worth and a social identity amongst the ECs.

The social identity that developed as a result of the skills-gain facilitated an incorporation of collectivism in the ECs to better the welfare of other residents. With the incorporation of collectivism, the ECs were transformed into “agents of change” who were deployed to motivate

behaviour change within the Mpophomeni community. They used various approaches such as the door to door campaign, street theatre and children and youth clubs to raise awareness amongst the residents on the need to change behaviour towards better sanitation and solid waste management.

Through the engagement with the ECs there was an emerging social norm within the Mpophomeni community as the ECs became the reference group against which other residents evaluated their behaviour. There was notable change in sanitation management which was evident in fewer surcharging sewers. In addition there also was an improvement in solid waste management as evidenced through a decrease in the number of illegal dumpsite. There was a noticeable progression in the community towards collective responsibility in water management as the residents became vigilant in reporting water leaks and also an uptake of water conservation through reusing water.

It is this notable success that sustained the participation of the ECs in water resource management. The sustained participation of the residents was due to the realisation that they had the competence to contribute to the solution through behavioural changes. Furthermore, the participation of the residents was also as a result of conforming to the emerging social norm precipitated by the anticipated social reward or sanctions from the reference group, a position at this stage that was filled by the ECs. A noted challenge, however, in the promotion of the emerging social norm of better sanitation and solid waste management was the failure of the municipality to provide the residents with effective service delivery. Though residents were motivated to properly dispose of their waste, failure of the required services provision resulted in some of the residents reverting to illegal dumping. Sustaining the emerging social norm of better solid waste management can only be attained if sanctions are also imposed on the municipality by the residents through electoral sanctions on the municipal members who fail to conform.

### 6.2. Contributions of the study

The study contributes to the deeper understanding of the potential of CS as a concept that can promote collective action in water resource management through its ability to motivate, raise awareness and sustain participation. This study brings into focus that to achieve these goals the volunteers within the CS projects have to be transformed into ‘agents of change’ who are motivated and equipped to bring about change of behaviour by establishing a change in the

social norms. The volunteers have to be collectively motivated to become a reference group from which other residents evaluate their own behaviour.

The study contributes to understanding of how to motivate residents in the township areas to participate in water resource management. It brings an insight into how to better design and manage CS projects so that they bring a meaningful impact to the water sector. This understanding is important to stakeholders who are concerned with the preservation of water resources such as the municipality and non-governmental organisations thus contributing to the scholarship in the field.

### 6.3. Suggestions for further study

A follow up study could be carried out to assess whether the behaviour changes that were starting to be evident in the community towards water resource management are self-sustaining.

In this study it was established that the one of the motives for initial participation for most of the ECs was because of the monetary reward that was created by the Save Midmar Dam project in Mpophomeni. The project was used as a blue print to establish another CS project in Amanzimtoti. However, the difference is that that project did not use a stipend model. Given that the projects used two different models, a comparative study of the two projects would offer further insight on what motivates the volunteers to participate in a CS project and sustain their commitment beyond the term of the project.

The limitation of this study was that it did not include participants from the municipality. However, this does not diminish the findings of the study. Findings of this study showed that the success of CS was dependent on motivating all the stakeholders to engage in collective action. The methodological challenge faced in the study were mainly in the data collection methods. There was limited documentary on the previous state of the community prior to Save Midmar project. Availability of such documentation would have aided in clarity on the reasons behind the amotivation of the public to participation in water resource management. However, the few available sources managed to provide a snapshot of the conditions prior to the project.

The timeframe of the project did not allow for the researcher to carry out field observation of the work of the ECs for the desired period. Deeper understanding would have emerged if field observation were carried out for longer periods. Despite this challenge, I was able to capture moments of central importance to the study such as images on figure 4.3 which depicted the changes in skills of the ECs.

A larger sample size would have been desired with regards to more resident participants. Some of the residents were unwilling to participate due to language barriers though this challenge was addressed using an interpreter. However, qualitative research depends mostly on data saturation, this point was reached with the sample size (15 participants) used in this study. An avenue for a future study would be the assessment of what motivates the service providers to improve service delivery and fully support CS initiatives.

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## APPENDICES

# APPENDIX I: Human Research Ethics Approval Certificate

MONASH University

**Monash University Human Research Ethics Committee**

**Approval Certificate**

This is to certify that the project below was considered by the Monash University Human Research Ethics Committee. The Committee was satisfied that the proposal meets the requirements of the *National Statement on Ethical Conduct in Human Research* and has granted approval.

**Project Number:** 7944

**Project Title:** THE ROLE OF PARTICIPATION IN IMPROVING SOCIAL LEARNING IN WATER SECURITY INITIATIVES: A CASE OF MPOPHOMENI, KWAZULU-NATAL, SOUTH AFRICA

**Chief Investigator:** Dr Bimo Nkhata

**Expiry Date:** 26/04/2022

**Terms of approval - failure to comply with the terms below is in breach of your approval and the *Australian Code for the Responsible Conduct of Research*.**

1. The Chief Investigator is responsible for ensuring that permission letters are obtained, if relevant, before any data collection can occur at the specified organisation.
2. Approval is only valid whilst your hold a position at Monash University.
3. It is responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by MUHREC.
4. You should notify MUHREC immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. The Explanatory Statement must be on Monash letterhead and the Monash University complaints clause must include your project number.
6. Amendments to approved projects including changes to personnel must not commence without written approval from MHUREC.
7. Annual Report - continued approval of this project is dependent on the submission of an Annual Report.
8. Final Report - should be provided at the conclusion of the project. MUHREC should be notified if the project is discontinued before the expected completion date.
9. Monitoring - project may be subject to an audit or any other form of monitoring by MUHREC at any time.
10. Retention and storage of data - The Chief Investigator is responsible for the storage and retention of the original data pertaining to the project for a minimum period of five years.

Thank you for your assistance.

Professor Nip Thomson

Chair, MUHREC

CC: Ms Tinashe Rimau

**List of approved documents:**

| Document Type | File Name | Date | Version |
|---|---|---|---|
| Focus Group questions | Question guide | 23/02/2017 | 1 |
| Explanatory Statement | Tinashe Explanatory form for community membersdoc(1) | 12/04/2017 | 2 |
| Explanatory Statement | Tinashe explanatory form for ngos and municipalities(1) | 12/04/2017 | 2 |
| Consent Form | Tinashe focus group consent form | 12/04/2017 | 2 |
| Consent Form | Tinashe Interview consent form | 12/04/2017 | 2 |
| Supporting Documentation | LETTER OF INVITATION FOR LOCAL COMMUNITY MEMBERS | 23/04/2017 | 1 |
| Supporting Documentation | LETTER OF INVITATION FOR NON GOVERNMENTAL ORGANIZATIONS AND MUNICIPALITIES | 23/04/2017 | 1 |

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## APPENDIX II: Explanatory Statement

**EXPLANATORY STATEMENT FOR NON-GOVERNMENTAL ORGANISATIONS**

**Project: Citizen Science and Motivation: A study of water resource management Mpophomeni, KwaZulu-Natal, South Africa**


Chief Investigator's name: A/Prof Bimo Nkhata Student's name: Tinashe Patience Rimau

Water Research Node Phone: [redacted]

Phone: [redacted] email: [redacted]

Email: [redacted]


You are invited to take part in this study entitled **"Citizen Science and Motivation: A study of water resource management Mpophomeni, KwaZulu-Natal, South Africa''**. The research is part of an international water security research project funded by the Lloyds Register (see www.watersecuritynetwork.org ). Please read this Explanatory Statement in full before deciding whether or not to participate in this research. If you would like further information regarding any aspect of this project, you are encouraged to contact the researchers via the phone numbers or email addresses listed above.

**What does the research involve?**

The aim of the study is to explore whether citizen science could be used as an instrument to motivate, raise awareness and sustain participation in water resource management. The study focuses on the township setting which is characterised of inadequate service delivery and economic hardships.

The participants will be expected to give their opinions on what motivates volunteer participation in citizen science projects, how awareness can be /was raised on water resource management and what sustains participation. Interviews which will be at most 90 minutes long will be conducted by the researcher with each participant during the agreed appropriate times. The interviews will be audio recorded for the researcher to transcribe later. An agreed venue will be communicated prior to the interview which is safe for both researcher and participant where participant can comfortably give their views such as their own office.

**Why were you chosen for this research?**

Participants are selected by the positions that they occupy as being managers or supervisors as there are perceived as key participants in the study. The contact details will be provided as a referral by the organisations.

**Consenting to participate in the project and withdrawing from the research**

Participants for the study will be required to read and complete the consent form manually before the interview is commenced. Completed forms are to be returned to the researcher before the start of each interview.

Participation in the research is voluntary and the participant is allowed to withdraw from the study at any stage. The withdrawal will however affect the quality of the data gathered as the researcher views the contribution of every participant as valuable and adding to the broader understanding of the research study.

**Possible benefits and risks to participants**

The benefits of this study is that it brings awareness on what motivates and sustains volunteer participation, helping in the better development and implementation of citizen science projects in the water sector.

The study poses no foreseeable risk to the participants.

**Confidentiality**

The researcher will not discuss the information with unauthorized personnel and will avoid using the name of the participant. The data collected is strictly for academic purposes. The information will be presented in a thesis and later in a journal article. The identities of the participants will be preserved by using randomly allocated participant identification numbers.

**Storage of data**

The data will be locked in a storeroom and it will only be available to the researcher and supervisor. Data will later be destroyed as per Monash Human Research Ethics requirements after 5 years. . Electronic data will be password protected on the computer and delated after 5years.

**Use of data for other purposes**

The data gathered will be used by the researcher in future journal articles. The data used will only be used for future articles if consent has been given by the participants.

**Results**

The results of the study will be available immediately after the research is completed. Participants that are interested in the research findings will receive the results as a report.

**Complaints**

Should you have any concerns or complaints about the conduct of the project, you are welcome to contact the research office of Monash South Africa via:

Hester Stols

Monash South Africa

[redacted]

Ruimsig, Johannesburg

Tel: [redacted]

Thank you,

[redacted]

BimoNkahata and Tinashe Rimau

## APPENDIX III: Consent Form

MONASH University

**CONSENT FORM**

**Project: Citizen Science and Motivation: A study of water resource management Mpophomeni, KwaZulu-Natal, South Africa**

**Chief Investigator: A/Prof Bimo Nkhata**
**Investigator: Tinashe Patience Rimau**

I have been asked to take part in the Monash University research project specified above. I have read and understood the Explanatory Statement and I hereby consent to participate in this project.

| I consent to the following: | Yes | No |
|---|---|---|
| Participation is voluntary | ☐ | ☐ |
| My responses will be audio recorded | ☐ | ☐ |
| No information that may identify me will be included in the research report | ☐ | ☐ |
| Information gathered can be used by the researcher in future research | ☐ | ☐ |
| All tapes and transcripts will be destroyed after research is completed | ☐ | ☐ |
| I may refuse to answer any question I prefer not to | ☐ | ☐ |

Name of Participant _____

Participant Signature _____ Date _____

## APPENDIX IV: Interview Guide

**INTERVIEW GUIDE**

Title of the thesis**: Citizen Science and Motivation: A study of water resource management in Mpophomeni, KwaZulu-Natal, South Africa**

1. What was happening in the community before the Save Midmar Dam was started?
2. Are there any opportunities that have been created in the community since the projects started?
    - Personal Opportunities
    - Community Opportunities
3. What makes people volunteer to be part of the projects?
4. How do people view you as a volunteer/ how do you view the volunteers?
5. How do you raise awareness within the community on water resource management?
    - What has been your experience during this process?
    - Can you briefly explain what you have learnt during the process?
6. Why do you continue to volunteer?
7. In your opinion what was causing the surcharging manholes?
8. What are the challenges that are being faced in the community with regards to solid waste management?
9. Are there any changes that you have observed since the project started with regards to surcharging manholes and solid waste management?
10. As an individual what are you doing differently since you have in contact with the ECs?
11. What does it mean to you as a volunteer seeing the changes within the community?

## APPENDIX V: Door to door flyer

WESSA
PEOPLE CARING FOR THE EARTH

uMGUNGUNDLOVU

DUCT

| PLEASE DO NOT THROW THE FOLLOWING THINGS IN THE TOILET: | | SIZA! UNGAFAKI LOKU OKULANDELAYO ETHOYILETHI: | |
|---|---|---|---|
| 1. Plastic | 5. Condoms | 1. Ucwazi | 5. Amakhondomu |
| 2. Newspaper | 6. Sanitary Pads | 2. Iphephandaba | 6. Amaphedi abesifazane |
| 3. Cardboard | 7. Nappies | 3. Ukhadibhodi | 7. Amanabukeni |
| 4. Rags | 8. Food items | 4. Amasaka | 8. Ukudla |
| These things cause blockages. Blockages then cause sewage spillages in the street and we all suffer.<br>Please be responsible.<br>• Report sewage leaks to 0800 864 911 | | Lezi zinto ezibalwe ngenhla ziyavimbanisa, zenza indle igxagxaze emgwaqweni futhi sonke siyathinteka.<br>Bamba iqhaza ngokwenza kahle.<br>• Bika indle ephuphumayo ku- [redacted] | |

## APPENDIX VI: Manhole Spread sheet

ENVIROCHAMPS REPORT SHEET – July 2016

Name: [redacted] Cell Number: [redacted]

House Number: [redacted]

Ward: 2 Call centre sewage: 0800 864 911, Collect Rubbish: 033 239 9245

Councillor: Mrs Zine Dlamini

Manhole number: AL1 , AL2 , AL3 , AL4 , AL5 , AL6 , AL7,AL8,AL9.AL10

| DATE OF SPILLING MANHOLE *if spilling from last month | MANHOLE NO. | DATE REPORTED | NAME OF PLUMBER. CELL NO. | DATE FIXED | DAYS SPILLING AFTER REPORTING | CAUSE OF BLOCKAGE | | | | | COMMENT (OTHER ITEMS, METHOD OF REPAIR) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | nappies, rags, spoons, towels, plastic bags | building material (sand, stones) | vandalism (rocks) | scrap metal | animal parts | |
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