

The assessment of the external costs of dust fallout in Blyvooruitzicht Gold Mining Village

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Mining is important for the South African economy, as it is for many developing African nations. In 2017, mining was reported to contribute 6.8 % to the South African GDP and provided more than 460, 000 jobs. Though mining adds an enormous amount of value to the country, it has significant impacts on the environment and the socio-economic factors of a society. The well-documented environmental impact of mining operations on surface and groundwater systems, known as Acid Mine Drainage (AMD), is just one of these environmental impacts. There are also other impacts such as the pollution of agricultural soils, the creation of sinkholes and air pollution. For example, airborne dust remains a persistent problem in South African urban areas due to the climatic conditions, extensive surface mining, unrehabilitated tailings dumps and mineral processing. However, very little is reported on the socio-economic costs that are due to poor environmental management. Some scholars assert that despite the Mine Health and Safety Act, deposition monitoring guidelines and national dust regulations, South Africa still experiences persistent dust problems, especially in coal and gold mining districts. This paper investigates the effect of gold mining dust pollution in and around Blyvooruitzicht Gold Mining Village, in South Africa. A quantitative and qualitative approach was used, where the community of Blyvooruitzicht was interviewed to examine their perceptions on dust pollution and their socio-economic environment. This paper examines how poor and premature mine closure by liquidation results in unrehabilitated mine tailings and how this has significant impacts on the socio-economic status of individuals and surrounding businesses. The community of Blyvoor being investigated in the paper, perceives the dust fallout impact to be a socio-economic threat. The paper finds that the community believes it incurs financial expenditures due to treating respiratory related diseases triggered by dust fallout.

Keywords: Mine liquidation, mine closure, Blyvooruitzicht, dust, socio-economic costs, perceptions

1. Introduction

The processes of winding up and business rescue have allowed mining companies to evade costly closure obligations (Humby, 2014). A winding-up process involves an insolvent company, placed under the custodianship of a liquidator, who manages the fair and equitable allocation of the company's assets to its various creditors while the remaining assets go to partners or shareholders. This has led to premature mine closure, and poor rehabilitation of tailings storage facilities, which is believed to affect surrounding communities. When a mine is disused, considerable amounts of trauma and frustration affect the surrounding mining community. The distress results from job losses, safety issues associated with 'Zama Zama' (illegal miners) invading the disused shafts, electricity cuts, soil, water and air contamination (Digby, 2016).

Recently labour costs per kilogramme in gold mining are on the rise while productivity stays approximately the same (Minerals Council of South Africa, 2018). This has resulted in some gold mining shafts being closed or placed under care and maintenance. Noronha (2001) indicates that the social and environmental impacts are pervasive in regions where mines are either newly established or closing down. South Africa is known to have a significant legacy of inadequately rehabilitated and closed mine sites, attracting an estimated 70 000 illegal miners (Digby, 2016). The World Bank (2002) predicts that in the next 25 years, several mines will be closed in developing countries; this is already being seen in South African and Zimbabwean mine closures or where mines are being placed under care and maintenance.

Blyvooruitzicht Gold Mining Company (BGMC) is a classic example of a mining company that has undergone premature closure through a winding-up procedure. BGMC is one of the oldest gold mines in Carletonville, South Africa. In 2013, BGMC was liquidated, leaving 1 700 employees without jobs and the surrounding communities and businesses affected by the environmental degradation (LHR, 2017). The community of Blyvooruitzicht at New Village (ward 27), the shopping centre and nearby ward 5 have been complaining about the dust that is dispersed during the windy season because of the unrehabilitated tailing storage facility number 6 (TSF 6) shown in Figure 1.



Figure 1: Tailings Storage Facility 6, a windy day in Blyvooruitzicht Mine Village.

The last companies to operate at BGMC, known as Village Main Reef (VMR) and Goldrich, left tailing storage facility number 6 unrehabilitated (LHR, 2017). Records from the Environmental Management Plan shows that only R35 million is available in the trust as financial provision for rehabilitation whereas an amount of approximately R108 million would be required for environmental rehabilitation (FSE, 2018).

The community of Blyvooruitzicht indicated that several organisations made false and endless promises to resuscitate the mine (LHR, 2017). Nonetheless, the Federation for Sustainable Environment, an NGO of environmental activists, has attempted to obtain accountability from the company through litigation. Humby (2014) argues that although the regulated closure model in the Mineral and Petroleum Resources Act (MPRDA) of 2002 appears to be in order, the right to transfer mining rights as per Section 11 of the Act is ambiguous in terms of ownership and liability. Humby (2014) further maintains that the winding-up process, as governed by the Companies Act of 1973 and the Insolvency Act of 1936, poorly articulates the mine closure model. This results in inadequate protection of the financial provision for environmental rehabilitation. The rehabilitation of the environment, the social issues arising from both premature and end of life of mine appear to be overlooked in the regulated model. She further articulates in detail the challenges associated with premature mine closure through the winding up procedure for mining operations in South Africa in her paper.

There are various drivers of premature closure which lead to a degraded environment and affected communities. These drivers include liability shifting amongst companies, unclear regulatory leadership on care and maintenance, challenges with enforcement of the integrated closure plan and generic company regulation relating to transactions, poor mine planning, business rescue as well as the winding-up process. Environmental and human rights activists view care and maintenance as a 'faux

legal term', referring to indefinitely warehousing mines instead of spending money on rehabilitation (FSE, 2018).

This paper focuses on the winding-up process as the main driver of premature closure and poorly executed mine closure processes in the Blyvooruitzicht case study, as there is a lack of research relating to identifying the key drivers. Laurence (2006) notes that only a small percentage of mines are closed according to the mine closure plan, with the majority closing prematurely or suddenly for various reasons. Milaras and McKay (2014) contend that numerous mines do not have contingencies or make specific plans for sudden or emergency closure. Milaras and McKay (2014) argue that there is a lack of institutional capacity in mine closure decision-making, compliance monitoring and enforcement as well as the support of long-term studies on mine closure impacts, costs and remediation.

Thus, the focus of this paper is to investigate the socio-economic costs of dust fallout in Blyvooruitzicht Gold Mining Village, due to premature mine closure. The perceptions of the community are assessed in order to articulate how premature mine closure can be linked to environmental degradation and effects on society's well-being.

2. The Mining Situation in South Africa

2.1 Mine Liquidation

As mentioned, liquidation is regulated under many Acts in South Africa, aimed to regulate the process of winding up. The purpose of liquidation is to dissolve the company in an orderly manner and not to rescue it. The company's existence ceases through the formal process of dissolution (Humby, 2014). The winding up may also be conducted in order to construct a brand-new company.

An early example of a mining company that experienced liquidation in April 2009, was the Aurora Empowerment System (AES) which took over Pamodzi Gold Ltd. The process of taking over was finalized in October 2009. Since 2008, this company had been operating a mine in Orkney, one of the richest gold mining areas in South Africa (Stuit, 2009; Van der Walt, 2009). However, some issues that arose included that post-liquidation, employees did not receive their salaries due.

Sudden mine closure is common in South Africa with catastrophic repercussions for the environment and surrounding communities. Blyvooruitzicht Gold Mine, for example, had no closure certificate and was liquidated in 2013, when a sale between

DRDGOLD and Village Main Reef fell through. The liquidator and activists failed to gain access to Blyvooruitzicht's financial provision, which was still managed by DRDGOLD personnel. According to Olalde (2017), the Promotion of Access to Information Act (PAIA) documents show the fund sits at about R35 million, a level DRDGOLD admitted was vastly inadequate to clean up the mine. Another example of a liquidated mining company is Mintails Mining South Africa; which holds three mining rights, which cover 1, 751 hectares near Krugersdorp. It is stated that Mintails requires about R 259 million to complete rehabilitation on those rights, a figure that is far too low, according to the environmental management programme report (FSE, 2018). The PAIA documents reveal that the company and related entities hold less than R17 million in funds for rehabilitation (FSE, 2018).

During the process of liquidation of a mining company, the financial provision for rehabilitation seems not to be recognised as a special claim against the company's assets to be set aside prior to satisfying creditors. This forms part of the reason why some mining-affected communities like Blyvooruitzicht are faced with environmental impacts from unrehabilitated tailings storage facilities.

2.2 Mine closure in South Africa

Mine closure planning is part of the mine life cycle, which includes exploration, pre-feasibility, development through operations to closure and rehabilitation. The closure planning is multi-dimensional and is mutually dependent on the surrounding communities (ICMM, 2010). In South Africa, mine closure is regulated under the MPDRA and National Environmental Management Act (NEMA) under the Department of Mineral Resources and Department of Environmental Affairs (DEA) regulatory authorities.

The best practice of mine closure planning is to consider closure at the exploration phase, when the feasibility of the mine, design and mining permits are established (Stacey *et al.*, 2010a). Mines normally close at the end of the mine's life cycle, when the mineral resources and reserves are depleted. However, it has been observed lately that mines are closing prematurely for reasons including economics, politics or geological complexities (Laurence, 2006).

Fourie and Brent (2008) point out that South Africa has adequate policies and legislature on mine closure, especially when considering social and community development. The promulgation of the MPRDA, aims to ensure that mining companies take responsibility towards community growth and

development. The MPRDA Section 43 (3) states that a holder of a mining right/permit must apply for a closure certificate upon cessation of mining operations or relinquishment of any portion of land to which the right/permit relates.

Until mid-2014, mine closure planning was regulated by the MPRDA. Since then, it has been regulated under NEMA as a sustainable development construct. However, some of the elements of mine closure, such as relinquishment are still regulated by the MPRDA. Section 2 of NEMA provides specific guidance on the closure of mining operations, mandating that a mining right holder:

1. Rehabilitate the environment as far as reasonably practicable to its natural state or to a land use which conforms with the generally accepted principle of sustainable development;
2. Set aside a financial provision - which only the state can access - to ensure such rehabilitation occurs; and
3. Retain liability for environmental damage even after closure of the operation

Most attention has focused on the financial provision, the duration of liability and the gaps which allow companies to contract out of their mine closure obligation (WWF, 2012; Humby, 2013). The issue with this provision is that it only applies if the new order mining right has been issued for a particular mining company. In the case of Blyvooruitzicht, this new order mining right had not been issued prior to liquidation, thus neither the DMR nor the liquidator could step in to take care of the community and avoid environmental degradation.

2.2.1 Socio-economic aspects of closure

Studies demonstrate the multi-factorial nature of mine closure. The various stakeholders have unique needs relating to mine closure. For example, mine owners want minimal liability for closure within a reasonable time frame while the government does not want to be left with high financial or social liabilities (Milaras and Mckay, 2014). On the other hand, mining-affected communities want an opportunity to maintain and improve their quality of life. Furthermore, communities want the socio-economic activities around the mine to continue in its absence. For most mining areas, the activity replaced subsistence agricultural farming, making communities overly dependent on mining. This dependence brings about numerous challenges when a mine closes, such as loss of employment and closure of businesses (Siyongwana and Shabalala, 2018).

South Africa can learn from other countries with regards to mine closure. In the international arena, the International Council of Mining and Minerals

(ICMM) in 2010 notes that mine closure requires the attention of multiple stakeholders. The stakeholders include the government, the global mining industry, the local community and international organisations that are actively involved in ensuring sustainability in the mining sector. This multiple stakeholder involvement is considered good practice internationally.

The ICMM allows for community participation in decision-making from early stages of mine development through to mine closure. The ICMM practices uphold ongoing maintenance and support of local mine communities even after the mine has closed.

The Eden Project in the UK, for example, a former clay-mining pit, was transformed into an environmental tourism attraction and educational charity (Eden Project, 2011).

2.2.2 Environmental challenges (dust)

The pollution of air, soil and water caused by mining activities has detrimental impacts on the health and well-being of surrounding mining communities. The Human Rights Commission conducted a study in 2016 on mining-affected communities in the Gauteng Province. The study reports that most communities complain about increased levels of dust, deteriorating health and threatened food security. Communities have drawn attention to poor environmental remediation and overall management (SAHRC, 2016). According to Anglo Gold Ashanti (2004), from 1997, South Africa produced an estimated 468 million tonnes of mineral waste per annum (DWAF, 2001). Of this quantity, gold mining waste accounts for 221 million tonnes – equivalent to 47 % of all mineral waste in South Africa.

NEMA acknowledges that the state's environmental obligation is linked to the responsibility to respect, protect and fulfil socio-economic rights. Environmental degradation due to a failure to rehabilitate tailings storage facilities by mining companies infringes human and socio-economic rights. Environmental rights go hand-in-hand with rights to sufficient food, water, health, land and dignity. Anglo Gold Ashanti (2004) reports that more than 270 tailings dams exist in the Witwatersrand Basin, which covers 400 km² of land.

With the introduction of the MPRDA, NEMA and the One Environmental System (OES), the state is trying to redress all the negative impacts caused by mining activities.

The OES integrates the roles of the various regulatory authorities i.e. DEA, DMR and DWS to avoid duplication.

Air pollution due to unrehabilitated tailings dumps is believed to trigger respiratory diseases to surrounding communities. Nkosi, Wichmann and Voyi (2015) find that exposure to mine dumps and residing in close proximity to mine dumps poses increased risk for respiratory disease. Illnesses such as asthma, chronic bronchitis, chronic cough, emphysema, pneumonia and wheeze are associated with communities residing in close proximity to mine dumps at a distance of less than 5 km (BMF, 2017). The respiratory illness is triggered by the fact that tailings material is usually fine-grained and can be inhaled; the material also contains toxic heavy metals.

Air quality monitoring and management are regulated under the National Environmental Management: Air Quality Act, 39 of 2004 (NEMAQA). In 2013, the DEA released the National Dust Control Regulations, founded on the need to prevent pollution and ecological degradation and ensure the protection of the right to an environment that is not harmful to health and well-being. Moreover, Section 33 of NEMAQA requires mining companies to notify the minister in writing if mining operations are likely to cease within a period of five years. Despite all these regulations and standards in place, non-compliance is still prevalent in the mining industry.

In Soweto, for example, the communities residing in close proximity to tailings dumps have ongoing respiratory illnesses (BMF, 2017). International Human Rights Clinic Harvard Law School (IHRCHLS) (2016) points to the chemical toxicity of the Witwatersrand tailings dumps. These tailings dumps contain significant levels of arsenic, cadmium, cobalt, uranium, lead and zinc (Coetzee et al., 2006; Heyl, 2007 in van Eeden et al., 2009). Uranium is of the greatest concern because it is radioactive and when broken down, it releases a toxic gas called radon. When this is inhaled or ingested, it can cause brain damage and cancer in the long term (Van Eeden, Liefferink and Durand, 2009). Other scientific research has shown that when water containing uranium is rubbed against animal skin, it causes skin irritation and damage.

2.3 Socio-economic challenges

The Mining Charter's Broad-Based Socio-Economic Charter is a South African Government instrument designed to promote sustainable growth and meaningful transformation in the mining industry. The Charter aims to promote equitable access to the nation's mineral resources to all South African people and to expand opportunities for Historically Disadvantaged South Africans (HDSAs). Furthermore, the Charter aims to promote employment and advance the social and economic welfare of mine communities and major labour-sending areas.

The Mining Charter acknowledges the issue of communities as an integral part of mining development. The social licence to operate for a mining company's deals with the meaningful contribution towards community development. To ensure the approval of the social licence to operate, mining companies should be consistent with international best practice and guidelines, where the company invests in ethnographic, consultative and collaborative processes with the community prior to mining project inception.

3. Study area

Blyvooruitzicht is a gold mining town located 6 km south of Carletonville, in the Gauteng Province of South Africa (Golder Associates, 2016). Blyvoor gold mine first commenced in the 1930s and continued up until August 2013, when the Blyvooruitzicht Gold Mining Company Ltd. was placed under liquidation. The mine is believed to have been liquidated 14 years ahead of schedule due to a slumping market and labour disputes. The mine generated about £ 2.5 million of gold, silver, uranium and other minerals but it is now a volatile wasteland (DRDGOLD, 2007). Before the premature closure of the mine, there were ten tailings (slimes) dams on the mine property, of which only two were active. The No. 6 slimes dam was the disposal area and the No. 1 slimes dam was utilised as a disposal area only in emergencies. Figure 2 shows TSF 6 located in close proximity (60 m) from the community of Blyvoor mine village.



Figure 2: Tailings storage facility number 6 in relation to the community location.

3.1 Challenges

In 2016, when the residents of Blyvooruitzicht (or "Blyvoor") were interviewed by Lawyers for Human Rights, they mentioned that the air was not clean. The district just west of the city recorded 42.24 metric tons of tailings-piles dust blowing into the air daily, some of it contaminating livestock and food

crops. Residents said that tailings caused health problems ranging from cancer to asthma, rashes, eye irritation and eczema, to name a few. However, a lack of local epidemiological studies has made it nearly impossible for communities near mine dumps to pursue litigation against mining companies. Residents also mentioned that there were several deaths in the area due to illnesses such as TB, which they believe, are triggered and caused by dust (LHR, 2017). Figure 3 below illustrates the fallout dust problem where, during the windy season, incidences exceeding SANS standard 9, occurred in October 2014.

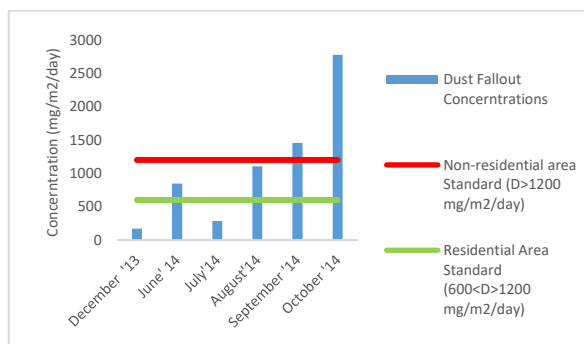


Figure 3: Dust concentrations in 2014 in Blyvoortzicht (Rayten Engineering, 2015)

4. Methodological Approach

This research utilises both quantitative and qualitative techniques to probe the subject of the socio-economic costs of dust at Blyvoor. A structured questionnaire was designed to obtain opinions and perceptions of Blyvoor residents. A series of semi-structured interviews were conducted with several businesses at Blyvoor. Other semi-structured interviews involved personnel from the Centre of Environmental Rights, Lawyers for Human Rights and various liquidators. To gather data on the socio-economic status of the Blyvoor community, a household survey was conducted. This data was augmented by census data, Integrated Development Plans, Service Delivery and Budget Implementation Plans. The Department of Mineral Resources (DMR) could not contribute to this paper, which is unfortunate for this research. The DMR's views and comments would have added significant value to the overall research as they are part of the key stakeholders in regulating mineral resources. It was expected that the DMR can explain whether they have any plans in place to curb the environmental and socio-economic impacts by holding liquidated mining companies liable.

4.1 Sampling

The key stakeholders were identified as informants of this research regarding the socio-economic impacts of dust in Blyvoor. A simple

random sampling technique was used when administering the questionnaires. This means anyone in the mine village had an equal chance of being selected.

The samples were selected at random, where 300 households were visited by five enumerators. The samples were first selected at Ward 5, close to the clinic of Blyvoor. The second set of samples were obtained at random in New Village, located 2 km away from the small OK shopping centre and about 60 m away from TSF6.

4.2 Data collection and instrument

Two questionnaires were designed for the study. The first questionnaire was directed at the residents of Blyvoor. The House Health Survey questionnaire was adopted during the design of the questionnaire to elicit specific, quantifiable information available such as household demographics, common illnesses linked to dust and health services. This questionnaire was adapted from the World Health Organisations' world Health Survey Guide to obtain the empirical information (WHO, 2002). The second questionnaire (open-ended interview questions) was directed at the businesses of Blyvoor and other stakeholders, which included Lawyers for Human Rights, liquidators and the Centre for Environmental Rights.

Data collection followed a typical Social Impact Assessment investigation by taking into consideration demographic factors, socio-economic determinants such as income, employment, labour migration, health, well-being and family composition. Furthermore, the social organisation and capacity of the households, the environment (air quality) as well as needs and values were investigated. Department of Environmental Affairs and Tourism (2006) suggests that social impact studies are complex and the input of the community in the assessment should never be underestimated. Thus, this paper bases its discussions on the community's perspectives.

4.3 Data analysis

The chartered statistician of the UJ Statistical Consultations Services assisted in analysing the responses; through the use of SPSS statistical software. Descriptive statistical analysis assisted in addressing the community perceptions regarding dust, socio-economic status and premature mine closure. The second questionnaire responses were analysed through conceptual analysis, such as deciding on the level of analysis, number of concepts to code, distinguishing the concepts, coding the text and analysing the results.

4.4 Data reliability

The questionnaire directed at residents was first administered to 20 households from Ward 5 and

another 20 households in New Village. The responses were analysed and some questions were amended, with ambiguous questions being rephrased or removed. The questionnaire was re-administered again to the same 40 individuals; the same responses were observed, making our respondents reliable and stable. Validity was tested by comparing the two wards and the manner in which the households responded was found to be similar.

4.5 Ethical considerations

The study methods and research instrument (questionnaire) was scrutinised and approved by the UJ Faculty of Engineering and Built Environments' ethics committee.

5. Results and discussion

Blyvoor is a typical gold mining town which consists of a mixture of individuals from different linguistic backgrounds including Afrikaans, Xhosa, Sotho, Tswana and very few Zulu speaking people. A significant number (72 %) of the residents have lived in this town for more than 10 years and originally came to Blyvoor for work purposes. StatsSA (2018) notes that the workforce of South Africa is between the ages of 25-64 years. What is observed in Blyvoor mining village is that this very same age group is unemployed.

At the time of conducting the study, individuals aged 30 to 50 were found at their homes and some were tenants. There was almost a 50/50 split in gender with females being slightly more prevalent at 54 %. This could be attributed to the historic belief that men should go and find work during the day while women do household chores. This could not, however, be confirmed. Another reason could be that there are more women (51 %) than men (49 %) in the country, as indicated by the census conducted in 2011 (Census, 2011). Some women explained that their husbands had returned back to their homelands after the mine was liquidated. Research by the World Bank and the International Finance Corporation (IFC) reveals that 90% of women in mining communities are not formally employed (World Bank and IFC, 2002). In each house, there were about 4 - 7 individuals residing. This is attributed to the fact that a household is made up of family members and tenants renting rooms inside the house as well as outside cottages. Homeowners are taking on tenants as a means of supplementing income through rentals. According to Michael Bauer Research (2018), the average household size in South Africa is 3.3 people. It is anticipated that households are larger in size in mining villages like Blyvoor due to the surrounding mining activities

which promise employment and thus increase migration.

Figure 4 indicates that since the liquidation of BGMC in 2013, most Blyvoor residents are unemployed (51 %). This number is higher than the national employment rate of 26.7 % in 2017 (StatsSA, 2018). The residents of Blyvoor explained that they struggled to find employment anywhere around the Carletonville area. Most respondents indicated that the only skills and experience they had been in gold mining. The individuals who had some form of employment were involved in economic activities such as mining, agriculture, livestock farming and subsistence business activities.

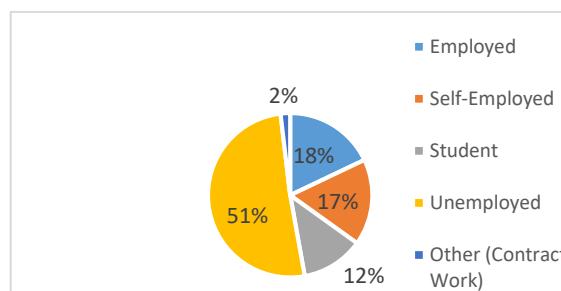


Figure 4: Employment Status of the respondents

As shown in Figure 5, 63 % of the residents had completed matric whereas others had not completed their schooling. The national South African household survey reported higher education level as a protective factor for respiratory diseases (Ehrlich, White, Norman, Laubscher, Steyn & Lombard, 2004). According to the 2011 census, only 28.4 % of South Africans over the age of 20 had completed the twelfth grade, 33.8 % had reached high school and 12.1 % had a tertiary qualification, which is reflected in this community.

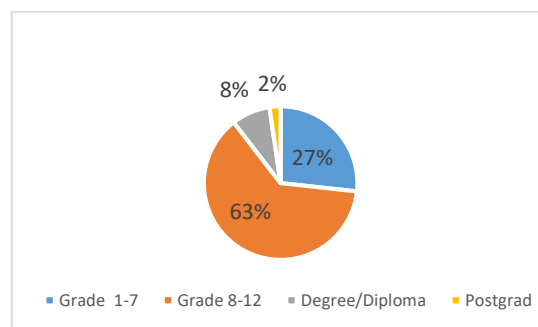


Figure 5: Level of education of the respondents

As illustrated in Figure 6, the average monthly income for Blyvoor residents ranged from less than R2 000 (39 %) to R3 000 (31 %). This amount is below the minimum wage of South Africa (National Minimum Wage Act, 2019). Furthermore, most respondents had matric as their highest qualification. According to Nkosi *et al.* (2015), residing in close

proximity to mine dumps, smoking habits, the use of paraffin for cooking and heating and low levels of education are significant factors for chronic respiratory symptoms and diseases. Furthermore, low levels of literacy are associated with low socio-economic status and have been identified as a risk factor for respiratory illnesses and symptoms (Karnevisto *et al.*, 2011). What is observed in the present study accords with the findings of Karnevisto *et al.* (2011) as the community complained of respiratory illnesses and seemed not to have reached a higher education level.

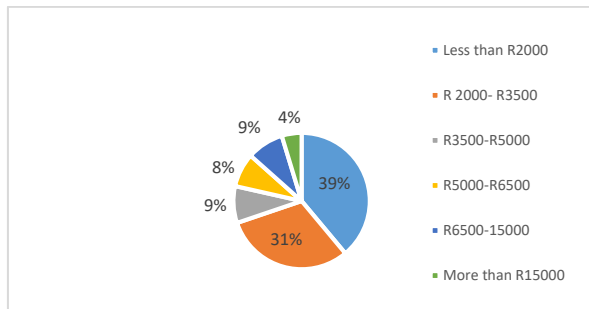


Figure 6: Monthly income of the respondents

Only 4 % of the respondents indicated that they earned more than R15 000 per month. These individuals are possibly the residents who indicated permanent employment.

The occurrence of smoking in the community was also assessed. Of the respondents, 78 % said that they did not smoke, 14 % responded in the affirmative while 8% said they were ex-smokers. This question was investigated to show that the respiratory illnesses that occurred in this mining village were not necessarily as a result of smoking but could be related to dust. The ex-smokers mentioned that doctors advised them to stop as they had been diagnosed with chronic respiratory symptoms.

5.1 The problem of air pollution by dust - environmental impact

The respondents in Blyvoor (36 %) mentioned that they considered pollution by dust to be a very serious problem. Only 1 % believed that dust was not an important problem.

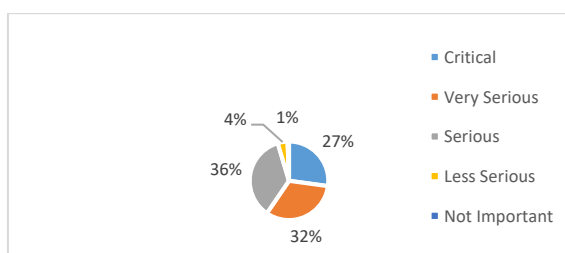


Figure 7: Level of importance placed on air pollution by dust

The respondents (63 %) answered that they were interested in environmental well-being. The majority of the Blyvoor community (94 %) admitted that there is a problem of dust pollution, and specifically from TSF 6. The Sotho and Tswana speaking respondents euphemistically called the tailings dump 6 'motoro' which means mud. The Xhosa and Zulu speaking people called it 'iindunduma' which means hills. All respondents (100 %) agreed that TSF 6 was the source of dust causing the air pollution.

This poses health threats to the surrounding community which inhales the toxic dust from the tailings, the community believes. A similar observation was made by Kitula (2006) in Tanzania's Geita District. There, the Geita Gold Mine Company (GGMC) was closed and the community suffered respiratory illnesses due to dust from poorly rehabilitated tailings dumps.

It was also investigated whether there were any indoor sources of air pollution (i.e. heating and cooking methods). It was noted that electrical heaters and stoves were used; as electricity is subsidized by the Merafong Municipality, during the period of mine liquidation.

The respondents mentioned that dust was most prevalent in winter (51 %) and early spring (31 %). The respondents were asked whether they were aware of national dust standards. Ninety percent of the respondents answered in the negative, indicating that they were not aware. A follow-up question was posed to find out what individuals wanted to be improved in the standards. The respondents explained that there was nothing wrong with the standards themselves; they did mention, however, that the enforcement of compliance was a problem. The respondents also expressed the hope that the government would strengthen the enforcement, management, monitoring and compliance with standards.

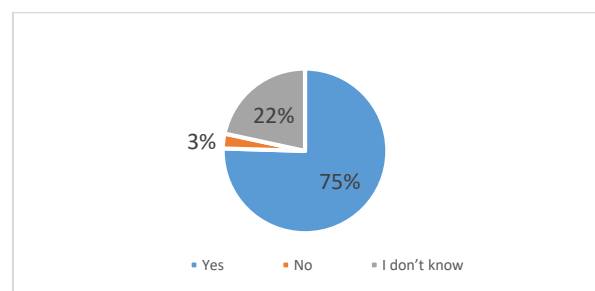


Figure 8: Dust's effects on individuals' economic status

The respondents were asked whether dust affected their economic status in any way (Figure 8); 75 % responded in the affirmative. Other respondents went on to explain that this was something they had never actually thought about,

therefore they did not know (22 %). According to Article 12 of the International Covenant on Civil and Political Rights (1998), there is a direct link between a healthy environment and quality of life, including the fulfilment of human rights. Similarly, the Committee on Economic Social and Cultural Rights (2002) recognizes that the enjoyment of economic, social and cultural rights depends on a healthy environment. For the Blyvoor community, those rights have been infringed due to air pollution from the tailings storage facilities as perceived by the community.

The respondents who answered in the affirmative, that dust did affect their socio-economic status, mentioned medical (97%) and cleaning costs (3%) as the major economic effect of dust. The residents of Blyvoor maintained that the dust brought about respiratory illnesses. During the windy season, the Blyvoor community mentioned that they spent increased amount of money on health care (about R400 per month).

Most residents perceived that dust management had not improved in the area of Blyvoor because tailings 6 had not been vegetated and there were no water sprinklers to suppress the dust.

About 71 % of the respondents mentioned that they had vegetable gardens and ate the vegetables from their gardens. Only 30 % of the respondents with gardens said they did not eat the vegetables from their gardens because of dust and went to the shops to buy vegetables. About 88 % of the respondents explained that they produced fewer vegetables during the windy season and more vegetables during the non-windy season. The concern is that plants absorb radioactive substances from the soil and are then consumed as food.

Businesses in the small shopping centre located approximately 120 m opposite TSF6 listed the following as costs due to dust from the tailings dump:

1. Damage to electronic equipment (printer, photocopier and scanner);
2. Purchasing dust masks for employees (petrol attendants); and
3. Cooked food products accumulating dust from the tailings dump having to be thrown away at the OK supermarket.

The community of Blyvoor was asked whether they would be willing to pay to offset the dust fallout impact. Some residents (55 %) of Blyvoor indicated that they were willing to pay to rehabilitate the tailings dump 6. However, the remainder mentioned that they had no employment and would therefore not be able to contribute to rehabilitation.

As can be seen in Figure 9, the bulk of the respondents (56 %) were not willing to pay more

than R100 to rehabilitate the mine. The respondents mentioned that they were not the ones who created the problem and therefore should not have to contribute so much money for something that was not their fault.

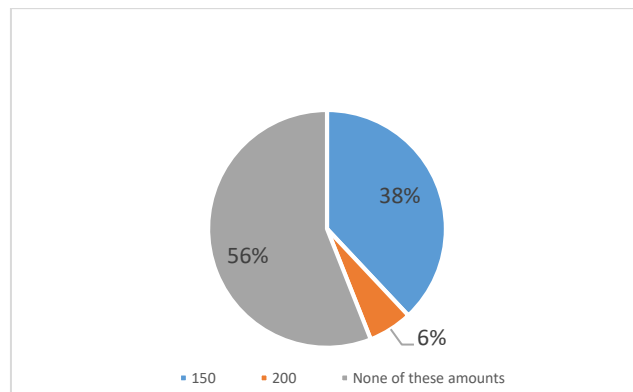


Figure 9: Households' amounts they are willing to contribute

The challenge is exacerbated when a mine closes unexpectedly and diminished growth and development are experienced. Numerous scholars have raised concerns about local communities, with regards to mine closure. The concerns focus on negative environmental effects such as disintegrated infrastructure, river contamination, and dust generation (Andrews-Speed et al. 2005; Murray et al., 2005). Other scholars focused on social impacts such as crime increase, drop in the quality of life, people exiting mining towns and food insecurity (Botha et al. 2014; Marais, 2013; McDonald et al. 2012; Rawashdeh et al. 2016; Rixen and Blangy 2016 ; Block and Owusu 2012; Ennis et al., 2014; Mengwe 2010 ; Ntema et al.,2017). It is obvious that communities become vulnerable after sudden mine closure.

6. Summary

It is disheartening to realise that despite the size of the mining industry, the direct and indirect environmental and socio-economic impacts are not clearly understood. Golder Associates (2003) note that possibly, the only true measure of sustainable development is quality of life, which is affected by many factors derived from Maslow's (1954) Hierarchy of Needs.

The hierarchy of needs of the Blyvoor community appears to have been severely impacted by the liquidation of the gold mine. The results of the study indicate that the community feels that the biophysical environment is degraded through air pollution by dust and this poses health threats. The community perceives that environmental degradation occurs as a result of unrehabilitated tailings storage facility

number 6. The community also perceives the dispersed dust as a threat to their health and economic status. Furthermore, the community of Blyvoor feels that their economic status is affected through medical expenditure to treat respiratory illnesses.

It is estimated that R890 million is the rehabilitation liability at Blyvooruitzicht mine. Instead, only R34 million is available to address this problem (Golder Associates, 2003). The community of Blyvoor is not willing to pay for rehabilitation because of the impacts of dust on their quality of life. Though the community in the mining village complains about the dust from TSF 6, it seems to be willing to accept the problem. This is shown by their willingness (and possibly their inability) to pay for a rehabilitation fund for the tailings dump.

Anger, depression and anxiety was observed amongst the community of Blyvoor because of TSF 6, and the sudden mine closure. Tailings storage facility No. 6 has been a major environmental problem for the Blyvoor mine village ever since the mine liquidation occurred. Dust is made up of solid particles ranging from 1-75 μm in size. Specifically, dust fallout has an average aerodynamic diameter of 20 μm , which can be transported into the air by physical processes such as wind, moving vehicles, stack emissions and fugitive emissions (Terblanch, 2009). People in communities such as Blyvoor are exposed to dust through inhalation as well as ingestion. Larger dust particles, greater than 100 μm , can settle in the nasal region while finer particles can penetrate through the respiratory tract into the lungs. The biggest threat with the dust from TSF6 is that it is a receptor for toxic heavy metals which are part of the mining waste.

7. Conclusion

The community perceives that conditions resulting from the unrehabilitated tailings dumps affect their health, well-being and economic status. The Blyvoor community has been unable, since 2013, to avoid breathing and ingesting the pervasive dust from TSF 6. Although the South African mining regulatory frameworks and dust standards seem robust, compliance, management and mitigation strategies seem to be offset by conflicting regulations such as the NEMA, MPRDA with the Companies Act, 1973 and the Companies Act, 2008. The effects of these conflicts result in uncontrolled dust pollution from unrehabilitated tailings storage facilities, which poses threats to communities' health, well-being and economic status. In policymaking and development, all stakeholders need to meaningfully contribute, including governments, citizens, civil society and companies. This paper shows that socio-economic impacts will be different for each stage of a mining project and

not all impacts will occur at each stage. For example, in the case of the Blyvooruitzicht community, the perception is that major environmental impact continues to affect the socio-economic status of the community, which is dust post closure.

8. Recommendations

South Africa can learn from countries such as Australia and Canada, which are under immense pressure to demonstrate that local indigenous communities gain socio-economic benefits from mining development on their land. For example, in New South Wales in Australia, a corporation was established as an organisation to safeguard indigenous heritage and maximise the socio-economic benefits that the community gains from the mine. The corporation established programmes that include a Business Hub to support local entrepreneurs, an education centre and a cultural heritage programme.

Though the community of Blyvoor links TSF6 with their respiratory illnesses and the nurses in the clinic support this, a quantification of dust through dispersion modelling is recommended to demonstrate the exposure of the community to dust. This study, as it stands, has not provided evidence for causality. Furthermore, a particle size analysis and chemical content analysis of the dust is required to assess the severity or threats posed by the dust from TSF 6. The study has only relied on perceptions of the community and local doctors as well as clinic staff in terms of the causes and prevalence of respiratory illnesses and symptoms.

This study recommends the following measures to address the issue of mine liquidation and its impacts:

1. The DMR should clearly define the minimum amount of financial contribution towards SLP projects annually.
2. The OES should not be limited to DEA, DMR, DWS; it should also include NNR and DRDLR.
3. The establishment of an independent task team is highly required to intervene before environmental and social problems arise.
4. Mining companies should be willing to attend and address community-specific, socio-economic challenges through the use of local and indigenous knowledge and by establishing community relation departments. A community engagement policy is recommended for mining affected communities.

5. A stringent enforcement mechanism for compliance with EIAs, EMPs, SLPs and their implementation is required. The visibility of the DMR throughout the life of a mine is highly recommended. Further transparency initiatives are recommended for the DMR to publicly disclose the performance of funds received from companies such as financial provisions for rehabilitation

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Appendix

Table 1 Dust Fallout Regulations

RESTRICTION AREAS	DUST FALLOUT RATE (MG/M ³ /DAY, 30 DAYS AVERAGE)	PERMITTED FREQUENCY OF EXCEEDING DUST FALL RATE
Residential area	D < 600	Two within a year, not sequential months
Non-residential area	600 < D < 1200	Two within a year, not sequential months