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12. Solid Waste Management and Implications for Women and Climate Change in India: Review of the Literature

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Abstract

This paper explores the intersection of solid waste management, gender dynamics, and climate change in India. As climate change threatens India's agricultural-based economy and food security, effective waste management becomes crucial. Current waste practices, such as landfilling and open burning, contribute significantly to greenhouse gas emissions. This study reviews these methods and emphasizes Waste-to-Energy (WTE) plants, considering their potential to mitigate climate impact. Adopting a feminist political ecology perspective, it delves into waste management's implications for women, who are disproportionately affected due to societal roles and vulnerability to climate-related challenges. WTE plants offer promise in reducing emissions and landfill space, yet their implementation presents gender-specific and environmental concerns. Waste picking, an essential but marginalized occupation primarily undertaken by women, plays a role in waste management and climate change mitigation. However, privatization and plant introduction disrupt waste pickers' livelihoods, intensifying inequalities. Though WTE technologies may alleviate emissions, they also pose challenges like waste segregation, air pollution, and adverse socio-economic effects on marginalized communities, especially women. The government's focus on waste segregation, necessary for WTE plants, places an extra burden on women. This paper underscores the need for inclusive solutions that consider both environmental goals and gender equity.

Key Words: Climate Change, Waste to Energy, Feminist Political Ecology, Waste Management

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Introduction

Climate change is one of the biggest challenges of the 21st century, and India is no stranger to the effects of this global challenge. India is a predominantly agriculture-based economy, which means a plethora of people rely on agriculture for their livelihoods. However, the IPCC estimates that the food sector in India is going to be hit the hardest by climate change. Rice production is predicted to decrease from 10% -30% and maize is predicted to decrease from 25%-70%, when there is a temperature increase (Masson-Delmotte et al., 2021, p. 1460). Since India has an agriculturally based economy, this threatens economic growth as well as food security. Furthermore, increased climate variability is impacting migration and displacement. In 2019, India reported about 4 million disaster displacements (Masson-Delmotte et al., 2021, p. 1460). Since 2000, there has been an increase in annual precipitation as well as heat waves associated with a higher temperature. The IPCC recommended that India adapts to climate change more vigorously, especially in urban areas. Therefore, climate change is a current issue and will only get worse for India, thus research regarding mitigation strategies is extremely timely and relevant.

Climate change is impacting India, but India also contributes to climate change as well, specifically through their waste management practices. Landfilling and open burning contribute directly to climate change. Waste made up 1.9% of total emissions from India. The decomposition of municipal solid waste is the third primary anthropogenic source of methane, contributing to approximately 11% of total anthropogenic methane emissions (Cheela et al., 2021, p. 2). Methane exacerbates climate change greatly, as it has a heat-trapping capability of 34 times more than CO2 over 100 years (Romm, 2018, p. 22). This heat-trapping causes the global temperature to rise, melting the permafrost, which again releases methane, creating a positive feedback loop. The increase in temperature also will lead to crop loss and rising sea levels, harming humans, and the environment alike.

About 62 million tons of waste is generated in India annually (Joshi & Ahmed, 2016, p. 4). Each waste disposal method contributes to climate change; however, some release more emissions than others. Due to India's vulnerability to climate change, as well as the contribution of waste to emissions, it is important to review the different waste disposal methods and their contribution to climate change. This paper will provide a comprehensive literature review of waste management techniques in India and their impact on climate change, specifically focusing on Waste-to-Energy (WTE) plants. This paper will utilize a feminist political ecology perspective to understand the implications of waste management for women in India, contributing to the literature as most reviews do not incorporate an FPE perspective on waste.

Objectives

To provide a comprehensive literature review of waste management techniques in India and their impact on climate change, specifically focusing on Waste-to-Energy (WTE) plants

To utilize a feminist political ecology perspective to understand the implications of waste management for women in India, contributing to the literature as most reviews do not incorporate an FPE perspective on waste

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Methodology

The present study is qualitative in nature, supported by theoretical basis

Open Burning

Looking more closely at the waste practices of India; first, open burning has led to intense air pollution and the release of greenhouse gasses (GHGs). 50% of the world's most polluted 20 cities are in India (Kumari et al., 2019, p. 2201). The pollution has led to the closure of more than 5,000 schools in Delhi, India, and most of the air pollution is due to the open burning of waste. Waste burning is a global phenomenon, with about 1 billion tons of garbage being burnt every year (Kumari et al., 2019, p. 2201). But in developing countries, it is a source of carbon monoxide, nitrogen oxide, sulfur dioxide, hydrocarbons, benzene, ethyl benzene, toluene, and hexane. This can cause environmental degradation by exacerbating climate change, and damaging crops due to acid rain (Kumari et al., 2019, p. 2202). Many countries tend to have proper disposal methods to reduce household burning of trash, but in many areas of India, this trash collection is often unreliable, leading households to burn their waste (Sharma, 2010, p. 4765). A total of 9162 MT/day of municipal solid waste was openly burnt in 10 metropolitan cities of India in 2014 and will increase by 1.5 times in 2021 (Kumari et al., 2019, p. 2206). The plastics in the burnt items will cause a more toxic effect on living things, exceeding the acceptable rates for human livability. This increases the chances of cancer, with an estimation of about a 50% increase in the number of people getting cancer in the next ten years (Kumari et al., 2019, p. 2207). Open burning in India is technically illegal, and yet it is still widely practiced (Yadav & Samadder, 2018, p. 884).

Waste burning can expose whoever is burning the product to smoke inhalation and carcinogens. For example, some women in rural India tend to burn sanitary, plastic napkins, which exposes them to smoke and carcinogens, when it is not burned at the correct temperature (Bhor & Ponkshe, 2018, p. 337). Waste burning is a direct threat to the climate as well as the human health of surrounding communities.

Landfilling

Landfilling also has precarious impacts on climate change. Landfilling as a means of waste management contributes the most to climate change due to high methane and carbon dioxide emissions, which contribute to the greenhouse effect, smog, and acidification (Yadav & Samadder, 2018, p. 839). In one study, the authors conducted a predictive analysis to estimate the worst waste management practices in Visakhapatnam, India. Landfills are the primary way to dispose of waste and therefore was considered the base scenario. This current system is predicted to release the most emissions and have the worst effect on the environment in comparison to other disposal scenarios, such as recycling, composting, and incineration. The baseline scenario (current scenario) has the highest global warming potential with a net value of 1107 kg CO2 due to the continuous release of methane into the atmosphere (Cheela et al., 2021, p. 10).

Landfills are also sites of e-waste. E-waste is very hazardous due to its' lithium and lead content. E-waste in India is a large problem and can contribute to the contamination of groundwater and water supplies. E-waste is very popular for informal recycling, which women and children

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predominantly take part in. Working in landfills, especially with e-waste, is extremely hazardous to informal recyclers. The women do not work with proper equipment, such as gloves, and the components that are not worth much or cannot be recycled are burned in the landfills, which exposes the workers to pollution. Since they do not work with proper equipment, women are often exposed to sharp objects, resulting in cuts or injuries (Joseph, 2007, p. 4).

E-waste is not the only type of waste that is recycled. Waste-pickers are located throughout India and sort through waste in landfills. They collect recyclable waste at all points during the waste process, selling it to small-scale dealers, who sell it to wholesalers who sell to recycling firms, so the products can get turned back into something consumable (Demaria & Schindler, 2016, p. 298). Waste-picking is a huge part of India's waste economy.

Waste-pickers are vital to sustainable waste management and climate change mitigation in India. In Ahmedabad, they were able to prevent about 200,000 tons of CO2 emissions by collecting and recycling waste (Oates et al., 2018, p. 1). However, despite contributing greatly to urban cleanliness and climate change mitigation, the profession of waste-picking is extremely stigmatized and does not pay very well. Most waste-pickers are women and of the Dalit caste, which is the lowest caste in the Hindu belief system. But many women rely on this form of income, especially those with no education and have families to take care of (Wittmer, 2021, p. 1). There are physical and mental problems associated with waste-picking. Many women face ailments such as back pain, injuries, and illnesses because of this occupation. However, since the pay in these occupations is low, they are unable to pay for doctor's visits (Wittmer, 2021, p. 4).

Female waste-pickers face a plethora of problems, especially since the onset of the pandemic. When the lockdowns were initiated in India, previous economic insecurity was exacerbated because the collection of waste was restricted. One study highlights that 90% of female waste pickers were impacted severely by the lockdowns while 37% reported that they lost their work (Banerjee, 2021, p. 6). After the lockdowns were recanted, 34% of the respondents were unable to get back to work, and those who were able to get back to work did so without PPE (Banerjee, 2021, p. 8). The lockdown also caused the waste rates to decrease, directly impacting their livelihoods.

Waste picking is extremely beneficial as a climate change mitigation strategy, which some municipal governments are starting to recognize such as in Pune. However, waste-pickers still face discrimination and a lack of social security nets.

The impacts of climate change in India will be catastrophic for the economy and livelihoods of the Indian people. India's current waste management system of open burning and landfilling is contributing greatly to climate change and adversely affecting the lives of urban citizens. Considering all this, the Indian government has been looking for climate-friendly policies to manage their waste, hence introducing waste to energy incineration plants.

Waste to Energy (WTE) Incineration

To combat climate change and hopefully mitigate the effects of it on India, the government introduced WTE incineration and solid waste incineration. In the developed world, WTE plants

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have been successfully implemented and have curbed GHG emissions. For example, in Sweden, once WTE plants were established, there was a 90% reduction in waste incineration emissions since 1985. Since the 90s, the developing world has been using WTE technology to supply a more sustainable form of energy, while also minimizing waste (Kalyani & Pandey, 2014, p. 114). Much of the literature contends that WTEs are India's best option for waste management and energy production for both climate change and the environment due to the clean energy produced. Energy produced by WTE was found to have 35%-60% less emissions than other sources of energy, and as a form of waste management, WTE plants generate less emissions than other practices of waste management (Monni, 2012, p. 83; Malav et al., 2020, p. 2).

WTE plants also could help India combat its growing waste and space issues in urban centers. WTE can be optimized so that the volume of landfills is reduced as much as possible. For example, in Thane, WTE and incineration were found to be the most optimal in terms of decreasing environmental concerns, as well as human health concerns (Kulkarni et al., 2014, p. 139). However, despite this, WTE technologies are safe and provide an environmentally friendly method of disposal, as some scholars contend (Gupta et al., 2018, p. 34).

WTE technologies seem to be the most attractive method to resolve India's MSW management, therefore, the government is scheduling many WTE projects in the next few years, but in the past, WTE management has not worked well due to a lack of logistical planning, lack of financial funding, and improper resource management. India's waste composition is not suited for WTE and incineration due to the huge organic composition, moisture content, and inert content of the waste (Gupta et al., 2018, p. 30). WTE plants, if not managed properly, can result in air pollutants, exacerbating climate change and adversely affecting the well-being of humans (Malav et al., 2020, p. 18). For example, in 2012, residents of Okhla, Delhi became alarmed by the toxic ash falling– a phenomenon that the residents believed was the first snowfall (Demaria & Schindler, 2016, p. 294). The ash came from Delhi's first WTE plant. Toxic ash is harmful to the environment and the health of the neighboring communities. This prompted the middle class community nearby, as well as the waste-pickers to protest the opening of this plant because of the contamination and impacts on air quality near middle-class neighborhoods. Furthermore, WTE depends heavily on solid waste segregation which is non-existent in India. For this to work well, the government and the public will need education on the importance of waste segregation for proper waste management (Malav et al., 2020, p. 19).

The waste segregation in India is manifesting in gendered ways as well. Because the Indian government knows that WTE plants require intense waste segregation, they have been pushing for unemployed women to take the burden of segregating household waste before it gets sent to the plants, to turn women's downtime in the household into more productive time. This initiative presumes that women's leisure time is unproductive, when taking care of the house, also called reproductive labor, is productive for maintaining society and kinship networks. In addition, most middle- and upper-class households employ a maid, who is often a woman, and often they do not pay these women more for the added task of segregating the waste (Luthra, 2021).

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WTE plants and incineration also have numerous social issues associated with it, especially for the waste-pickers. WTE plants is particularly worrisome for the waste-pickers, especially as numerous cities all over India, like Delhi, start pushing for WTE plants for solid waste management. WTE plants have begun to plug the leakage points, such as privatizing collection at households and landfills, making it increasingly difficult for waste-pickers to maintain their livelihoods (Demaria & Schindler, 2016, p. 302). As a result of this, numerous trade unions formed to demand access to waste and advocate on behalf of the waste pickers in India, but limited success has come from this.

WTE plants may also be contributing to climate change indirectly. Since waste-pickers are being crowded out, they can no longer rely on more sustainable sources of cooking fuel, due to the high costs of such, resorting to using unclean fuels. Because the kitchens in these households are not necessarily separate from the living areas, the waste-pickers and their families are subjected to intense air pollution from the unclean fuels within their houses (Luthra et al., 2021). This impacts the women in the household, as they are subjected to an increase in air pollutants due to traditional gender roles which place women as meal providers. Since they spend time in the kitchen, utilizing unclean cooking fuels, they are exposed to smoke and indoor air pollution, which has resulted in increased rates of lung cancer (Behera & Balamugesh, 2005, p. 190). Indoor air pollution due to unclean cooking fuels also has caused stillbornes in pregnant women, increased bronchitis, and increased cataracts (Sehgal et al., 2014, p. 1).

Female waste-pickers are also dually marginalized by the implementation of WTE plants. Waste-pickers' marginalized identities regarding gender, caste, and class are associated with the symbolic pollution of the untouchability narrative found in many Hindu teachings (Wittmer, 2021, p. 2). Female waste-pickers contribute to urban cleanliness, but the privatization of the urban waste management system, like WTE plants, has dispossessed women from their livelihoods (Wittmer, 2021, p. 3). Chakraborty et al. found that the entry of the private sector limited the access to waste for waste-pickers, severely damaging their livelihoods. Women had an even harder time; they struggle to find space in community bins to segregate trash to sell it to the collectors. The pandemic had a greater perceived impact on women because they already had such limited opportunities (Chakraborty, 2020, p. 12). Banerjee et al. echoed this finding, contending that the introduction of the private sector pushed waste-pickers out of the market, which plunged them into further depravity (Banerjee, 2021, p. 6). Thus, from a feminist political ecology perspective, there are economic and social factors that further marginalize women with the introduction of WTE plants.

Results and discussion

Waste is a very politicized and important issue in India, affecting all people. The current system in place is negatively contributing to and worsening climate change due to the greenhouse gases that landfilling as well as open-burning practices contribute to. Waste-pickers and waste-picker collectives seem to be a sustainable solution to waste, however, the lack of social security as well as stigma prevents this sector from being completely formalized.

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Each of these methods of waste management has direct and indirect impacts on women in India. Solid waste management is very gendered in India and, therefore requires a careful analysis of how different techniques affect women and men differently.

WTE plants have been credited as a sustainable solution to India's waste management issues, however, the literature is quite contested on whether WTE plants and incineration are contributing positively to climate change. Some scholars believe that because of the optimization of energy as well as the decrease in the amount of waste present on land, contributes positively to mitigating climate change and helping the environment. However, in India because of the composition of the trash and the lack of waste segregation, WTE plants have had limited success. Any push from the Indian government to promote waste segregation falls unequally on women, and therefore cannot be considered a beneficial solution that balances gender equity and environmental concerns.

Furthermore, WTE plants have a lot of social issues connected with them. The lower classes and waste-pickers are being further marginalized due to the privatization of waste. Because the WTE plants are cutting off their access to their livelihoods, waste pickers are impacted by a decrease in income and are therefore resorting to using unclean fuel which contributes further to greenhouse gasses, air pollution, and climate change. Female waste-pickers are doubly exposed in this regard because of their gender as well as their low caste. Thus, the social impacts of these waste energy plants are negatively impacting both the lower and middle classes of India.

From a feminist political ecology perspective, incineration as a mitigation strategy helps to combat climate change to a limited extent due to the controversy in the literature as well as the social impacts of the WTE plants. There is some evidence in developed countries that WTE plants are decreasing emissions which is possibly contributing to its mitigation strategies but in a developing country like India where incineration is not necessarily feasible and where waste is a highly socialized aspect of Indian livelihoods, these WTE plants seem to be doing more harm than good.

Conclusion

To conclude, any waste management strategy will have an impact on women and climate change. From the current literature, it seems that formalizing waste-pickers could benefit climate change mitigation as well as help female waste-pickers by providing social security nets for them. Landfilling and open burning seem to contribute to climate change and directly harm women, therefore efforts to adapt these strategies have been long overdue. Although WTE plants seem to be an ideal solution, since emissions are quite less than the current management practices in place, Indian waste is not suited for WTE and incineration, and there are still social and climate-related issues associated with this technology. It is imperative that the government considers the repercussions of this strategy and creates safety nets for waste-pickers to alleviate the social strain that may occur with the adoption of this technology.

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