IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

# SUSTAINABILITY A Step Forward To Land Grant Pattern"

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## Abstract

Around the world, pollution of the air, water and soil, from municipal, industrial and agricultural operations continues to grow and the limited availability of non-renewable sources are creating question in front of scientist and common man. The program of the 'four R's', which stands for Reduce, Reuse, Recycle, and Renewable energy, has generally been accepted as a useful principle for waste handling and the use of renewable sources[1]. Mankind can face this threat successfully with the help of biogenous methane. This paper presents the use of biodegradable waste material of G.B. Pant University to produce biogas through biogas plant.

**Keywords**:- Sustainability, Renewable .

## Introduction

India is an agricultural hub having 198mha of farming land and 489 millions of animals that produces tremendous amount of waste material, similarly our university is also an agriculture university. We never think about the waste material which is present in large quantity and it can generate income. At present we can collect 10095 kg amount of waste material which is available at free of cost but can generate income as well as employment, protects environment and give us carbon credits. The university waste material is of no use except IDF waste, as they are preparing vermi compost from it. At university farm, instead of burning the crop residues we can utilize it in biogas production. In this activity we have collected data about each and every thing related to bio-waste and tried to explain the sources of waste material, their amount, and how much effectively we can utilize it in the campus.

## Biofuel

Bio gas production is an anaerobic process. The process of biogas production takes place in anaerobic conditions and in different temperature diapasons. There are psychrophilic (temperature diapason 10-250C), mesophilic (25-400C) and thermophilic (50-550C) regimes of bioconversion[2]. Biogas production in a thermophilic regime is much higher than for the mesophilic and psychrophilic regimes. In addition, less $CO_2$ is released during the anaerobic fermentation process than aerobic fermentation i.e. composting, and no methane escapes to the atmosphere. There are important aspects when "global warming" is considered. The anaerobic fermentation process also produces compost which be used as soil conditioner. Anaerobic digestion is a biological process of degradation of organic input materials[3][4].

## Objectives

Our objective is to promote the recycling/utilization of waste material of Pantnagar University. In terms of weight, almost 90% of waste material we collect from Instructional Dairy Farm, Poultry farm, Piggery farm, Waste mess food, Waste paper,
Crop residues .

By collecting and processing all kinds of wastes separately a significant contribution can be made to realize these objectives:

1. Land use plan and to renew the Land Grant Pattern of our university.
2. To replace LPG cylinders from pantnagar university.
3. To generate employment :
   * the waste material from university premises will be collected by persons.
   *plant maintenance engineer.
   *other helping staff
4. To set up a biogas plant using the waste material of university to promote renewable energy.
5. To provide enriched vermi-compost to the farmers.
6. To generate income.
7. To set an example as the first agriculture university of India, to set up such a large plant of renewable sources.

## Sources of Waste Material

**1. Animal waste**

- Around 750 animals waste material
- Poultry farm waste material
- Piggery farm waste

**2. Waste paper**

- office waste papers
- Students rough copies
- All school students rough and waste paper
- News paper of all university campus

**3. TDC waste**

- Wheat husk
- Paddy husk

**4. Crops Residue**

- Two seasonal crops residue

(Harvest index=Economic yield/Biological yield)

Total residue=BY-EY

Thus,

Residue from Paddy: 60q, as HI of paddy is 0.4 and EY is 40.

Residue from wheat: 25q, as HI of wheat is 0.5 and EY is 25.

- All vegetables crop residue
- Rotten fruits

**5. Waste material of university mess**

- All faculty waste bio material
- All remaining food of universities mess

**6. Other waste available:**

- Mushroom research and training centre
- Vegetable waste material of Heat
- Food shops and juice corner waste of badi market

## Waste Material Calculation

| Source | Yearly Collection | |
|---|---|---|
| Animal waste | 2920000 kg | |
| Paper waste | 5000 kg | |
| Crop residue | 50000 kg | |
| Waste food from mess | 359500 kg | |
| TOTAL | 3334500 kg | |

**PLANT TECHNICAL DESCRIPTION:**

The fermentation plant we are planning to design is for processing of 3634200kg of waste per year. This is based on an average daily supply of 10095 kg, depending on the season.

After collection of waste material, the waste first undergoes a pre treatment process and then it is mixed with water and already fermented material in the mixer. It results in organic slurry that can be pumped effectively without any major problem.

During the fermentation process biogas is produced, water is removed mechanically from the fermented material, which is then processed into compost i.e. water is recycled.

The biogas generated by the fermentation process is stored in a low pressure gas holder and it is transferred by means of ventilators to the neighboring treatment plant for purification. The air is extracted at several points and treated in order to eliminate any pollution or odors in the surrounding area of the plant.

## Plant Potential

***For 2 kg solid waste (including waste food, crop residue, dry leaves) with 20-30 liter organic waste water can generate 1CUM biogas.**

**<u>One CUM biogas=.5kg LPG</u>**

**we will get 862 kg waste material daily for 290 working days(250000kg/year).**

**we can generate 431CUM biogas that can generate 215.5 kg LPG per day.**

**we can generate 62495 kg LPG per year.**

**If we include the waste material of faculty members also we will get interesting results.**

**An extra of 300 kg/day waste material, so we can get 109500 kg./year.**

**Total 250000+109500=359500kg/year**

**We can generate 89875kg. of LPG /year.**

***reference from ARTI**

** **BIOGAS CALCULATION:**

**Daily biogas =(volatile solids (kg/year)** *0.4*1.1(m3 biogas/kgvolatile solid) * 0.7)/365

Now our annual volatile solid is 2920000kg

Daily biogas is 2464 m3/day

As one CUM biogas=0.5 kg LPG then we can produce 1232kg LPG per day.

Yearly we can produce 449680 kg LPG per year.

1. we required 604800 kg LPG in our campus.(268800kg in hostel mess+336000kg in faculty residences.)
2. to purchase such huge amount of LPG university spend 16329600 Rs.
3. if university sells this biogas @15 Rs. Then annual income generation is 18250000 Rs.
   These calculations are based only on the data collected by us .there may be some

variation but here our calculated data is in positive direction means we are generating more than our requirement .

**In energy aspects** From 700 animal's waste we can generate 381 kwh.

| SNO. | | QUANTITY/PERYEAR | PER UNIT COST | COST(Rs.) |
|---|---|---|---|---|
| 1. | Instructional dairy farm | 2920000 kg. | Zero | Zero |
| 2. | Food waste from mess | 359500 kg. | Zero | Zero |
| 3. | Paper waste | 5000 kg. | Zero | Zero |
| 4.other sources | 1.Crop residue | 50000 kg | zero | |
| | 2.Haat waste | | Zero | |
| | 3.TDC waste | | Zero | Zero |
| | 4.MRTC waste | 22400 kg | Zero | Zero |
| 5. | Bio gas plant | 10 | 15 lakh | 150 lakh |
| 6. | Bio agent | 15511 kg. | 100 | 15.51 lakh |
| 7. | Labour cost | 100 | 6000 | 72 lakh/ year |
| 8. | Infrastructure(working shed) | 1 | 1 lakh | 10 lakh |
| 9. | Transportation charge | | | |
| 10. | Pipe line | 3 km | 60000 | 1.8 lakh |
| 11. | Maintenance | | 1 lakh | 1 lakh |
| | | | | 250.31 lakh |

## Benefit Cost Analysis

| Tim | ITEM | QUANTITY/PERYEAR | RATE/perunit cost | COST(Rs.) |
|---|---|---|---|---|
| 1. | Industrial dairy farm | 899360 M3 | 15 | 135 lakh |

 ISSN: 2277-9655

| | | | | |
|---|---|---|---|---|
| 2. | Food waste from mess | 124990 M3 | 15 | 12.5 lakh |
| 3. | Faculty house waste | 54750 M3 | 15 | 8.2 lakh |
| 4. | Vermin compost | 2920000 kg | 5 | 146 lakh |
| 5. | Food+paper compost | 182250 kg | 5 | 9.11 lakh |
| 6. | Garbage engyme | 12.15 lakh liter | 15 | 121 lakh |
| 7. | Carbon credits | 18614.20 | 720 | 134 lakh |
| | | | | 565.81 lakh |

## Advantages

1. With anaerobic digestion, a renewable source of energy is captured, which has an important climatic twin effect.
2. The use of renewable energy reduces the $CO_2$-emissions through a reduction of the demand for fossil fuels.
3. At the same time, by capturing uncontrolled methane emissions, the second most important greenhouse gas is reduced.
4. CARBON CREDITS
   By filling one ton of $CO_2$ in cylinder, we can avoid its release in atmosphere, then 12 euro (INR 780) (1euro=65 Rs.) is offered by CCC. As methane is 21 times more polluting than $CO_2$, we can claim 252 Euros (INR 15000) for one ton. By this we can save pollution, but also add income source to project. Calculation of carbon credits:
   Total production of biogas is 1079110 m3 as Mass =density * volume so Density of methane is 1.15kg/m3 and total mass of 1m3 biogas is 1.15 kg.For 1079110 m3 it is 1240976 kg. 1.15 kg has 30% $CO_2$ and 70% methane Mass of $CO_2$ is 372292 kg. Mass of methane is 868683 kg. One carbon credit is equal to one ton carbon We have 372.29 carbon credits. As methane is 21 times more warmth than carbon So for 868683 kg we have 18242 carbon credits 1 methane credit=21 carbon credits One ton methane=21 ton carbon
5. Advantageous as agricultural point of view: Residue of production plant is well suited for the compost production by enriching through bioagents developed by university itself namely:
   Pant bioagent-1(Trichoderma harzianum), Pant bioagent-2(Pseudomonas fluorescens), Pant-bioagent-3(Trichoderma + Pseudomonas),Pant bioagent-4(Bioagent 2+3), this compost can decrease the infestation of White grub (Holotrichia consanguinea) as white grub is the prevalent problem of tarai region as well as hills. And the biogas produced after purification and upgrading upto natural gas quality can be used in different ways.
6. The reduction of 1 kg methane is equivalent to the reduction of 23 kg $CO_2$. The reduction of greenhouse gases with a high global warming potential can be more efficient compared with the reduction of $CO_2$.
7. We can also use our waste material of rotten fruits and vegetables in for making "garbage enzymes"[9]. These are the product of fermentation of vegetable/fruit waste in a mixture of water and brown sugar after a period of 3 months. These can be used as fertilizer, insecticide, plant hormone and anti- odour agents after dilution.

## Draw Backs

1. Methane forms explosive mixtures in air, the lower explosive limit being 5% methane and the upper limit 1methane. Biogas mixtures containing more than 50 % methane are combustible, while lower percentages may support, or fuel, combustion.
2. As biogas displaces air it reduces the oxygen level, restricting respiration, so any digester area needs to be well ventilated to minimize the risks of fire/explosion and asphyxiation [5].
3. Biogas consists mainly of $CH_4$ and $CO_2$, with low levels of $H_2S$ and other gases.

Each of these components has it's own problems, as well as displacing oxygen [6][7]:
CH4 - lighter than air (will collect in roof spaces etc), explosive (see above).
CO2 - heavier than air (will collect in sumps etc), slightly elevated levels affect respiration rate, higher levels displace oxygen as well.
H2S - (rotten egg gas) destroys olfactory (smelling) tissues and lungs, becomes odorless as the level increases to dangerous and fatal[8][9].

- The higher concentrations - 1-3ppm a person may not smell it as H2S numbs the olfactory nerves and effectively at these concentrations is odourless
- If the H2S is above 3ppm it may cause you health problems.

## Conclusion

- Biogas consumption is much better than biogas production
- At last we can say this project is not only beneficial for our university but ecofriendly also.
- It vanishes our dependency on non-renewable energy.
- It reduces the food bill of students and helps faculty members to maintain their monthly expenses.
- It save our university, our nation,our earth and feel us proudly. A large volume of population is get benefited by the given proposed architecture.

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