

# The Effect of Poor Environmental Impact Assessment (EIA) Implementation on the Wellbeing of the KwaMathukuza Community, Newcastle Municipality in South Africa

Shadung John Moja<sup>1</sup> & Simphiwe Ntokozo Mnguni<sup>1</sup>

<sup>1</sup>Department of Environmental Sciences, University of South Africa, Florida Campus, Roodepoort, South Africa  
Correspondence: Shadung John Moja, Department of Environmental Sciences, University of South Africa, Florida Campus, Roodepoort, South Africa. Tel: 27-114-713-878. E-mail: mojasj@unisa.ac.za; shadung@yahoo.com

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## Abstract

This study investigated the possible health impacts a waste water treatment plant (WWTP) will have on a community that reside near it. The study area was a low cost housing residential area within the Newcastle municipality in South Africa due to its close proximity to a WWTP. The data was acquired through informal interviews, questionnaires and observations. The participants were recruited mainly from the residents who resides about 5.0 km from the plant, local health caregivers, municipality official and the local government management.

A survey of the study area showed no other possible source of the odorous gases except the WWTP. About 97.0% of respondents have smelt the bad odour that is probably released from the plant. The results also indicates that a significant number of people suffer from headaches, vision, olfactory and breathing problems which could be linked to the nearby WWTP. It was also discovered that the respondents who are at a distance of more than 5.0 km from the WWTP were also negatively impacted by the gases as the residents who are within 5.0 km.

Looking into the future, every development needs to follow the proper procedure of EIA to reduce negative impact on human health. It also means that governments should review the buffer distances between such facilities industry and human settlements.

**Keywords:** environmental impact assessment, sustainability, policy making, waste water treatment plant, odour intensity, distance, health effects, KwaMathukuza, Newcastle Municipality, South Africa

## 1. Introduction

A number of studies have been done worldwide regarding the implementation of EIA regulations with regards to WWTP and related gases that are emitted from such facilities (Harris et al., 2009; Tobias et al., 2008). EIA potentially covers a wide range of negative and positive health impacts that can be direct (for example, odour nuisance from a wastewater treatment plant) and indirect (for example, majority of people in an area who suffer from chest pains).

Furthermore, because EIA is a regulatory requirement in many countries, it provides a potentially powerful mechanism for addressing the health and wellbeing of populations. The integration of health considerations can add differential distribution of impacts on various population subgroups to the EIA process. For the past 20 years empirical research into EIA practice and documentation has consistently revealed lack of coverage and deficiencies in consideration of health (Harris et al., 2009).

The wellbeing of people and a healthy environment depends mainly on the decisions governments make. Therefore effective regulations towards reasonable distances between residents and industries of different kinds need to be properly revised to ensure that people enjoy their environment and live to the advanced old age. In general, older WWTP's were not specifically designed to limit odour due to the gases released in the area immediately surrounding the site boundary. Many of the sites were therefore built in areas that were remote from sensitive receptors. The odours produced in the "noxious zone" will not stop at the fence line. This is why it is

internationally recognized that in order to minimize odour annoyance a separation distance between the odour source and residential areas is required (Schauberger et al., 2012). The noticeable odour from the WWTP can have a detrimental impact on the quality of life to the local environment for those living close by, yet it cannot be ignored that WWTP's are essential for maintaining standards in water quality.

The high level of odour perception and annoyance in residents living near WWTP's draw attention to the need to prevent odour nuisance constricting emission peaks and frequent emissions. Since odours may affect fairly distant residential areas, planning of the locations of waste treatment operations is essential. Generally, but not always, impacts on the environment decrease with increasing distance from the source of the emission (Zarra et al., 2008). If the impacts from a particular industry or industrial estate are considered to be unacceptable at the boundary of the site or estate, then there is usually a need for a buffer area to separate industrial land use and sensitive land use.

Volatile compounds such as those released from the WWTP can cause irritation of the eye, nose and throat. In severe cases there may be headaches, nausea, and loss of coordination. In the long run, some of the compounds are suspected to cause damage to the liver and other damages to various parts of the body. According to Munˆoz et al. (2010), odour emissions affect the quality of life leading to psychological stress and a range of symptoms such as insomnia, loss of appetite and irrational behaviour (Zarra et al., 2008). Examples of these compounds include nitrogen ( $N_2$ ), hydrogen sulfide ( $H_2S$ ), carbon dioxide ( $CO_2$ ), methane ( $CH_4$ ), ammonia ( $NH_3$ ), biological organisms, water vapor, and other chemicals discharged (Bruno et al., 2007). All these gases can come in contact with human body via inhalation and can lead to lung diseases as they have the ability to asphyxiate the body by denying it access to oxygen.

One of the best ways to reduce odour nuisance is to use a separation distance between the odour source and residential areas. According to Schauberger et al. (2012), different governments have different rules and ordinances, yet there is a current global trend showing the implementation of major community involvement, individually and as a whole, in regulatory steps. This trend can be seen in regulations being proposed and promulgated in Europe, Australia, and North America (Frechen, 2003). The determination of the buffer area is necessary in many situations to avoid or minimise the potential for land use conflict. While not replacing the need for best practice approaches to emission management, the use of buffers is a useful tool in achieving an acceptable environmental outcome.

The transformation of undeveloped, vacant or derelict land is subject to compliance checks with environmental policies and legislative environmental requirements in order to determine risks associated with any upcoming project and expose them for correction (P eti, 2012). According to Harris et al. (2009), internationally the inclusion of health within EIA has been shown to be limited. Advocates of human health have been interested in the inclusion of human health in EIA for a range of reasons to protect people and the environment. Furthermore it helps by reducing the chances of sudden attributions hindering the progress of development by enabling the development review process to better encourage and promote development design that reduces vulnerability due to hazards (Toro, 2012).

The study area is located within the Newcastle municipality in Northern KwaZulu-Natal province of South Africa. The wastewater treatment plant is situated at geographical coordinates of -27.758819 E 30.008573 S and approximately 15 km east of Newcastle. It is in close proximity to the low cost housing development. The plant receives and treats domestic sewage and some light industrial wastewater. The KwaMathukuza is a low cost residential settlement located within the Newcastle municipality in Kwazulu-Natal province of South Africa. The close proximity of this settlement to the WWTP was of concern considering the possible health impacts. This study intended to investigate the impact the WWTP has on the health of people living at a nearby KwaMathukuza residential area.

## **2. Method**

### *2.1 The Data Collection Methods*

A mixed method approach was applied to collect data. A mixed method approach was chosen because the researcher concurs with scholars (Mnguni, 2012; Creswell, 2009) who argue that mixing methods strengthen research findings, in that each approach is validated by the other when used together. The researcher wanted to tackle a research challenge from two or more perspectives and this approach was useful for that purpose. The quantitative method instrument consisted of open ended and closed ended questionnaires which were meant for the residents in the study area and its surroundings (5.0 km away); the caregivers and municipality officials.

The use of qualitative data gathering method was also applied to refine research ideas as the study progressed. One of the notable strengths of the qualitative instruments is that they evoke a more realistic feeling of the research setting which cannot be obtained from statistical analysis and numerical data utilized through quantitative means (Creswell & Plano Clark, 2007). For this particular use semi structured interviews were directed to the municipal officials.

### 2.2 Sampling

A non-probability sampling was used because not everyone in the area had an equal chance of being included in the study. Selected samples were accessible and convenient to sample. Furthermore, the probability sampling was used after the population was identified and a random process was applied to decide on each individual's probability. A stratified sampling technique was further applied to divide the entire target population into 7.0 regions from where the final participants were randomly selected.

About 85 participants were targeted, both male and female of between the age group 18 – 65 years were invited due to their ability to give reasonable answers. The participants were recruited mainly from the residents who resides more than 5.0 km from the WWTP, local health caregivers, municipality official and the local government management.

Among the significant ethical issues that were considered in the research process include consent and confidentiality. A concern form that contained a clause on the right not to participate, to participate or to withdraw was explained before being signed by all the participants. Participant's personal details were not included in the reports to ensure their privacy and anonymity.

### 2.3 Questionnaire Design and Validation

The questionnaire was validated by using the face validity method because it is not quantified using statistical method. The simplicity of this form of validity helps to establish if the questionnaire measures what is intended to measure. In this regard, ten randomly chosen people were given a validation questionnaire to scrutinize each instrument and determine its legitimacy and appropriateness for the research. These questions were designed to address two fundamental questions, through which the validity of the instruments would be established:

- a) Does the instrument question what they ought to be? Given that each section of the instrument was meant to assess some specific information and to determine whether the instrument met the specified standards.
- b) Is the instrument suitable for the purpose it is designed for? In this instance the main focus was on the conceptual background of the instrument as per propositional knowledge given.

The content validity method was also applied to complement the face validity method. Content validity doesn't rely on people's perceptions for measuring constructs but it uses statistical tests. The content validity method was measured using the *Statistical Programme for Social Sciences* (SPSS) to strengthen the validation. The content validity index (CVI) was calculated and the validity of the questionnaire was based on scoring. As suggested by Hyrkäs et al. (2003), questionnaires that score above 0.79 are regarded as acceptable, those between 0.7 and 0.78 as in need of attention and those below 0.69 as requiring revision or elimination. This particular method showed that the instrument was valid and reliable due to the 0.80 score obtained in this study. Both these methods were applied to strengthen the validation process and to ensure that the instrument was suitable for the research.

### 2.4 Data Collection and Analysis

The final questionnaire was administered for data collection where responses were analyzed to identify the most prominent trends. The initial step of the analysis was:

- Gathering together information from all sources and observations.
- Making photocopies of all recording forms and any other collected materials, to guard against loss, accidental erasure, or other problems.
- Entering narratives, numbers, and other information into a computer program, where they can be arranged and/or worked on systematically.
- Coding data in a way that make them easier to work with.

Analyzing data involved examining, describing and drawing conclusions on the patterns and trends that exist among variables which can be found useful in statistical operations.

### 3. Results

#### 3.1 Odour Perception and Meteorological Conditions

Sakawi et al. (2011) indicated that weather is one of the environmental components which influence the frequency and the intensity of odour perceived by sensitive receivers. The influence of weather such as wind direction and wind speed, temperature and rainfall can all affect the concentration of odour from the WWTP. In this study, the majority of respondents (56.1%) who live in close proximity to the WWTP further indicated that the odour is perceived more during the day, 12.1% respondents were more sensitive to the odour at night and 15.2% of respondents indicated their sensitivity towards the smell when it's windy, 10.6% indicated that they are more affected during the day whereas 3.0% are more sensitive to the odour when it rains, 1.5% in cold days and 1.5% did not give a valid response (Figure 1).

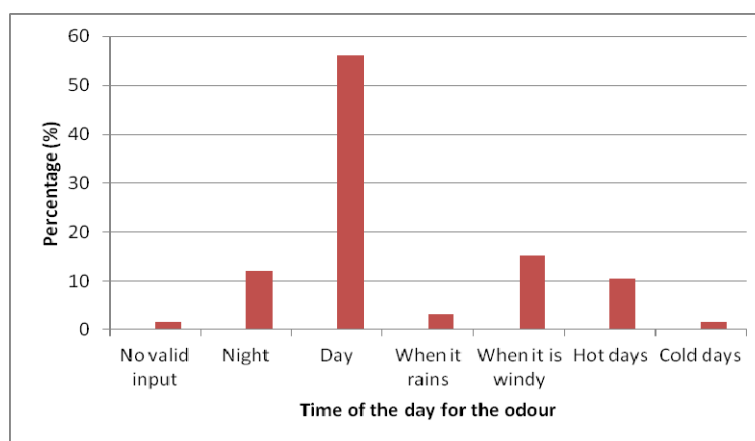


Figure 1. The time of the day in which most receivers are sensitive to odour

The study further revealed strong correlation that odour blows from the WWTP wind direction to the North West of KwaMathukuza study area which makes the WWTP a major source of odour in the neighborhood. The investigation also reveals that the area is more prone to flooding from the nearby river during the rainy seasons or from October to January. The Newcastle municipality personnel indicated that in 2011 more than 1800 trees were planted in the study area to mitigate the effects of odour to people's health however many of those trees have since died from neglect.

#### 3.2 Odorous Gases Released by the WWTP

A survey of the study area showed no other possible source of these gases except the WWTP. These gases lead to an unpleasant odour which probably affects the health of the residents as well as the environment in general. The odour in this regard was described by the respondents as a skunk or rotten eggs. In the following paragraphs the researcher presents detailed description of the odour trends as revealed by the data.

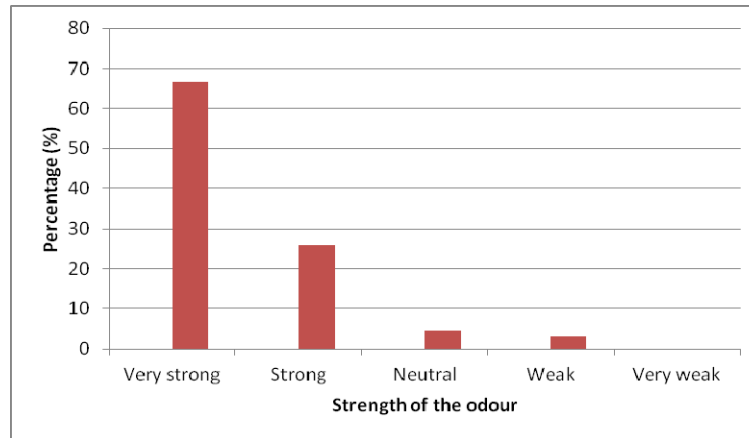


Figure 2. Strength of the odour according to respondents

The results indicate that 97.0% of respondents have smelt the bad odour that is probably released from the WWTP. This includes all respondents (n=10) who reside more than five kilometers from the WWTP. A majority of the respondents described the odour as strong to very strong (Figure 2).

Data also revealed that a majority of respondents 59.1% perceived the frequency of the odour at least once a day; some 18.2% indicated that the smell is there once every hour whereas some 15.1% indicated that it's only once a week that they smell the odour. Data shows that only 7.6% indicated that they experience the odour only once a month (Figure 3).

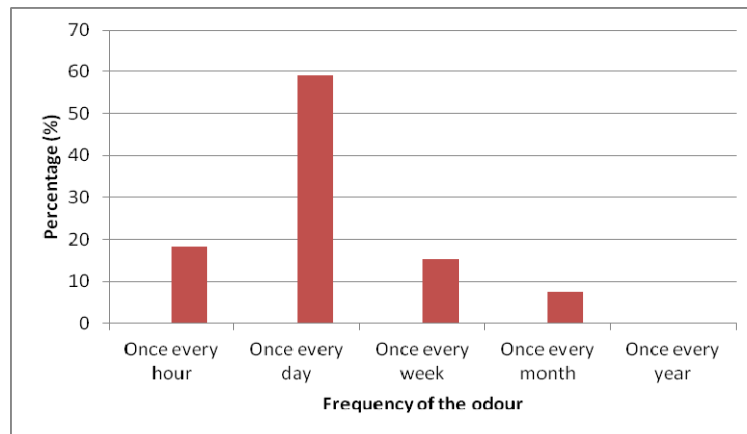


Figure 3. Frequency of the odour as perceived by the respondents

### 3.3 Effect of the Gases on the Community Housing

The effect of the gases released from the WWTP on the community housing of KwaMathukuza were also investigated. Qualitative data collected from officials in Newcastle municipality suggests that they have received complaints regarding the odour at least once every year and they also perceive the smell as unbearable. It must be mentioned that the community may be reporting an "odour" and not "gases" because they experience an odour and may not have a scientific understanding of the relationship between the gases and the odour.

Data also revealed that some officials believe that KwaMathukuza site is unsuitable for occupancy not only due to the WWTP but also due to its close proximity to the river and the cemetery. A concern was raised about possible flooding in the area and that some of the houses have been built much closer to the river belt. The possible flooding may lead to leakage at the WWTP which may spill over to the houses. In this regard, most of the houses in the site were found to have visible structural defects which may be due to chemicals released from the WWTP or simple water.

### 3.4 Effect of the Gases Released From the WWTP on the Community Health

The potential negative effects of gases released from the WWTP on the health of the community were also investigated. According to the healthcare givers who participated in the study, people who are exposed to gases (odours) were “most likely to suffer from allergens, sinusitis, nausea and lung diseases” (e.g. Respondent #16).

To start with, the researcher asked the respondents (residents) if they perceive the WWTP and the gases released as hazardous. Seventy two percent of respondents indicated that the odour (gases released from the WWTP) possibly causes health problems to humans. A further 74.0% indicated that they believe the gases probably affect their lungs. This was based on the fact that at least 57.0% of the respondents indicated that they visit the health facilities at least once in a month. About 40.0% of the respondents that reside five kilometers away from the site visited the health facility on a monthly basis. About 50.0% of respondents from five kilometers away indicated that they consult the public clinic the most and 40.0% go to the public hospital whereas 10% can afford to visit private doctors. In KwaMathukuza 51.5% people indicated that they consult mainly the clinics when they are sick and 39.4% visit hospitals whereas a minor shortfall of 6.1% visits the doctors and 3% never gave clear indication to the institution they consult (Figure 4).

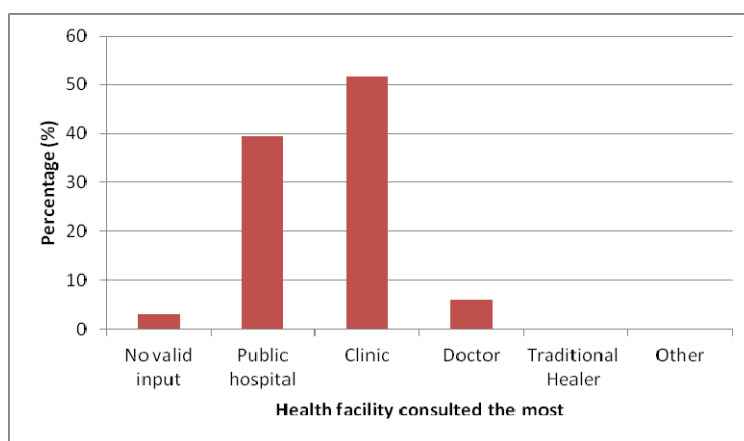


Figure 4. Health institutions consulted the most by residents in the area

Previous research has identified common ailments related to gases released from WWTP (Zarra et al., 2008). Data revealed that 10.0% of the respondents indicated to have suffered a miscarriage. However there was no evidence suggesting that residing in close proximity to the WWTP increases the chances of miscarriages. Results did however indicate that a significant number of people suffer from headaches, vision, olfactory and breathing problems.

About 71.2% of the respondents indicated that they regularly suffer from blocked nose when their at home, whereas 3.0% observed that their nose get blocked when they are at work and 25.8% did not observe this olfactory impact. This was in line with an observed significant correlation between shortness of breath, regular sore throat, regular cough, tightness of chest, redness of eyes and the blocked nose. The researcher further discovered that there was a significant correlation between trouble of concentrating with numbness of hands and/feet and tingling of hands and/feet. About 40.0% respondents indicated that they experience numbness of hands and/feet when at home, 10.0% experience this numbness when at work and 50.0% do not have any of such symptoms (Figure 5). Memory problems also had a significant correlation between the numbness of hands and/feet; the tingling of hands and/feet and swelling of feet and ankles.

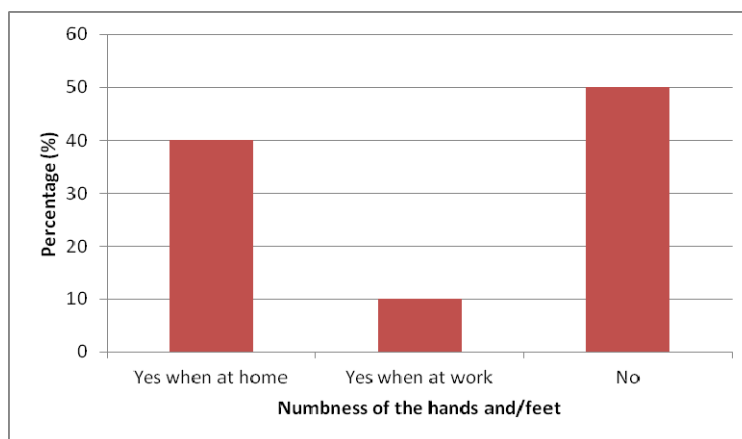


Figure 5. Respondents who experience numbness of hands and/feet

## 4. Discussion

### 4.1 New Knowledge Revealed by the Study

The critical finding in this regard is that the wellbeing of communities is put at risk when service delivery outweighs proper implementation of EIA regulations. It does not matter how good regulations are, if they are not properly implemented, then their existence is pointless. In particular, this study has revealed that there exists a gap between policy and practice in the area of EIA. While the study was based on a small community in South Africa, the authors believe that the same trends could be found in other places around the country. As a consequence, there is urgent need to explore and perhaps revise the role of EIA in South Africa against the backdrop of demand of service delivery.

The researcher further agrees with Kakonge (2013) who indicated that lack of transparency on how to mitigate and monitor the environmental impact of projects has resulted in widespread frustration, thus also causing inconsistencies in EIA quality and an EIA process that can be difficult to understand or reproduce. The results presented in this study illustrate how poor communities bear the brunt of environmental injustice and include not only race but also gender, age and educational level. This could be linked to a known fact that poorer communities are less likely to cause disputes or oppose any flaws that are linked to the environmental regulatory systems.

### 4.2 Findings that Contradict Literature

The study discovered that the surveyed residents who are at a distance of over 5.0 km from the WWTP are still negatively impacted by the gases as the residents who are within 5.0 km. While the number of participants who reside within 5.0 km of the plant were 16, the information conveyed was consistent. Thus WWTP should be zoned at a distance of more than 5.0 km away from any residential area. These findings contradict those of Maddock (2011) which recommend a buffer distance of 400.0 m to the nearest residential dwelling, there seemed to be a great impact of the odour annoyance besides the presented health issues at this particular distance. The wind speed and predominant wind direction from source to the receiving environments should be considered since they can influence the distance the impacts will be experienced.

This study focused on the effects of EIA implementation on the well being of local communities. Such effects take a while to resurface and to mitigate against them may be very costly. Future explorations should focus on ensuring that the EIA practice improves. The study proposes more use of planning and obligations use including the expansion of the use of formalised Environmental Management Plans to deliver them. Furthermore, the study suggests that there should be a body or professional institute that drives and monitors the implementation of EIA by various members in the practice.

## 5. Conclusion

All the above factors indicate that EIA is mandatory in South Africa however developers may struggle to understand the authenticity of the process if it lacks proper implementation. The lack of EIA practice can result to economic, social other significant morbidity and mortality risks, cumulative and intergenerational effects, and broader determinants of health which could have been avoided if things were done in the appropriate way.

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