

## Conversion of Food Wastage into Biogas: A Case Study of Girls' Hostel

**T.D.Mahanwar**

Head, Dept. of Commerce D.G.College of Commerce, Satara, MS, India

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### Abstract

Biomass resources is available by the way of cattle dung, agriculture wastes and other organic wastes. It is have one of the main energy sources for the human being since from the civilization culture. There is a wide scope to convert these energy sources into biogas. Biogas production is a clean and it is low carbon technology for efficient management and conversion of fermentable organic wastes into clean cheap & versatile fuel and bio/organic manure. In the recent age the production of bio-fuel is agenda before government for the sustainable development of the nation. There is negative impact on the environment, economy, food security and nutrition due to bio-waste. There is need of time to minimize the problems created from food wastage, like: Air Pollution, Water pollution, unhygienic environment, disease. Therefore, the bio-methanation process of converting biomass into gaseous fuel is superior and a sustainable process that needs to be preferred for such biomass materials that can be processed in biogas plants. For solving this problem researcher has undertaken experiment to study 'Conversion of Food Wastage into Biogas in women hostel and the capacity of the girl students of the hostel is 80. Bio west involves catering food, vegetables, fruits and bakery products etc

**KEYWORDS:** biomass, energy, biogas, slurry, food wastage, energy, recycling, waste management etc.

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**Introduction-** Waste management is a major problem in urban areas. Due to urbanization, industrialization has resulted in increasing solid waste. The effective was temangement is basic challenge due to high density of population in urban area. Maintaining standard of living is becoming more difficult in India. Waste management systems in India have remained relatively unchanged. The recycling of waste materials is undoubtedly a reasonable way to waste management but Disposal and treatment of biological waste represent a major challenge for the waste industry. The availability of organic substances from agriculture, foodstuff of feed industries, anaerobic digestion is a superior alternative to composting.

**Statement of problem:**Agro processing industries, hospitals, hotels and hostels are centers of liquid and solid west. Current Solid west management systems are inefficient, with waste having a negative impact on public health, the environment and the economy. Considering the problem of solid and liquid waste the researcher have tried to undertake a case study of Women's College Hostel in a Satara city and conducted project on Conversion of food wastage into Biogas. The capacity of the girl students of the hostel is 80. Liquid and solid Bio west involves catering food, vegetables, fruits and bakery products etc. It was observed that there is wide scope for recycling waste and better use of resources, which can be possible to optimizing energy demand and minimizing cost of energy.

Basically extracting proper value from waste is the challenge. Most of the organizations have approximately 90% of residual waste and they are currently dumping traditionally, rather than properly converging in to recycle or in biogas. There is an urgent need to move waste to more sustainable Solid waste management, which requires new management systems and waste management facilities.

**Objectives of the study** –following are the objectives of the study.

1. To know the nature of food waste in women's hostel.
2. To evaluate bio-gas production through food waste.
3. To understand importance of food waste management.
4. To provide suggestions for effective implementation of Conversion of food wastage into Biogas projects.

**Scope and Limitation of the Study-** Present study helps to analyze and identify how much gas (Energy) and slurry produce from food waste of Women's hostel. Present study and data is collected only one women's hostel canteen of Satara district (With intake capacity-80 Girl Students)

**Methodology of the study:** Considering the objective of the study, researcher has used case study method and conducted an experiment regarding food waste and find out gas production through mini biogas plant as a primary data. The quantitative and graphical techniques are used for conclusion and findings.

**Concepts and Literature review:** India is implementing one of the World's largest programs in renewable energy. The country ranks second in biogas utilization. Biogas can be generated and supplied round the clock in contrast to solar and wind, which are intermittent in nature. Biogas plants provide three-in-one solution of gaseous fuel generation, organic manure production and wet biomass waste disposal/management. Biogas is a natural fuel that is obtained through anaerobic digestion, i.e. bacterial fermentation that takes place in the absence of oxygen of organic residues from plant or animal residues. About 50-70% of the biogas produced is made up of methane and the remainder of carbon dioxide and other minor components. Biogas is a product of bi-methanation process when fermentable organic materials such as cattle dung, kitchens waste, poultry droppings, agricultural wastes etc. are subjected to anaerobic digestion in the presence of methanogenic bacteria. In contrast, when biomass is subjected to combustion/gasification process, it ends up in the destruction of biomass and only ash is left after extraction of energy.

**a. Biogas:** Biogas is produced by bacteria through the bio-degradation of organic material under anaerobic conditions. Natural generation of biogas is an important part of bio-geochemical carbon cycle. It can be used both in rural and urban areas.

**b. Composition of Biogas:** Component Concentration (by volume) Methane (CH<sub>4</sub>) 55-60 % Carbon dioxide (CO<sub>2</sub>) 35-40 % Water (H<sub>2</sub>O) 2-7 % Hydrogen sulfide (H<sub>2</sub>S) 20-20,000 ppb (2%) Ammonia (NH<sub>3</sub>) 0-0.05 % Nitrogen (N) 0-2 % Oxygen (O<sub>2</sub>) 0-2 % Hydrogen (H) 0-1 %

**c. Characteristics of Biogas:** Composition of biogas depends upon following feed material.

1. Biogas is about 20% lighter than air has an ignition temperature in range of 650 to 750 °C. An odorless & colorless gas that burns with blue flame similar to LPG gas.
2. Its caloric value is 20 Mega Joules (MJ) /m<sup>3</sup> and it usually burns with 60 % efficiency in a conventional biogas stove.
3. This gas is useful as fuel to substitute firewood, cow-dung, petrol, LPG, diesel, & electricity, depending on the nature of the task, and local supply conditions and constraints.
4. Biogas digestive systems provides a residue organic waste, after its anaerobic digestion(AD) that has superior nutrient qualities over normal organic fertilizer, as it is in the form of ammonia and can be used as manure. Anaerobic biogas digesters also function as waste disposal systems.
5. Biogas technology is particularly valuable in agricultural residual treatment of animal excreta and kitchen refuse (residuals).

**d. Bio Slurry** – Bio slurry is used to improve soil fertility, soil structure, and crop productivity, and it can be an excellent fertilizer. However, very few farmers are familiar with the advantages of bio slurry.

**Data Collection-** For the present study primary as well as secondary data have been collected.

1) Primary Data:

A. Observation and discussion: The primary data have been collected through observation and discussion with the rector of the ladies hostel and collected data of regarding problems of food waste, quantity of dry and wet waste.

B. Data through experiment: we have conducted an experiment regarding process of feeding food waste into biogas plant, and find out gas produce from biogas plant and this data is used for research paper as well as project.

2) Secondary Data:

The secondary data necessary for completing study have been collected mainly from published source in Newspaper, Articles, Books, Research Journal and websites etc.

**Data Analysis and Interpretation:-**Data is being analyzed by the using statistical tools, like table, Graphs and Chart and with the help of statistical techniques such as average, percentage, etc.

**1. Use of raw material:** Canteen and catering waste can be defined as all waste food, vegetables, fruits and bakery products etc. which includes un-used cooking material that is available in restaurants, catering and kitchens. which prepare food for human consumption. This waste raw material is used for producing bio-gas by experimental method.

**Table1.1**

**Food Waste Consumed and Biogas Production**

Tank Size in Ltr.	Food waste consumed in Kg		Total Material	Daily Biogas Production in gram.
	Dry	Wet		
1000	1 kg	2kg	3 kg	250-300.gm
	2kg	4kg	6kg	300-600.gm
	4kg	6kg	10kg	600 -900.gm
	6kg	8kg	14kg	900-1200gm

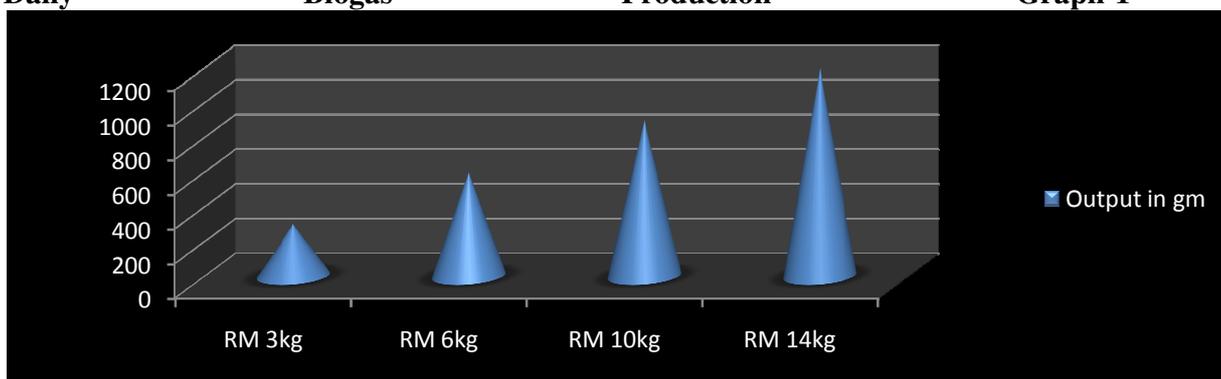
(Source: Primary Data Complied)

1. Above table no 1.1 shows that we have 1000 liter tank size and maximum waste of 14 kg per day is available in girl’s hostel canteen and it produces 900 to 1200 gram biogas form this pant.

2. It was realized that daily requirement of gas in hostel canteen is 1.189 gram (yearly requirement of cylinders is 31and average weight of each cylinder is 14kg)

3. It was found that the gas requirement of the hostel canteen is fulfilled by this bio waste plant. This hostel will become self-sufficient through this project.

**Daily Biogas Production –Graph-1**



**2. Biogas and Financial Saving** :According to objective of case study researcher has been calculating the output of gas in rupees (save rupees)(1 LPG cylinder -14kg-Rs.700)

**Table1.2**

**Biogas Production and Financial Saving**

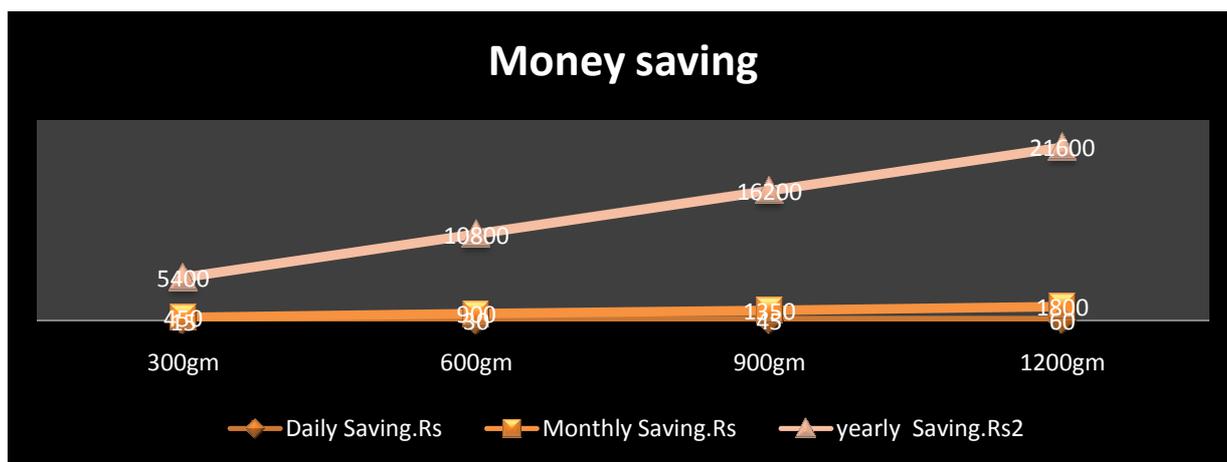
Tank Size in Ltr.	Feeding Material in Kg		Total Material	Daily Biogas Production	Daily Saving Rs	Monthly Saving Rs	Yearly Saving Rs
	Dry	Wet					
1000	1 kg	2kg	3 kg	250-300.gm	15	450	5400
	2kg	4kg	6kg	300-600.gm	30	900	10,800
	4kg	6kg	10kg	600 -900.gm	45	1350	16200
	6kg	8kg	14kg	900-1200gm	60	1800	21600

Source-Primary Data Complied

Note: Using biogas plant of food waste-save about 31cylinder of LPG in year from 14 kg food waste

1. As per table no 1.2 it was found that output of bio gas of that girl’s hostel was in the range of 300gm to 1200 gm per day.
2. It was realized that financial saving of the institute is in the range of Rs. 5400 to Rs 21600 within the year.

**Money Saving Graph-2**



**Table1.3**  
Slurry Production and Income(In Rupees)

Waste Material	Slurry Production in Kg( In 3 Days)	3 days Income	Monthly Production	Monthly Income	Yearly Production In kg	Yearly Income
3 kg	1.5kg	516	15kg	5160	180kg	61920
6kg	3kg	1032	30kg	10320	360kg	123840
10kg	5kg	1720	50kg	17200	600kg	206400
14kg	7kg	2408	70kg	24080	840kg	288960

(Source- Price of 1kg Slurry- Amazon.com and Flip craft .com.Average Market Price of Slurry.0.344gm)

1. It was found that the slurry production within 3 days was in 1.5 kg to 7 kg and monthly production of slurry was 15 to 70 kg.
2. Estimated monthly income from slurry production is Rs. 5160/- to Rs. 24080/\_ as per price rate of Amazon and flip card.com.

**Observations and Finding:**1. Conversion of waste into biogas it will helpful for minimizing the amount of waste. In few decades bio energy will become the most significant energy source. These small level projects have good exposure.

2. It was found that the bio waste in hostel is all vegetables and fruits, cooking food, grains, dairy items and meat. Food wastage is frequently a result of unwittingly taking more food in your plate than required.

3. Most of the people are unsure how to store fruits and vegetables, which can lead to premature ripening and, eventually, rotten produce.

4. Biogas-fueled gas engines improve waste management while maximizing the use of an economical energy supply.

5. If food wastes are used for renewable energy, it is proved that possible to decrease pollution and disease

6. Conversion of food wastage into biogas is tool of saving money and LPG gas.

7. It is concluded that the digested slurry from biogas plants is available for its utilization as organic manure in agriculture, horticulture as a substitute of chemical fertilizers.

8. Slurry use as fertilizers with free of cost to the garden of the college. It saves the money of college.

**Suggestions:** 1) There is a need of hour that all hostels, hotels and boarding should take initiative for this experiment of converging of waste in to biogas. Ultimately these students are become aware about waste management and social responsibility.

2. There is need to provide small plastic containers for home kitchen and 2000.ltr.plastic container for Hotels, Factories, and Companies.

3. Municipal corporations and local bodies should take imitative for collecting liquid garbage by providing small plastic containers to society and citizens for the purpose of bio-gas plants.

4. A biogas plant can be set up within institute. The leftover food along with other organic waste can be utilized for the production of clean energy.

5. Conversion of food wastage into Biogas is expensive so government should provide financial support with proper funding.

6. Students should make aware about the food scarcity and food security and the large quantities of food wasted globally. Workshops should be conducted depicting the same. With the help of students' support, food wastage can almost be eradicated.

7. Bio slurry is the solution of providing organic fertilizer to college garden and students of the college will be able to understand importance of organic fertilizer and they can undertake such practice in their farm and agriculture.

8. All the farmers should train for maintain such plants of bio-gas. It can be possible to facing the challenges with regards to (organic) waste, fertilizers and composting. Especially for smallholder farmers, this is an interesting solution in organic farming challenges.

Therefore, the use of biogas and bio slurry should become regular practice as much as possible.

**Conclusion:** Food wastage is a serious issue that contributes to social, Environmental, and economic problems. It leads to high rates of food insecurity, causes atmospheric pollution, and results in a lot of capital wasted on inputs. For the purpose of overcoming this issue, we can make aware staff and students about this issue and the outcomes of food wastage. Biogas of food waste is much cleaner than its also use for hostel kitchen for cooking food, so it is recycling process. Slurry is useful for institute garden as well farming. Conversion of waste into biogas it will be helpful for minimizing the amount of waste. In next decades bio energy will become the most significant energy source. These small level projects have good exposure.

The students will be able to implement such technique through the biogas project and they can understand importance renewable energy and organic manure to the garden and agriculture. It was realized that this is a feasibility study on waste-to-biogas from organic waste. The success of this project is started from small level and in future the broad variety of usable forms of biogas for the production of electricity and Bio-fuel will be implemented. It is an effective waste management System.

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