International Journal of Innovative Research in Science and Engineering
Vol. No.2, Issue 12, December 2016
www.ijirse.com
ISSN (O) 2454-9665
ISSN (P) 2454-0663

GENERATION OF GREEN ENERGY FROM PADDY STRAW: A NOVEL INITIATIVE IN SUSTAINABLE AGRICULTURE

Nahid Akhtar[1], Manish Jain[2],

NeeruGoyal[3], Prashant Kumar Tayal[4]

[1]*Faculty, Department of Mechanical Engineering, L.I.E.T, ALWAR (Raj), (India)*

[2]*Faculty, Department of Electrical Engineering, Govt. Polytecnic College, ALWAR (Raj), (India)*

[3]*Faculty, Department of Electrical Engineering, Sriganganagarr(Raj), (India)*

[4]*Faculty, Department of Electrical Engineering, L.I.E.T, ALWAR (Raj), (India)*

ABSTRACT

Energy is the basic requirement for all progress and uninterrupted supply of energy from clean sources is essential for sustainable development. Energy is the driving force of all economic, social, and environmental processes that strengthen the global sequences. Sustainable development is a challenging task considering the energy needs of any country. It is an important component in the modern economy to be evolved and deployed in all aspects of the development process. Developing countries have additional considerations of energy quality for urban population, energy security for industries and agriculture, and of energy availability for rural subsistence as well as development. The energy resources around the globe are dispersed unevenly and have a progressive deviation in most of the renewable sources. Biomass is one such source that can be used to provide sustainable supply of the required energy through biogas and other bio-fuels. The sustainability lies in the technical feasibility, economic viability, environment friendliness, and social acceptance. Recent developments in technology have opened the possibility of using paddy straw and other crop residue other than dung and vegetable waste for biogas generation. Thus, continuous endeavour needs to be expanded in the intersection zone by undertaking innovative projects involving leading edge technologies, such as paddy straw-based biogas power plant to overcome the air pollution and health hazards, resulting in sustainable agriculture for food and livelihood security.

Keywords : Sustainable Development,Paddy Straw,Energy Resources ,Renewable Sources Etc.

I.INTRODUCTION

Agriculture is a major contributor to India's gross domestic product (GDP). With a large agricultural produce comes equally large agricultural waste. Unfortunately, management of agricultural waste is lacking. Burning of crop residue is a common practice that leads to pollution, which further creates health hazards. In this case study, an initiative to generate electricity using biogas produced from paddy straw is brought to light.'Sampurn

ISSN (O) 2454-9665
ISSN (P) 2454-0663

Agri Ventures Pvt. Ltd'.(SAVPL), Fazilka, is working on an innovative integrated project on paddy straw based biogas power production including development of shrimp farms,biogas plant, and agro processing units (Pictures 1 to 8). The project started in 2006 at Panchanwali village of Fazilka,Punjab, with electricity production capacity of 1.0 MW by 10.0 tonnes paddy straw per day. The business model of SAVPL involves establishment of water bodies in existing water logged fields for commercial use that are further used as biogas digesters to process paddy straw. Bio-methanization technology is applied for production of bio-energy through processing of paddy straw. The present scenario of biogas plant has changed its view from only biogas to sustainable development in agriculture. It reduced dependence on chemicals and fertilizers, enlightening a new era of organic farming through bio-fertilizers. This type of project is an asset to water logged area of Malwa region of Punjab, which works as synergy with overall development. In order to improve livelihood of the farmers, this project aims to supply renewable energy based power with bio-fertilizer as by-product and manure and paddy straw managements for extra income to the farmers. Paddy straw is available in abundant in this region and is used as the raw material to produce bio-energy in the form of biogas. The project envisages collection of paddy straw from the farmers' field divided into different clusters to simplify the logistics problems. A sustainable energy supply model for the purpose of generating income from paddy straw is demonstrated, which would serve as a model for creating future energy policies for rural regions in India for sustainable development. Moreover, it will provide opportunities for income generation to the farmers and also empowers for economic growth. Table 1 gives essential information about the project. During an interactive session with Shri Sanjeev Nagpal, proprietor of 'SAVPL', Fazilka, said "It is promising solution for crop residue management with additional revenue to the farmers for sustainable agriculture and also resolving the issues, that is, straw burning, carbon emission, employment, organic manure and bio- fertilizer for agriculture, electricity production.

Table 1: Typical information about the project

Capacity of Biogas plant	1.0 MW
Biogas Generation Capacity	12,000 m^3/day
No. of working days	350 days/year
Paddy Straw require	25 tonnes/day
Power Generation	1,247 MWh/year
Manure(Compost)	439 ton
Slurry	560kilolitres/year
Payback Period	5.16Years

International Journal of Innovative Research in Science and Engineering
Vol. No.2, Issue 12, December 2016
www.ijirse.com
ISSN (O) 2454-9665
ISSN (P) 2454-0663

Picture1: Paddy Straw Bales Stored in Open Area

Picture.2 :Paddy Straw Bales at the Storage Site of Plant

Picture 3: Paddy Straw Storage Sheds

Picture 4: Paddy Straw Being Fed to the Conveyor Unit for Grinding

Picture 5: Conveyor Unit

Picture 6: Overview of Biogas Plant

International Journal of Innovative Research in Science and Engineering
Vol. No.2, Issue 12, December 2016
www.ijirse.com
ISSN (O) 2454-9665
ISSN (P) 2454-0663

Picture 7: Electricity Generation Unit Along with Hydrogen Sulphide Scrubber **Picture 8: Biogas Genset**

PROJECT LAYOUT

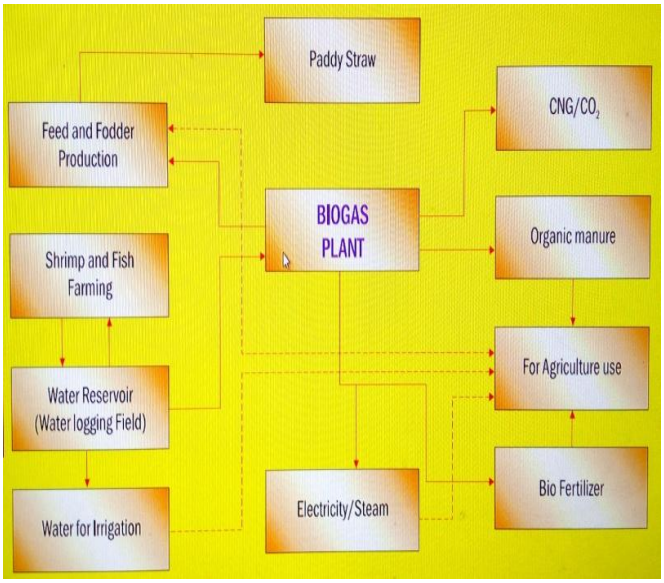

Figure.1: Presents a flow diagram with the basic layout of the project.

II. KEY COMPONENTS

❖ Paddy straw

Paddy straw, being the raw material, is the key component of the project. It is procured from the farmers' fields in the form of bales to be stocked in the storage unit of the plant, which are further fed into a pulverizing unit of capacity 1 tonne/hour through conveyer belt. The obtained ground paddy straw of size 3–5 mm is mixed with desired ratio of water, up to 15 percent of solid content, and fed to the anaerobic digester of the biogas plant.

❖ Biogas plant

ISSN (O) 2454-9665
ISSN (P) 2454-0663

Biogas is a product of anaerobic digestion of organic matter by methanogenic bacteria containing combustible gaseous mixture primarily of methane and carbon dioxide. The biogas plant of the project comprises of three anaerobic reactors with the total water capacity about 5,400 m^3. The reactors are fitted with the stir machinery operated as per the requirement basis. The average production of biogas per day is about 3,000 m^3. The biogas produced from the plant is further filtered through hydrogen sulphide scrubber to reduce the concentration of hydrogen sulphide gas below 50 ppm. The effluent obtained in the form of slurry from the biogas plant has high fertilizer value and is used as nitrogen-rich liquid fertilizer with minimal adverse environmental implications.

❖ **Bio-fertilizer**

The manure used as substrates at biogas plants go through a process of decomposition during change in material characteristics. The physical and chemical change that takes place in biogas reactor produces a modified fertilizer in the form of slurry with significant increase in ammonia nitrogen content. The obtained digestate further dried for agriculture applications with silica rich bio-fertilizer.

❖ **Electricity production**

The electricity generation unit comprise of German-make six cylinders Biogas genset for electricity production with capacity 1.2 MW/H 3-phase 415V alternator with biogas consumption about 500 m^3/hour. The power produced from the electricity generation unit is being supplied to the government electricity grid through 11 kV transformer.

III.SUSTAINABLE DEVELOPMENT APPROACH

The proposed biogas-based energy solution holds well on all the criteria of sustainability. The solution is 'technically feasible'. Various substrates given before have been observed for their potential outcome and functionality.

- Open field burning of paddy straw and other crop residue can be avoided through installation of commercial biogas production industries.
- It reduces methane emissions that taken place due to rotting of the substrate.
- The use of biogas can reduce the use of fertilizer, pesticides, and insecticides with enhanced soil health and having potential to recover damaged saline infertile land.
- The bio-fertilizers can help in overcoming the phosphate fixation problem.
- The government has heavily subsidized electricity and fertilizers and the products of the biogas plant have to compete with the subsidized price. Hence, organic fertilizer manufactured from the biogas plant can be retailed at the same price as phosphatic chemical fertilizer.
- It will also save foreign exchange outflow as most chemical phosphates are imported in India.
- Electricity produced from biogas can be retailed at differential prices.
- The current productivity of 300 m^3/tonne of biogas from paddy straw could be improved with further research and development in this field to make it more sustainable.
- The project therefore helps in employment generation directly and indirectly due to which it is not just economically viable but also attractive.

ISSN (O) 2454-9665
ISSN (P) 2454-0663

IV.CONSTRAINTS

As per Shri Sanjeev Nagpal, "The major constraint that we are facing in this project is promotion of organic manure of biogas plant. Government department, particularly agriculture, does not mention the use of organic manure in package of practices of crops proposed by universities. Unlike chemical fertilizers, organic manure does not show immediate results but have long-term significant outcomes. Hence, government should take initiative to aware the farmers in more effective way to make it viable."

V.CONCLUSION

Thus to conclude, it can be said that given the benefits, supply of energy generating out of biogas would assist rural businesses and enterprises to grow and prosper, production and use of organic fertilizers would improve soil and increase yields, and the project would also help employment generation by creating local job opportunities; it would not be a questionable fact to say that biogas-based energy could provide sustainable solution for rural areas. Considerable savings in subsidy bills and foreign exchange outflow could be further achieved through such projects. Moreover, through availability of fuel and energy, the overall health and hygiene in the region will improve, and most importantly, the project promises 'empowerment' of rural community, which makes it appropriate to become a multipliable and scalable model. Due to their wide-reaching positive effect on environmental, energy, and agricultural sectors, paddy straw based biogas plants are important pillars of mutual benefit among farmers and the industry.

REFERENCES

[1] Liliana Alzate-Gaviria, Microbial Fuel Cells for Wastewater Treatment, Available from: http://cdn.intechopen.com/pdfs/14554/InTech-Microbial_fuel_cells_for_wastewater_treatment.pdf

[2] Microbial fuel cell, Eco-friendly sewage treatment, Orianna Bretschger - correction Available from : http://www.earthtimes.org/energy/microbiol-fuel-cell-eco-friendly-sewage-treatment/1900/

[3] Zhuwei Du, Haoran Li, Tingyue Gu, A state of the art review on microbial fuel cells: A promising technology for wastewater treatment and bio-energy, 10 May 2007, Biotechnology Advances 25 (2007) 464–482, Available from - http://132.235.17.4/Paper- gu/MFCreview.pdf

[4] B.K. Pandey , V. Mishra , S. Agrawal, Production of bio-electricity during wastewater treatment using a single chamber microbial fuel cell, Vol. 3, No. 4, 2011, pp. 42-47, Available from - http://www.ajol.info/index.php/ijest/article/viewFile/68540/56618

[5] Deepak Pant, Gilbert Van Bogaert, Ludo Diels, Karolien, Vanbroekhoven, A review of the substrates used in microbial fuel cells (MFCs) for sustainable energy production, 7 October 2009,

6] In S. Kim, Kyu-Jung Chae, Mi-Jin Choi, and Willy Verstraete, Microbial Fuel Cells: Recent Advances, Bacterial Communities and Application Beyond Electricity Generation, Vol. 13, No. 2, pp. 51-65, 2008, Available from http://www.eer.or.kr/home/pdf/In%20S.%20Kim