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Short Research Paper

Examining Impact of Industrial Pollutants on Human Health, Ecosystem's, Biodiversity of Local Estate Communities in the Lowveld District, Zimbabwe, Partly as a Result of Sugarcane Production.

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ARTICLE DETAILS

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ABSTRACT

This paper provides a narrative systematic review of impacts of industrial pollutants from fossil fuel combustion, sugar cane burning, and industrial emissions from sugarcane production on human health, local ecosystems and biodiversity of local communities.Data was collected through household questionnaires, key informant interviews, focus group discussions, desk study,air and wastewater quality index analysis results, and field observations. A total of 60 households from 4residential compounds in Hippo valley and Triangle estates, 3 Environmental Health Technicians, 2 SHE officials were interviewed and data was collected and analysed using quantitative and qualitative methods. Data was analysed using Statistical Package for Social Science, Microsoft Excel Spreadsheet, and nVIVO.Results reveal substantial health risks, such as respiratory diseases, along with environmental degradation, particularly soil and water contamination. These findings support recommendations for sustainable industrial practices to mitigate negative effects. The study underscores the urgent need for the adoption of cleaner technologies and practices within the sugar production process.

1. Introduction

The Lowveld District of Zimbabwe hosts one of the country's largest sugar production industries, primarily led by Tongaat Hulett's Sugar Cane Company with two sugar processing mills at Hippo Valley and Triangle estates .Cane sugar factories play a paramount role in promoting and ameliorating the host population's incomes by providing more significant opportunities for occupation and employment, particularly in the tropical and subtropical zone worldwide (Turinayo, 2017; Silalertruksa et al., 2017). Despite this, the cane sugar industries generate water pollution. Its processes demand substantial water and generate plenty of wastewater during production (Sahu, 2018). Wastewater is polluted and considered unserviceable due to its discharge in surrounding areas near river streams (Sahuet al., 2017).

The sugarcane industry has substantial waste generation and high economic, social, and environmental ramifications (Torres deSande et al., 2021). This industry uses chemical substances which have massive consequences on the ambient environment by releasing toxic pollutants (Varjaniet al., 2020). Water pollution and wastewater are physio-chemical parameters for which Environmental Impact Assessment (EIA) is a must. It is a solid instrument to identify the intended consequences on the environment (Kaab et al. 2019b) the processing of sugar cane involves multiple stages, resulting in air emissions from cane burning before harvest and coal use for energy. These practices contribute to air pollution, impacting both the environment and human health. In light of the global focus on climate change, it is essential to understand how these emissions contribute to greenhouse gases to inform regional environmental policies.Industrial

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pollution from agricultural irrigation remains a critical environmental and public health challenge in developing countries, where industrial activities are often carried out with minimal regulatory oversight. In Zimbabwe's Lowveld District, the operations in sugarcane processing have been causing air, water and soil pollution which have detrimental effects on the wellbeing and livelihoods of communities.

1.1 Objectives:

- To assess the types and levels of air, water and soil pollution in the resulting from sugar production activities in surrounding communities and animal habitats
- To evaluate the impact of these pollutants on human health, ecosystem and biodiversity of both communities and animal habitats
- To recommend strategies for mitigating the negative impacts of these pollutants from sugar production.

1.2 Literature Review:

Industrial effluent contains massive amounts of pollutants in the form of organic matter, biological and chemical elements and other materials (Yadav & Daulta, 2014). During the production process of sugar, there are equally significant amounts of Total Suspended Solids (TSS), Organic Matter (OM), sewage, sludge, press clay, bagasse, and others (Muthusamy et al., 2012). The generation of such an amount of wastewater comes from the fact that milling one ton of cane requires 2000 liters of water and the disposal of about 1000 liters of wastewater (Tiwari, 2016). Sugar mills expressively harm the environment by generating different kinds of wastewater, emissions, and solid wastes. Wastewater has several sources, such as washing, condensation, leakage, and spillage from valves and pipelines, syrup, and molasses in different segments and sections (Sahu & Chaudhari, 2015). Disposing of wastewater in the ambient environment creates a suitable ground for chemical and microbial contamination in downstream areas and drinking water (Wang et al., 2017). This pollution is a modification in water's feature, making it unwanted, unsafe, and malevolent for human and animal health (Ahmed et al., 2017). The wastewater discharged from sugarcane processing has a significant role in altering the chemical characteristic of water and causing severe issues in the ambient environment (Marinho et al., 2014; Comwien et al., 2015; Sahu, 2016; Anastopoulos et al., 2017; Galvis et al., 2018).

2. Research Methods

2.1 Study design

Information on the impact of pollutants was collected from the community, institutions responsible and stakeholders involved. Both quantitative and qualitative data was obtained from household survey, focus group discussion, key informant interviews and physical observation. Primary data was obtained from households, Chiredzi Town Council, Hippo Valley Estates officials and Environmental Health Technicians. Secondary data was obtained from annual reports and inventories. Qualitative data were used to collect data based on facts from an individual point of view. Attitudes, perceptions and knowledge of stakeholders with regards to pollution management practices were assessed. Qualitative methods were conducted in a natural setting, without intentionally manipulating the environment

2.2 Sample size and sampling technique

Probability and non-probability sampling techniques were employed to select study area and study sites. Purposive sampling was used to identify the areas in Chiredzi town under study. Systematic convenience sampling was used to select the households which were interviewed as suggested by Depoy and Gitlin (2005). Only households willing to participate in the research were interviewed. Purposive and systematic sampling techniques were employed to identify key informants and households to be interviewed, respectively

2.3 Data analysis

The primary data collected from household survey through structured questionnaires were first checked for accuracy and data entries were coded. Thereafter, data were entered, edited and analyzed using statistical package for social science (SPSS) version16.0 software. Data were explored for frequency of responses, distribution trends and statistical relationships. Responses from the key informant interviews were used to validate the responses of the households. The levels and types of air, water and soil system pollutants were analyzed by assessing data from ZINWA, Zimbabwe Sugar Association and Tongaat Hullet.

3. Results

Findings from household surveys conclude that most sugarcane field workers aged between 30 and 45 suffer from diseases caused by PM2.5 pollutants such as stroke, ischemia heart disease, chronic obstructive pulmonary disease, lung cancer, pneumonia and cataract. Young children and women also suffer from cholera, diarrhoea, dysentery, hepatitis A, typhoid and polio from using canal water for domestic purposes.

The negative impact of sugarcane production on biodiversity was found to be mainly on the effects of fertilizers ,pesticide herbicides and irrigation practices on species such as fish, earthworms, termites, ants, preys, spiders,boars, snakes and amphibians.This is evident in the presence of habitat azolla, water hyacinth, water lettuce ,Kariba weed and Parrot feather . Soil acidification is a common problem of soils under sugarcane cropping mainly due to the use of Nitrogen (N)

fertilizers (and other major components e.g. phosphorus and potassium (P:K) under different forms) and to the mineralization of organic matter

Table 1. Quality Index

Quality index	Pollutants	Parameter level	Rating
Air quality index 36 Good	PM 2.5	35 8.3ug/m3	High
	CO	5 110ug/m3	Good
	O3	24 54ug/m3	High
	NO2	32 1ug/m3	Good
	PM10	15 1ug/m3	Good
Water quality index	ph	4.2	Acidic
	Hardness CaCO3	650	Good
	chlorine	240	Moderate
	Dissolved oxygen	700	Good
	Temperature	29 Degrees	Good
	Salinity	1.55	Good
	Ammonia	0.6	High

4. Discussion

Transitioning from traditional methods of sugar cane burning to more sustainable alternatives, such as trash mulching or green harvesting, could significantly reduce particulate matter and toxic emissions. Furthermore, implementing effective air quality monitoring systems and adopting stringent regulations on industrial emissions are critical steps toward safeguarding public health and preserving the surrounding ecosystems. Additionally, community engagement and education on the risks associated with industrial pollution are essential. Local populations must be informed about the health impacts linked to pollution, empowering them to advocate for their rights to a cleaner environment. Collaborations between the government, health organizations, and the sugar industry can foster innovative solutions tailored to the specific needs of the Lowveld District. To address the soil and water contamination identified in the study, the implementation of proper waste management systems is necessary. Treatment of waste water before discharge and responsible management of agrochemicals can help prevent further degradation of natural resources. Furthermore, restoring degraded areas through reforestation and soil enrichment programs could enhance biodiversity and promote ecosystem resilience in the face of climate change. In conclusion, the findings of this study call for an integrated approach that balances industrial development with environmental stewardship and public health protection. By prioritizing sustainability, Tongaat Hulett can lead the way in transforming the sugar industry in Zimbabwe, fostering both economic growth and ecological integrity for present and future generations.

5. Conclusion

The study concludes that Tongaat Hulett's sugar production activities in the Lowveld District are a significant source of air pollution, posing serious health risks to local communities and contributing to environmental degradation. Industrial emissions, coupled with the burning of sugar cane, exacerbate respiratory problems and degrade soil and water quality. Furthermore, the company's operations contribute to climate change through greenhouse gas emissions. Immediate interventions, including cleaner production technologies and stricter emission controls, are recommended to mitigate these negative impacts.

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