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CONFERENCE PAPER

ART OF SOLID WASTE MANAGEMENT: SUSTAINABLE MUNICIPALITY & ITS DIVERSIFICATION IN ODISHA

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Abstract

Sustainable integrated solid waste management encompasses advanced technologies and management methodologies aimed at realizing waste management objectives. In the formulation of a sustainable waste management strategy, a multitude of factors, including socio-economic, cultural, legislative, technical, institutional, and environmental dimensi ons, are meticulously considered. Sustainable municipal solid waste management (MSWM) forges connections among the various stakehold ers engaged at each tier and the diverse components of MSWM strategies. It presents a comprehensive interdisciplinary framework to address the challenges associated with sustainable MSWM, particularly in developing nations characterized by inadequate solid waste manage ment services.

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Introduction:-

Sustainable integrated solid waste management is the rapid technologies and management strategies for achieving waste management goals. While framing sustainable waste management strategy, multi aspects such as socio-economic, cultural, legislative, technical, institutional and environmental aspects are considered. Sustainable MSWM (municipal solid waste management) establishes link between the stakeholders involved at each level and different aspects of MSWM strategies. It offers far reaching inter- disciplinary agenda to deal with the problems related to sustainable MSWM, especially in developing countries with poor solid waste management services. The sustainable approach takes into account almost every possible aspect of MSWM such as, generation of waste, its segregation at the source of generation, its collection and transport, recycling and resource recovery, existing waste disposal methods and its up-gradation along with communities' participation.

Literature Survey:

Kandel et al., 2025 studies municipal solid waste management (MSWM) is a significant environmental and public health issue, particularly in rapidly urbanizing areas. The economic feasibility of sustainable waste management is supported by findings that a substantial portion of waste is organic, presenting opportunities for composting and energy production.

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Grishaeva et al., 2022 describes solid waste management is crucial for sustainable municipalities, as it addresses the challenges of managing municipal solid waste (MSW) from dispersed sources. Improving eco-cultural awareness and implementing administrative regulations are essential for effective waste management and promoting sustainable development.
Dey et al., 2023 studies a typical garbage monitoring system using IoT which provides complete solution for the modern solid waste and its consequences.

Problem Formulation:
Listed below are some common problems and they are treated as P1, P2, P3 and P4.
P1: Increased household trash and commercial waste.
P2: Lacking of segregation practice at the source itself.
P3: Lack of collection and transportation facilities for collection of waste and its disposal.
P4: Inefficient and insufficient capacity of the disposal system and unsuitable means employed for the disposal of waste.
The aforementioned issues are extensively encountered in a majority of developing nations and consequently necessitate interventions and rehabilitation to ensure sustained viability.

Approaches to sustainable municipal solid waste management:
- **Upstream strategy:** This method takes into account fundamental guidelines like waste reduction, segregation at the source of production, promotion of recycling practices, and solid waste composting methods. The industries and manufacturing facilities are guided by the upstream strategy's cleaner production principle in the creation and delivery of environmentally friendly goods and services. This will undoubtedly result in waste reduction at the manufacturing level itself, as opposed to at the point of consumption.
- **Downstream strategy:** This approach is appropriate for nations that have a critical need to enhance their current municipal solid waste management system. The notion of cleaner production here advises separating mixed waste before it is transported and dumped. Waste segregation offers a number of benefits, including: 1.Lower the amount of waste during final disposal. 2. Remove any detrimental impact on the environment. 3. Costs of operation are kept to a minimum. 4. The amount of land needed for garbage disposal is eventually decreased.

Proposed Algorithm:
Algorithm SustainableMunicipality_WasteManagement
BEGIN
// Step 1: Waste Segregation
FOR each household IN municipality DO
Separate waste INTO Organic, Recyclable, Hazardous
END FOR
// Step 2: Collection & Transportation
Schedule collection routes BASED ON waste type and volume
Transport segregated waste TO respective processing centers
// Step 3: Waste Processin *FOR each waste category DO*
IF Organic THEN
Process THROUGH composting or biogas plant
ELSE IF Recyclable THEN
Send TO recycling facility
ELSE IF Hazardous THEN
Dispose SAFELY in controlled landfill or incinerator
END IF
END FOR
// Step 4: Resource Recovery
Generate renewable energy FROM biogas and recyclables
Produce recycled materials FOR reuse
Minimize landfill waste
// Step 5: Environmental & Social Benefits
Promote clean city initiatives
Reduce pollution levels

Create green employment opportunities
// Step 6: Monitoring & Improvement
Collect data ON waste generation, processing efficiency, emissions
Evaluate performance AGAINST sustainability metrics
Implement continuous improvement strategies
END

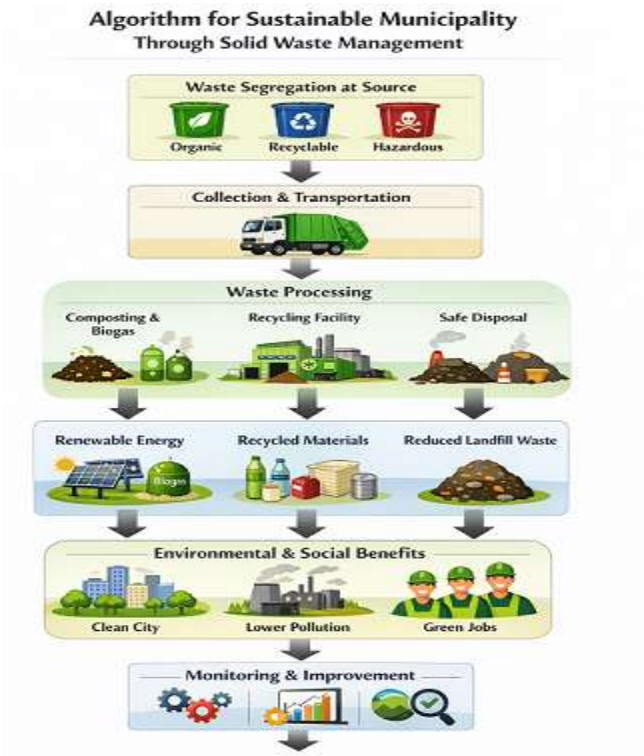


Figure 1: Innovative schemes in solid waste management algorithm

Critical characteristics for future sustainable MSWM:
Proper management would be facilitated by a viable and implementation plan outlining the strategy for enhancing environmental quality in the area of municipal solid waste management at the regional level.
• The 'Polluter pays principle' ought to be extended to all waste producers, including the various sectors of government, non-government, business, and private.
• To minimize waste creation at the manufacturer's and consumer's end, an environmental management plan that includes product stewardship, the notion of cleaner production, and specifications for packaging materials should be implemented. In addition, it will aid in resource recovery, which will lead to resource conservation.
• Creation of an organized information system that is useful, comparable, and current for monitoring the solid waste component and for ongoing monitoring.
• The identification of appropriate waste disposal sites within each state/region is always a component of a long-term strategy for managing waste sustainably.
• In order to regulate and oversee solid waste management, accountable government organizations should be established to oversee the local government and private companies.
• The engagement of NGOs, Community Based Organizations, and the private sector should be promoted in the provision of managerial assistance.

Result Analysis:-



Figure 2: Monthly SWM data sheet for Odisha

The analysis shows an innovative way where for five months the waste collected in metric tons are being processed to utility from different forms like plastics, paper and metals.

The reduction rate is 28% and electricity generation upto 18GWh.

Table 1: Solid waste approx weight with reduction rate

Solid Waste	**Approx Weight**	Waste reduction rate	**Renewable Energy Generated/Utility Percentage**
Plasitic	800 tons	28%	• Biogas Produced 1.2 million m^2 • Electricity generated up to 18GWh.
Paper	500 tons	26%	
Metal	300 tons	27%	

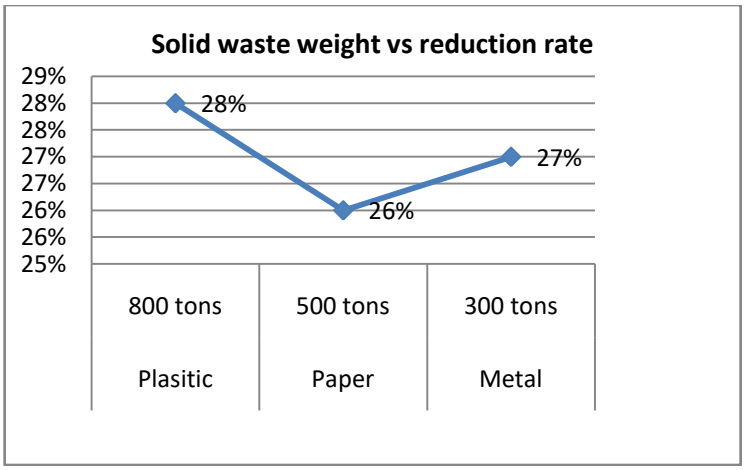


Figure 3: Solid waste approx weight with reduction rate graph.

Conclusion:-

Sustainable MSWM (municipal solid waste management) establishes link between the stakeholders involved at each level and different aspects of MSWM strategies. It offers far reaching inter- disciplinary agenda to deal with the problems related to sustainable MSWM, especially in developing countries with poor solid waste management services. The sustainable approach takes into account almost every possible aspect of MSWM such as, generation of waste, its segregation at the source of generation, its collection and transport, recycling and resource recovery, existing waste disposal methods and its up-gradation along with communities' participation. This paper in its proposed algorithm gives an clear idea of managing solid waste through innovative manner and giving a sustainable environment to live in.

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