# Monduli District Solid Waste Management Plan

Case Study Analysis of Arusha Scrap Metal Economy

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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### Introduction

The integration of culture in technical projects and promoting equal access to community resources is imperative for the improvement of health and environmental quality for all. An important factor in the overlap of human and environmental health is adequate solid waste management that is implemented at a local level. Current methods of waste management in Monduli District, Tanzania do not adequately address these issues, thus a new approach that considers a comprehensive array of factors, in addition to the technical, must be taken. Working to recognize the role of local culture in changing current practices and working within the economic, social, and environmental constraints of the region, the technical design and implementation of a municipal solid waste management system in Monduli District will meet these requirements. The final design will prevent contamination from solid waste, reduce further environmental degradation that is harmful to human health, and be socially acceptable.

Understanding grassroots drivers of systems, especially pertaining to waste management, through a scrap metal recycling case study in Arusha is crucial to ensuring the successful implementation of new systems. In this case, I will examine the undervalued perspectives of the waste pickers, or those who collect scrap metal from the source waste, to understand the successes and vulnerabilities of this network, resulting in crucial knowledge to be applied to future design and practice. I will draw on the STS framework of actor-network theory to investigate how local grassroots voices drive change for the betterment of their communities. If the technical aspects are focused on, without much thought to the social, there will be much higher risks of failed projects and vulnerable systems that could be detrimental to human and environmental health. Because the challenge of solid waste management is sociotechnical in nature, it requires attending to both its technical and social aspects to be successful. In what

follows, I set out two related research proposals: first, a technical project proposal for developing an improved solid waste management system in Monduli District, Tanzania and second, an STS proposal for examining the significance of culture and waste pickers in the Arusha scrap metal economy.

#### **Technical Project Proposal**

Proper solid waste management (SWM) is critical for both human and environmental health. Britannica defines solid waste management as "the collecting, treating, and disposing of solid material that is discarded..." (Encyclopædia Britannica, 2024). There is a considerable and concerning lack of SWM in many parts of the world. It is these regions that struggle under the heaviest burden of human health risks, environmental degradation, and lack of options.

Regional government for Monduli District, Tanzania highlighted that solid waste is a growing issue that needs to be addressed in its strategic plan for the period of 2016 to 2021 (Monduli District Council, 2016). No further information on solid waste or a plan to manage it can be found on the district website. However, old shoes, food packaging, clothes, and plastic bottles line the streets of the villages. Trash often ends up in the korongos (rivers) or is burned outside of homes or in open dumps. According to locals, during the rainy season excess trash dams up the rivers where they narrow under bridges, likely worsening flooding.

The lack of SWM in Moduli District poses serious health risks to local people and the surrounding environment, in addition to issues like aesthetics. Many problems can arise as a result, "poor waste management – ranging from non-existing collection systems to ineffective disposal – causes air pollution, water and soil contamination. Open and unsanitary landfills contribute to contamination of drinking water and can cause infection and transmit diseases" (UN Environment Programme, n.d.). Burning trash releases harmful particulate matter into the

air, resulting in increased respiratory illness and long-term health problems (Wisconsin Dept. of Natural Resources, n.d.; Vinti et al., 2023). Solid waste in waterways leaches microplastics and toxic chemicals that contaminate water needed for drinking, household use, and agricultural practices downstream. In cases where sanitary disposal methods are not used, leachate liquid containing heavy metals, sulfates, and more, drains from waste leads to contaminated ground and surface waters that are not safe for human use without treatment (Vasanthi et al., 2007).

A method for managing solid waste that is technically effective, economically viable, and socially accepted must be designed and implemented to protect against such risks. This design would improve human health, slow environmental degradation, and provide employment opportunities. Water and air quality will continue to decline, and human health will worsen if measures are not taken – even as more waste is being generated.

I will take into account the local government, culture, environment, economics, and social factors, as I research and design a solid waste management system that meets the needs of Moduli District while protecting human and environmental health. I will employ prior knowledge of solid waste management learned from classes taken at the University of Virginia, understanding of design principles, environment and water quality challenges, and their relation to human health. I will also use communication skills to speak with local leaders who have in-depth knowledge of the culture and customs of Monduli District, in order to obtain details on the geotechnical and hydrological characteristics of the district. In speaking with leaders and reading relevant literature, I will collect and analyze data concerning how much solid waste is generated per capita, current methods of disposal, the availability of funding for a project of this magnitude, and the benefits of managing solid waste (Anwar et al., 2018; Vinti and Vaccari, 2022). I will look at examples of successful SWM in regions or countries similar to Monduli

District. After analyzing this information, I will be able to proceed with designing a system of SWM that is socially acceptable, economically viable, and environmentally friendly in Monduli District, Tanzania. At the end of this project, I will be able to deliver a design plan for the Moduli District Solid Waste Management system that includes a comprehensive layout of the system, instructions on how to use it and measure its success, and a plan to ensure active participation from locals.

## **STS Project Proposal**

Over 314 tonnes of valuable scrap metals are traded monthly in Arusha City, the tourism hub of Tanzania and home of 519,000 people (Onesmo et al., 2023). Aluminum alone results in a 90% energy use reduction when recycled instead of using virgin materials (Steinert, n.d.). A robust scrap metal recycling economy has sprung up in Arusha due to the high value and relative ease of recycling. This trade in Arusha has transitioned from a linear economy to a more circular one, with annual revenue of \$200,000 and contributing to potential carbon dioxide emissions reductions of the global waste sector totaling 58% annually (Onesmo et al., 2023). In a linear economy a material is extracted from the Earth, manufactured into a product, used, and then thrown away. A circular economy emphasizes reuse and recycling, preventing "...the consumption of virgin resources and a reduction in carbon impact on [the] circular supply chain" (Kadio, 2023). This case study examines the economic and environmental impacts of the Arusha scrap metal economy from the perspectives of scrap metal dealers – categorized as small, medium, or large based on how many tonnes of scrap they process monthly. They buy scrap metal from waste pickers or middle-men and then sell it to manufacturers who will reuse the materials in their products.

Previous writers have examined the economic and environmental factors of this case study, but have not yet adequately examined the social actors that are vital to maintaining this network. They fail to take into account how the competition mixed with cooperation drives the grassroots labor behind the scrap metal economy of Arusha. Insufficient comprehension of the complexity and potential vulnerabilities of the network exist from the lack of full understanding of the interactions between some of the actors: labor, government, waste, markets, and more. Additionally, they lack focus on cultural and social factors that would lead to a more holistic understanding of the industry, placing too much emphasis on emulating western countries and their economics. For example, Onesmo et al. (2023) fails to examine why scrap is generally collected at a household level, rather than brought to a central location. It does not account for human labor versus mechanization.

These shortcomings point the reader towards a narrow understanding of economics and the environment, missing the people who drive the scrap metal trade and are most affected by any vulnerabilities. I argue that by viewing this trade from the perspective of its network builders – the waste pickers – readers will be able to understand the unique challenges that they face day to day, leading to a deeper appreciation of the benefits and consequences of semi-informal networks similar to Arusha's scrap metal economy.

Actor network theory (ANT), a framework that focuses on connections among human and non-human actors recruited by a network builder to accomplish a goal, allows the reader to develop an understanding of the complexities associated with the scrap metal trade. The concept of translation, which studies the process of forming and maintaining an actor-network with five sub-steps defined by renowned sociologist Michel Callon. Callon (1986) defines the first, problematization, by focusing on how the network builders define a problem and then find other

actors to solve it. [Text removed] Next comes interessement, where the network builders recruit other actors to begin forming a network. Roles are assigned to the actors in enrollment. From there the network builders secure their roles and mobilize the network, known as mobilization. It moves into the black-box stage once the network is defined and functional.

Studies on the scrap metal industry, on waste pickers in Arusha, and the role of competition in stabilization of industries will be used in this analysis, drawing on ANT to provide a conceptual framework. Data on social, environmental, and economic actors will provide insight into the complexities of this semi-informal network, resulting in a holistic understanding of its network builders and components.

### Conclusion

The technical and STS project proposed above will demonstrate the potential of integrating local culture into large scale human and environmental health and quality projects, which can be used for future projects of similar nature. The design of a solid waste management system specific to Monduli District, Tanzania addresses the lack of sanitary disposal options for waste. Understanding the roles of waste pickers in the Arusha scrap metal economy case study will allow the design to properly take into account the culture and needs of the users of such a solid waste management system. The STS framework actor-network theory provides valuable insights into how networks are built and what factors lead to their stabilization or vulnerability. Analyzing the interaction of actors in the Arusha scrap metal economy will help the technical design address the variety of concerns of actors in the network it will become a part of, increasing its stability and success.

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