

EFFECTIVE SOLID WASTE MANAGEMENT TO EMPOWERING COMMUNITY-A CASE STUDY OF POKHARNI VILLAGE

Goal 3- Good Health and Well-Being, Goal 11- Sustainable Cities and Communities,
Goal 15- Life on land

^aMs. Aditi A. Patil

^aStudent, Annasaheb Dange College of Engineering and
Technology, Ashta, India

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Abstract: The pursuit of the Sustainable Development Goals (SDGs), which aim to address difficult issues while assuring the welfare of both present and future generations, has become a worldwide necessity. By concentrating on the evaluation and design of solid waste management solutions in Pokharni Village, this article explores the backdrop of sustainable development. This study examines the solid waste management practices used in ‘Pokharni Village’ in detail, taking into account trash creation rates, composition, disposal procedures, and environmental effects. The study highlights major obstacles to efficient waste management and contributes to environmental degradation by using quantitative and qualitative research approaches. Since these issues frequently interact with socioeconomic variables, finding sustainable solutions requires an all-encompassing strategy.

The study also describes the creation of an integrated solid waste management system that is adapted to the unique requirements and limitations of Pokharni Village. The remedies that are being suggested include garbage separation at the source, the construction of facilities for recycling and composting, the introduction of effective collection techniques, and educating the neighborhood on the significance of sustainable waste management practices. These actions are expected to have results that promote a healthier environment, better community engagement, and alignment with the SDGs. This study provides insights that can be applied to similar rural areas facing comparable difficulties by addressing the gaps in the current solid waste management techniques and aligning them with the SDGs. As the focus of the world's attention shifts to sustainable development, this work adds to the conversation by providing a real-world case study that illustrates the potential for change at the local level.

Keywords: Sustainable Development Goals; solid waste management; Pokharni Village; environmental impact; community engagement; sustainable solutions.

1. Introduction

The current scenario demands good research on management. Solid Waste Management is one them. The SWM Plan for Village aims to develop an effective and sustainable Waste disposal system that

will benefit the local population. Focus of this project is to prepare empowering communities by devising the appropriate effective management plan includes assessment of daily waste generation rate and to prepare an effective plan for solid waste management for Pokharni village.

1.1 Importance of Solid Waste:

Solid waste management is the systematic and organized process of collecting, transporting, processing, and disposing of solid waste to minimize its negative impact on the environment and public health. It involves practices such as waste reduction, recycling, composting, and safe disposal to ensure a cleaner, healthier, and more sustainable environment. The goal is to manage solid waste efficiently, promote resource recovery, and reduce environmental pollution and health hazards caused by improper waste handling.

Solid waste management is critical for environmental, public health, and natural resource protection. It reduces pollution, encourages recycling, and assures safe disposal, resulting in a cleaner and more sustainable world. Solid waste management is critical for environmental, public health, and natural resource protection. It reduces pollution, encourages recycling, and assures safe disposal, resulting in a cleaner and more sustainable world.

The management of solid waste is essential for preserving the environment. Effective waste management contributes to the reduction of greenhouse gas emissions, resource conservation, pollution prevention, and the preservation of wildlife habitats. This succinct introduction describes how important it is to manage garbage properly in order to protect the environment. It emphasizes the significance of responsible waste disposal and recycling practices for a sustainable future.

Currently society faces a critical need for effective solid waste management because of the exponential rise in trash production brought on by population growth and rapid urbanization. Solid waste management mistakes can result in resource loss, environmental damage, and health risks. Different techniques and approaches have been developed to manage solid waste effectively and sustainably in order to address these issues. The major methods and innovations that help ensure our communities have a cleaner, more sustainable future are examined here.

³ Fig 1: Current Scenario of Village



1.2 Functional elements of solid waste management system to be operated by municipal authorities^[9]

Functional element	Description
Waste generation	Those activities in which materials are identified as no longer being of value and are either thrown away or gathered together for disposal
On-site handling Storage processing	Those activities associated with the handling, storage, and processing of solid wastes at or near the point of generation
Collection	Those activities associated with the gathering of solid wastes and the hauling of wastes after collection to the location where the collection vehicle is emptied
Transfer and transport	Those activities associated with (1) the transfer of wastes from the smaller collection vehicle to the larger transport equipment and (2) the subsequent transport of the wastes, usually over long distance, to the disposal site.
Processing and recovery	Those techniques, equipment, and facilities used both to improve the efficiency of the other functional elements and to recover usable materials, conversion products, or energy from solid wastes.
Disposal	Those activities associated with ultimate disposal of solid wastes, including those wastes collected and transported directly to a landfill

	site, semisolid wastes (sludge) from wastewater treatment plants. incinerator residue, compost, or other substances from the various solid-waste processing plants that are of no further use.
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2. Objectives of the Project

Following were the objectives of this project work :-

1. To conduct a reconnaissance survey with the aim of providing an overview of the village.
2. To plot the layout of village for effective rough planning using Drone survey.
3. To identify sources of solid waste using village observations and Public survey.
4. To calculate daily waste generation rates for improved waste management.
5. To prepare an effective solid waste management plan for Pokharni village.

3. Methodology

The methodology adopted for the study was as follow:

1. A reconnaissance survey with the aim of providing an overview of the village was conducted.
2. A drone-survey was used to map out the routes and the entire area of village.
3. Various sources of solid waste were identified conducting response survey, discussion with local authorities and visual observations.
4. Chemical analysis of solid waste was done to know the further possibilities like water consumption and methane generation in case of anaerobic digestion.
5. The existing system was assessed by comparing it with basic functional elements of solid waste management.
6. Various possible waste management techniques were explored suitable to 'Pokharni Village'

4. Result & Discussion

The chosen methodology for this study provided a comprehensive approach to assess and address the solid waste management issues in Pokharni Village. Each step was crucial in gaining valuable insights into the current state of affairs and formulating effective recommendations for improvement.

Fig 2: Improper management of solid waste in Village



The reconnaissance survey played a pivotal role in establishing a foundational understanding of the village's solid waste management situation. The visual documentation in Figure 2 highlights the significant challenges posed by improper waste management practices. This initial assessment was crucial in setting the stage for subsequent investigations. The utilization of drone-survey technology allowed for a detailed and accurate mapping of the village, including its routes and overall layout. This spatial information proved invaluable in understanding the logistics and spatial constraints associated with waste collection and disposal.

Fig 3: Photograph of Drone Survey along With the Map



Next step involved a thorough investigation to identify the various sources of solid waste. The combination of response surveys, discussions with local authorities, and visual observations provided a multi-faceted perspective on the origins and types of waste generated in the village. This information

was instrumental in tailoring waste management strategies to specific sources. Various sources identified were as follows....

1. Agricultural activities
2. Residential activities
3. Open spaces in and around village
4. Small commercial activities like glossary shops and saloons.

Chemical analysis of the solid waste was a critical component in assessing its composition. This analysis not only shed light on potential environmental concerns but also opened avenues for exploring alternative waste treatment methods. Specifically, it provided insights into water consumption and the potential for methane generation through anaerobic digestion. Also the rate of generation was estimated by weighing the waste generated in one day and dividing it by the population. On a specific day the

total waste was found around 320 kg (excluding cow dung), for the population of 1700. It has resulted in the waste generation rate to be approximately near 200gm per person per day. The chemical formula was derived using observation presented in table 1.

Table 1: composition of solid waste and chemical formula

			composition					
composition	wet wt (kg)	dry wt	C	H	O	N	S	ASH
food wastes	9	2.7	1.296	0.1728	1.0152	0.070 2	0.010 8	0.135
paper	20	18.8	8.178	1.128	8.272	0.056 4	0.037 6	1.128
cardboard	4	3.8	1.672	0.2242	1.6948	0.011 4	0.007 6	0.19
plastic	4	3.96	2.376	0.2851 2	0.90288	-	-	0.396
rubber	0.3	0.3	0.234	0.03	-	0.006	-	0.03
yard waste	10	3.5	1.673	0.21	1.33	0.119	0.010 5	0.157 5
wood	1	0.8	0.396	0.048	0.3416	0.001 6	0.000 8	0.012
total	48.3	33.86	15.82 5	2.0981 2	13.5564 8	0.264 6	0.067 3	2.048 5

The chemical formulas without sulfur are:



Without water: $C_{69}H_{109}O_{44}N$

With water: $C_{69}H_{1746}O_{87}N$

The chemical formulas with sulfur are:

Without water: $C_{627}H_{989}O_{403}N_8S$

With water: $C_{627}H_{1746}O_{786}N_8S$

Comparative assessment of the existing system against fundamental elements of solid waste management was a crucial step in gauging its effectiveness. This evaluation allowed for the identification of strengths and weaknesses, which served as a foundation for suggesting targeted improvements.

- Onsite handling and storage - Cow dung converted in to manure, combustible waste have been burned for generation of energy which is future utilized for different purposes such as cooking or boiling of water for bathing.
- Collection - Community bins are very less in number, certain specific collection units are placed only for the collection of plastic waste, which is filthy because of throwing other type of waste in it, this observation demanded the development of better collection system.
- Transfer and transport - transfer and transport system is not available in 'Pokharni village'
- Processing and Recovery - Processing and Recovery of waste is not available in 'Pokharni village'
- Disposal - There is no proper method of disposal of waste was available. Waste was gathered on ad-hoc basis with no fixed frequency and dumped at open spaces on the outskirts of village.

Fig. 4: Collection & On-site Handling of Solid Waste in Village



Final step involved an exploration of various waste management techniques suitable for Pokharni Village. This phase was informed by the data and insights gathered in the preceding steps. It enabled

the selection of strategies tailored to the specific needs, resources, and constraints of the village, ensuring a holistic and sustainable approach.

The first option was to design the collection system consisting one bell card, which will collect the waste from each individual house and dispose it in the community bins available in the village. This waste can be transferred to the designated land filling site using a large vehicle twice a week. The site for landfilling was also identified, which is located around 2.5 km from the village.

Calculate landfilling pit size on the basis of waste generation data:

Land filling calculations-

- Current population - 1700
- Population after 10 years – 3500
- Average population per year :- 2650
- Waste generated approximate:- 220 gm / person / day
- Land filling :- 110 gm / person / day
- Density of MSW:- 400 kg / m³
- Land filling site area :- 30*30M = 900 m²
- Excavation :- 270 x 2 = 540 m³
- Land filling :- 0.11 kg / day
- Land filling per day :- 2650 x 0.11= 291.5 kg / day
- Waste generated per year – 106.397 ton

This much area is sufficient for next 10 to 12 years

Second option was to provide either small composting units or the small ‘Bio-Liquid composter’ for either individual household or the group of four to five households. This can be a very significant step for managing organic waste of the village. The generated biogas can be used for any suitable purpose. The details of various systems available are presented in table no. 2.

Table 2: various models of composting units^[10]

Sr. no	Model	Input waste (daily)	Fertilizers generated (per year)	Cost.	Size required
1	100 ltr	500gm – 750gm	100 lit	Rs.2,500	1.5ft x 1.5ft
2	200 ltr	750gm-1.5 kg	200 lit	Rs.4,000	2.5ft x 2.5ft
3	1000ltr	7-10 kg	1000 lit	Rs.15,000	4ft x 4ft

Table 3: Various models of ‘Bio-gas’ and related information.^[10]



Sr. no	Model	Input waste (daily)	Output gas daily (time&gm)	Cylinders saved	Fertilizers generated (per year)	Cost.	Size required
1	200 ltr	500gm -2kg	35-45 min 80gm	2-3	300 lit	Rs.16,500	3ft x 6ft
2	500 ltr	2-5 kg	1-1.5hrs 200gm	5-6	750 lit	Rs.32,000	4ft x 4ft
3	1000ltr	7-10 kg	1.5-2.5 hrs. 400gm	11-12	1500 lit	Rs.45,000	4ft x 7ft
4	2000ltr	14-18 kg	3-3.5hr 500gm	15-17	3000 lit	Rs.70,000	9ft x 9ft
5	3000ltr	25-30 kg	6-7 hrs. 1200gm	28-30	5000 lit	Rs.95,000	12ft x 12ft

Overall, the adopted methodology provided a robust framework for comprehensively addressing the solid waste management challenges in Pokharni Village. By combining on-ground assessments, technological tools, chemical analysis, and comparative evaluations, this approach ensured a well-informed and tailored solution to the unique context of the village. The subsequent recommendations and interventions are grounded in a thorough understanding of the existing conditions and potential avenues for improvement.

Fig. 5: Biogas and Bio-Liquid Composter a product of Wastecart



5. Conclusions

An in-depth analysis of solid waste management in Pokharni Village revealed a multifaceted waste generation scenario. Through a comprehensive village survey, we quantified the daily solid waste generation rate. To ensure effective management, we propose a three-fold approach, including landfilling, biogas production, and the establishment of a robust waste collection network. These measures collectively offer a sustainable solution for the village's solid waste challenges, promoting environmental cleanliness and resource utilization. The findings of this study can be mirrored in similar sized villages having analogous conditions.

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