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Effects of Mining and Power Station Gas Emissions on Health of the Urban Population in Zimbabwe: a case of Hwange Thermal Power Station in Matabeleland North Region

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Abstract

This study sought to analyse the impacts of gaseous emissions from operations involved in the generation of thermal power in Zimbabwe and elsewhere in the developing nations, but with particular reference to Hwange Power Station, basically focusing on the health of local residents of high density areas bordering the station. Concerns of the residents and stakeholders from EMA, health and education departments on the apparent exposure of human life to air borne pollution emanating from power plant operations were instrumental in motivating the study. To achieve set objectives a stratified random sampling technique was used to draw a sample of 140 participants from an estimated population of 1401 inhabitants comprising employees of ZPC, Ingagula Residents Association, HPS Workers Committee colliery mine workers, medical staff at Hwange and the general populace. These were used for purposes of primary data collection where questionnaires were employed as the main instrument for soliciting responses from participants. Direct observations coupled with oral interviews were also used on the medical staff and the HPS Workers Committee, in an effort to establish the nature of health complications associated with gas emissions from the power station; establish their effects and mitigation strategies. Secondary data to compliment the primary gathered facts was obtained from the company records, local clinics and archival records provided by stakeholders. The resultant data was presented through narrations, graphs and tables which were obtained by employing the quantitative method of Statistical Package for Social Sciences (SPSS) windows based program as an analytic tool. The major findings of this study were that, gaseous emissions are a serious health hazard particularly to people exposed to massive emissions such as the Hwange community. It was also observed that the longer people are exposed to such environments the more susceptible they become to acute respiratory infections. The study therefore opines that the existing power generating plant should be rehabilitated to incorporate de-sulphurising units, which reduce gaseous emissions and air pollution. However considering the current economic hardships facing the country this cannot be an easy option.

Key words: gas emissions, thermal power, air borne pollution, power plant operations and

health complications

1 Background of study

According to Salam, (2008) coal which is a highly combustible sedimentary organic rock discharges huge amounts of carbon emissions into the atmosphere when burnt which are hazardous to health and depletes the ozone layer leading to global warming and heat waves which have become a common phenomena in most parts of the world. When coal is burnt as a fuel source in thermal power plants the gaseous emissions generated by the thermal decomposition of the coal includes sulphur dioxide (SO2), nitrogen oxide (NOx), carbon dioxide (CO2), mercury (Hg) and other chemical by-products which have all been established to have negative impacts on the environment and human health. These gaseous emissions cause acid rain, recurrent droughts, lung cancer and vascular diseases. Rushworth, (1975) cited that impacts of coal-fired thermal power stations on human life and the environment have shown that coal dust and gaseous emissions can lead to chronic bronchitis, lung cancer, aggravated asthma, visibility obstruction (haze) and premature death among other potential hazards.

World Health Organisation WHO, (2008) established that if emissions are not controlled pollution from coal particulates would cause approximately one million deaths annually across the world which accounts for a third of all premature deaths related to all air pollution sources. The survey also observed that coal–fire powered plants shortened the life span of about 24000 workers directly involved in the burning of the fossil mineral particularly in countries where thermal is the main source of electricity as workers would be exposed to dehydration, throat infections and lung cancer.

Zimbabwe's Power Company ZPC) employees are highly exposed as their work place and immediate environment as well as residential areas are always engulfed in heavy clouds of coal dust and emissions from the power generating plant. The workers and residents of the surrounding areas have endured the brunt of air pollution from emissions emanating from thermal power generation activities for decades as the government and other stakeholders seem to be reluctant in controlling such emissions and improving the general welfare of the workers and their families in the area.

Pokalo, (2012) established that fly ash, bottom ash and boiler slag are some of the coal waste products which have the potential to release about twenty (20) toxic-release chemicals with arsenic, lead, mercury, nickel, cadmium, vanadium, copper, zinc, beryllium and selenium topping the list. These are classified as highly toxic substances which are lethal when discharged into the ambient or immediate environment. Cachier et al, (2005) cited that burnt coal releases numerous toxic chemicals and particulates, which can be costly for developing nations with staggering economies to control and address. Various negative health effects of coal occur through the mining, coal preparation, combustion, waste storage as well as transportation.

Environmental Management Authority EMA, (2016) noted that the soot deposits observed on tree leaves and rooftops of buildings as well as the coal dust clouds that engulf residential areas blown from the power station were polluting the environment and exposing human lives to toxic discharges and emissions, hence encouraged

companies to devise better waste treatment and management strategies. While some technological advancement indicate that not all by-products of power plants can be deemed to be toxic, clean practices in advanced world seek to use mechanisms that trap gases such as hydrogen, sulphur and nitrogen for use in such activities as cooling of machines and manufacturing of fertilizer among other uses. This has however not been possible for smaller economies as the benefits can not offset the cost associated. The study therefore sought to establish the authenticity of the common assumption among health experts in the area that gaseous emissions from the power station operations is the contributory factor to high morbidity on the residents of the mining town.

1.1 Statement of the problem

The Ingagula suburb is located in the proximity of Zimbabwe's Hwange Power Station. As such it has been observed that dust from coal handling activities and fly ash, with inherent toxic gases, from burnt coal engulf surrounding residential areas on a daily basis polluting the environment and exposing human life to the detrimental effects of the lethal toxic emissions. Though government and other stakeholders such as Environmental Management Authority EMA and ministry of health and child welfare have made it mandatory for companies concerned to adopt better waste management and treatment strategies, it has always been futile as companies around have been reluctant to take up the initiative citing the cost associated as prohibitive. The continuous release of toxic gases and coal dust in to the environment has therefore raised concern on the health of the residents who fear for their lives as high volumes of respiratory ailments are reported at local health centers daily. It is therefore imperative that the study sought to establish the authenticity of the common assumption among health experts in the area that gaseous emissions from the power station operations is the main contributory factor to high morbidity rates in the mining town.

1.2 Objectives of the Study

The study shall assess the negative effects of gaseous emissions from HPS on the health of people residing in the proximity of the station by focusing on the following objectives:

- To establish types of gases emitted by power generating companies in Zimbabwe and the extent to which they pollute the environment and humans
- To identify health issues related to the emissions and how such issues threaten human life
- To establish implications of the resultant situation on the company's brand name and the people's livelihood.

2 Methodology

2.1 The study area

Hwange is a coal mining town in the Hwange District of the Matabeleland North Province. It is situated in the north-west corner of Zimbabwe 335km and 100km from Bulawayo and the tourist resort town of Victoria Falls respectively. Hwange is also 45km south west of the Zambezi River as well as adjacent to the Hwange National The environmental and topographical setup of Hwange presents a unique setup from other thermal power plants such as Munyati, Bulawayo and Harare in Zimbabwe as it is situated within a coal mining town and where

extraction is basically opencast, with the Zambezi River, its source of water – one of the main raw materials in thermal power generation, only 40 km away. HPS has a workforce of about 2 000 inclusive of casual/hired and permanent workforce, most of whom are housed in company premises which are in the vicinity of the pollution zone hence the proneness of the residents to pollutants from the power plant operations. Safety measures, as outlined by the relevant statutory instruments such as those which are administered by EMA and the Factories Act of Zimbabwe if any, that were put in place to address issues of pollution to protect workers and residents from adverse impacts of gas emissions have not been adopted as companies fear the cost associated.

2.2 Population and sample

To achieve set objectives a stratified random sampling technique was used to draw a sample of 140 participants from an estimated population of 1401 inhabitants comprising employees of ZPC, Ingagula Residents Association, HPS Workers Committee colliery mine workers, medical staff at Hwange and the general populace. These were used for purposes of primary data collection where questionnaires were employed and used as the main instrument for soliciting responses from participants. Direct observations coupled with oral interviews were also used to establish the nature and extents of health complications associated with gas emissions from the power station operations and establish their effects on local residents and mitigation strategies to be put in place to curb their effects. Secondary data to compliment the primary gathered facts was obtained from the manuals, reports, company records, clinics and archival records provided by stakeholders. The resultant data was presented through narrations, graphs and tables which were obtained by employing the quantitative method of Statistical Package for Social Sciences (SPSS) windows based program as an analytic tool.

The sampling was conducted as shown on Table 2.1 below:

Table 2.1: Stratified Random Sampling

Strata	Total Population	10% Sample
Thermal Power Station Employees	580	58
Ingagula Residents	800	80
Medical staff at HPS	21	2
Total	1401	140

3 Results and Discussions

3.1 Response rate of participants

Table 3.1: Response rate of participants

Strata	Number of Questionnaires sent out	Number of Questionnaires Returned
Cooperative Employees	58	51
Cooperative Residents	80	56
Cooperative Medical staff	2	2
Total	140	125
Percentages	100%	78%

A response rate of 78% registered was due to the fact that most of the residents and workers from the study area were so bitter about their living conditions hence they preferred to remain reserved on the issue. The interviews with representatives of workers and the community revealed that dialogue with Company management in a bid to find lasting solutions to address the negative impacts of pollution from the station were failing to yield as companies were reluctant to fund such initiatives.

3.2 Respiration related diseases for 2015

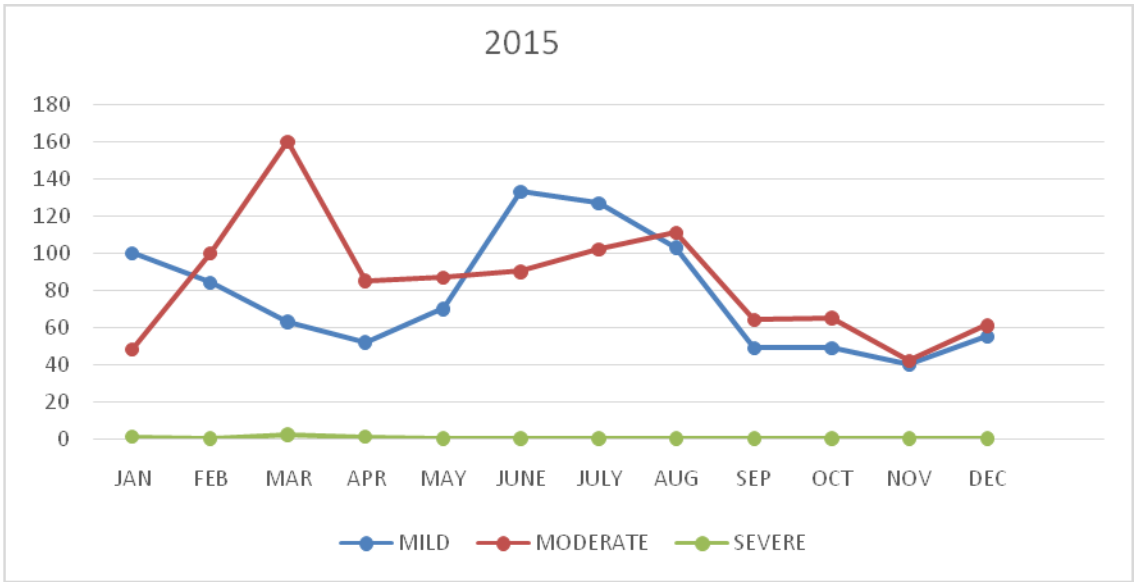

Figure 3.1: Respiration related diseases for 2015

Source: department of statistics ministry of health 2016 Hwange District

3.3 Respiration related diseases for 2014

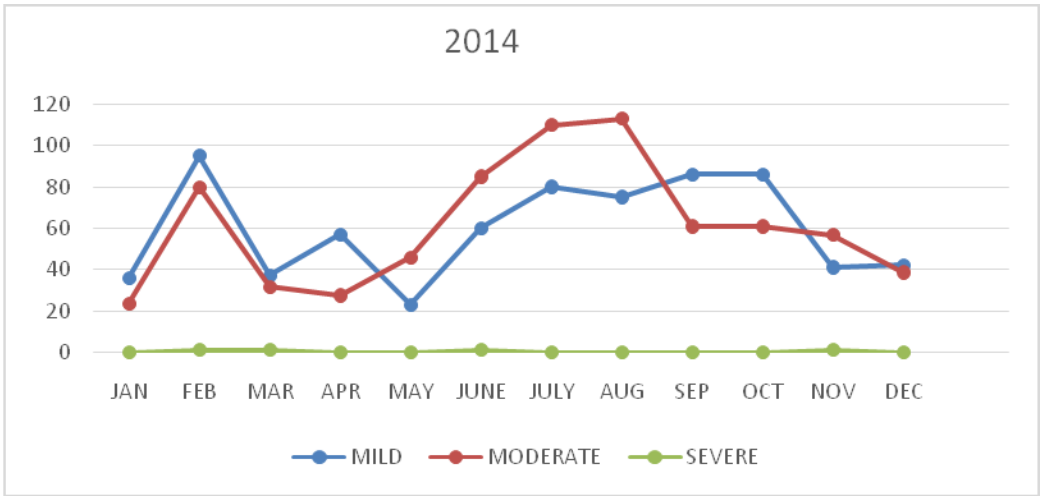

Figure 3.1: Respiration related diseases for 2014

Source: department of statistics ministry of health 2015 Hwange District

Secondary data generated from archival records of the ministry of health through local health

centers reveal that the dust from the power station and the mine's coal dump sites which is basically in the form of coal dust and ash is metallic and contains asbestosis causing elements. Long term exposure to such metallic dust gives rise to pneumoconiosis and other long term health complications. The sulphur and nitrates in the metallic dust are irritants to the respiratory tract and cause an additional burden on the air purification and oxygen intake capacity of the respiratory system. As shown by figures 4.1 and 4.2 above though the occurrences of severe respiratory related infections are rare and mainly translated as pneumoconiosis, mild to moderate conditions which manifest as severe coughs/asthma have been on the increase in both years particularly in the winter months when wind activity is high hence blowing clouds of dust to residential areas. Such pollutants have also been associated with cardio vascular complications such as artery blockages which lead to heart attacks resulting from tissue rapture and heart damage due to oxygen deprivation. It is estimated that if unchecked pollution from power plants and mining would contribute about 70% of the country's cumulative pollution level followed by agriculture and manufacturing sectors respectively. The finding concurs well with Reddy et al., (2003) who established that the concentration of pollutants from power plants in West Bengal, India were high in winter as compared to summer and their results indicated that found ash deposits contained harmful heavy metals such as boron, arsenic, and mercury which are highly toxic to human health.

3.4 Environmental effects

During the fieldwork it was noted that besides having direct catastrophic effects on health power plants and mining pollution also has a direct bearing on people's livelihoods particularly in terms of food security as it interferes with agricultural activities through massive accumulation of ash dust on plant leaves incapacitating the photosynthetic processes and spoils quality of the yield in fewer cases where there is some yield realized. Due to penetration of pollutants inside the plants through leaves & branches, imbalance of minerals, micro and major nutrients in the plants take place which affect the plant growth severely. Spreading & deposition of SPM on soil disturb the soil strata thereby land becomes less productive.

A study on the Environmental impacts of Power plants by The Public Service Commission of Wisconsin USA harmonizes the assertion as it established that the reaction of rain water with sulphur dioxide SO2 has been a cause of acid precipitation, commonly known as "acid rain," which can damage vegetation and acidify lakes, and due to such reactions ground water gets polluted and becomes unsuitable for domestic use. Station Godish, (2003) in support of the hazardous impact of acid rain formation noted that species vulnerable to acidic conditions were rendered infertile as they had difficulty in reproducing and, in some cases, died in numbers and became victims of total extinction.

4 Conclusions & Recommendations

The research set out to investigate the negative impacts of Hwange power station emissions on the residents of Ingagula was largely triggered by disgruntlement of Hwange residents who feared for their health as a result of prolonged exposure to mining and power station toxic gas emissions. It was therefore found out that;

- The power station emits harmful gases and particulate matter into the environment and in the case of Hwange power station the polluted environment includes residential areas of Ingagula Township.
- The emissions from the power station are causing mild to moderate cases of respiratory related infections and consequently diseases to residents of the Township.
- The emissions from the power station cause severe respiratory related infections and diseases after exposure for a lengthy period of time, the illness may be fatal.
- Due to the international liquidity crunch the power station does not have money to curb most of the pollution and its effects.
- The majority of participants feel that the relevant authorities and stakeholders are not doing enough to curb the pollution and hazardous effects of the emissions from the mining and power station activities

4.1 Recommendations

In light of the findings by the study recommended the following;

- The power station management should install flue gas analyzers which can detect the amount of SO_X and NO_X gases being emitted into the atmosphere so that the levels can be monitored and controlled.
- The power station management should ensure that the ash plant's normal ashing regime is effective and also ensure dust suppression is done at the coal plant and on the roads in order to curb dust bowls which pollute the air and affect residents of Ingagula.
- The power station management should ensure cutting of terraces on the downstream slopes of the ash dams, spreading of gravel on the slopes and planting of grass to reduce creation of dust bowls which cause air pollution.
- Awareness campaigns should be undertaken to alert the employees and management on the effects of pollution on humans to ensure a culture change on the enforcement of original working regimes of the plant.
- Pneumoconiosis examinations which are done every two years for the employees should be encouraged for the residents and also extended to cover the dependents of the workers as well.

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