Exploring the Emergence of Waste to Energy sector in India through an Input-Output Framework

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Effective waste management is a pressing global concern, and in the context of a rapidly growing nation like India, it poses unique challenges and opportunities. This paper explores the application of Input-Output (IO) framework as a strategic tool for optimizing waste management practices in the Indian context. A transitioning economy such as India which is undergoing demographic growth paired with rapid urbanization and industrialization generates 62 million tons (MT) of waste annually; of which 70 percent is collected and only about 17 percent is treated while rest are dumped in landfill sites. The IO framework, traditionally employed in economic analyses, is adapted here to provide a holistic understanding of the interconnected relationships between various sectors of the economy and their environmental impacts, specifically focusing on waste generation, disposal, and recycling. Understanding the linkages between the economic activities and waste generation in an IO framework is crucial for both environmental impact accounting through sectoral waste footprints, while also extending the premise of waste to energy (WtE) as a sector in the economy. WtE is a nascently emerging sector in the Indian context, at present only about 66MW is being generated from primarily from incineration in the existing 12 WtE plants across the country. Yet, there is an untapped potential of power generation based on waste generated from industrial and household activities of about 5690 MW. The Ministry of New and Renewable Energy (MNRE) has been incentivizing private players for public private partnership (PPP) towards setting up of WtE plants through capital and revenue subsidy. Furthermore, preferential tariffs are being presented to encourage state utilities to purchase power from WtE plants at competitive rates.

The incorporation of waste IO framework is introduced as a systematic methodology capable of capturing the intricate web of relationships between different sectors of the economy, shedding light on the environmental implications of resource consumption and waste generation along with WtE as a separate sector. The study has undertaken using 2018-19 IOTT for India wherein waste footprints have been determined in physical terms while the WtE sector has been created in terms monetary flows. The waste footprint analysis delves into the composition of varying waste generated through industrial activities along with potential for reduce, recycle and reuse linkages among the sectors. Meanwhile, introduction of the WtE as a separate sector sets the premise, both in terms of economic accounting of an emerging sector along with the potential of achieving renewal energy demands from rising urban demands. The varied technologies at present and being prospected towards WtE have differing suitability conditions governed by physicochemical properties of the waste, the quantity of waste feedstock, and the desired form of energy. Apart from these physical factors the potential economic costs and environmental implications in the regional context. Hence, we also take into account of these varying suitability and feasibility conditions associated with technologies such as incineration, gasification, pyrolysis, anaerobic digestion, and ethanol fermentation. Such a study is novel both in the model conception of hybrid waste IO frameworks while also enabling to chart unique policy implications and sustainable pathways for development in the regional context of Indian economy.