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A Framework for Utilizing Domestic Waste as Resource to Address Energy Crisis and to Enhance Income of Rural Population: Case Study of District Jhajjar, Haryana

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Abstract

The rural Haryana has vast population of small and large domestic animals mainly buffalo, cattle, sheep and goat. The state has huge unexploited potential of domestic animals waste which can be utilized as resource to address the energy crisis and to enhance the income of rural population. The utilization of domestic manure as resource rather than waste offers numerous social, agriculture, energy and environmental benefits. It plays a key role to achieve social and food security, support socio-economic development, ensure self employment and play an indispensible role in poverty elimination and rural prosperity.

In this study, a framework for utilizing domestic waste as resource to address energy crisis and to enhance income of rural population a case study of district Jhajjar, Haryana is presented. Firstly, efforts have been made to assess domestic animal residue of large and small animals for district Jhajjar, Haryana. The corresponding biogas potential of livestock residue is estimated and corresponding equivalent fuel option is determined to address the energy crisis and to enhance the income of rural population Haryana. It is obvious from present study that district Jhajjar has possibility of generating animal manure of 3,351,068 kg which results in 120638.45 $m^3$of biogas and 150798 kW of electricity resulting in saving of money by utilization of livestock manure as resource.

Keywords: Energy, Domestic animals, Residue, biogas, Jhajjar, Haryana, Biogas, bio-fertilizer, Income.

1. Introduction

Haryana has a vast population of large and small domestic animals mainly buffalo, cattle, sheep and goat across state. Livestock sector plays an indispensible role in socio-economic development of state of Haryana. It provides livelihood to almost two-third population of Haryana. The animal husbandry activities play a pivotal role in the rural economy of state through a variety of contributions in the form of income generation, draft power, socio-economic upliftment, renewable energy generation, employment avenues and better nutrition to human population. It enables the rural population to withstand the sudden crop failure shocks and provides organic manure which is widely utilized in agriculture and horticulture sector to increase crop yields. It generates a continuous stream of income and employment and reduces seasonality in livelihood of rural population of state. Infact, the available domestic animal residue is probably being used in cooking and heating in household activities and is being used as organic fertilizer and the rest is damped outside villages in pit [1-3]. However, it can be utilized in effective way to address to energy crisis and to enhance income of rural population iof District Jhajjar, Haryana. In this study, efforts have been made to utilizing livestock waste as resource to address energy crisis and enhance income of Income of Rural Population in context of District Jhajjar, Haryana.

2. Utilization of Livestock Manure: As Resource

Looking at livestock static in context of state available from animal husbandry and dairying Govt. of Haryana that each district across state, it is obvious that each district has reasonably good livestock population mainly cattle, buffalos, goats and sheep [3]. Animal waste from large and small animals is a useful raw material for biogas generation in rural Haryana.

. Indeed, state has vast unexplored possibility of cheap, environment friendly biogas energy from livestock waste in different regions of rural Haryana mainly from large and small animals. Bio-energy potential from domestic animal has a wide scope and offer promising solution to support essential contribution to a sustainable energy generation as standalone solution of rural population. The utilization of surplus livestock residue of state not only fulfill the regional energy requirement of the region but also provide a viable solution to address the problem of waste disposal in 'clean and green' way. The proper planning in utilization of biomass resources will certainly serve and contribute in a better way to the great 'Clean India Campaign' [4-8].

Usually, the family size in rural Haryana consists of four to six family members and generally each family has 2-4 buffalos/cattle population. Infact, if it is analyzed from point of view of raw materials availability for biogas generation the presence of 2 to 4 large animals enables to meet the rural energy demands of small family across state. Further, it increases the income of rural farmer by providing alternate fuel options and thus lead economic benefits as per the objective of central and state Govt. But despite of economic benefits the rural population is unable to harness the vast potential of livestock sector due to lack of awareness about govt. polices and scheme by farmer in rural Haryana. Thus, utilization of livestock manure for biogas generation, reduce farmer rural household cost mainly the cost of energy and provide value addition to the rural community utilizing the same as an equivalent fuel to diesel and LPG [9-10].

Livestock residue across state is utilized in state for various activities such as in rural household's activities in preparation of dung cake for utilization as fuel for domestic cooking and heating, bio fertilizer and also in already existing bio-digester setup across state. The generations of biogas from bio-digester utilizing animal residues offer multiple social, environmental, energy and agriculture benefits etc. It ensures hygiene and better health for rural children and women. Moreover it improves economic conditions of the farmers by trading the bio-manure. It reduces green house gas emissions and offer huge untapped potential in state [4-10].

Utilization of animal residue in bio-digester results in biogas and bio-fertilizer as two major byproducts. Biomethane generated from bio-digester has tremendous potential and can be utilized in multiple ways to generate electricity, bio-CNG, bio-manure, bio-fuels etc. Needless to say, it is decentralized, alternative viable solution to replace traditional fossil fuels for vehicular, industrial and domestic applications. A tentative brief summary of utilization of livestock manure as resource is presented here:

- As bio fertilizers in organic farming in agriculture, horticulture sector to increase crop yields. It also leads to rural population income generation and economic benfits by utilizing alternate fuel.
- As domestic fuels in cooking and heating in rural households activities.
- In planning of self driven small size independent family having their own self sustainable bio-energy solution. The utilization of livestock residue pays an indispensible role in waste removal, pollution control and environmental management, greenhouse gas emissions reduction, energy production, disease control, enhance agriculture productivity, rural development to name only a few.
- Livestock manure can be used as an alternative to other traditional fuels for energy saving in rural area. It ensures hygiene and better health for rural children and women.
- It improves economic conditions of the farmers by trading the bio-manure.
- Reduces green house gas emissions.

After a brief overview of utilization of livestock manure as resource in the succeeding section an outline of energy requirement in context of rural Haryana is presented.

3. Energy Requirements

In digital era, human needs energy in each walks of its daily life for various activities. Rural Haryana utilize animal dung cake, firewood, mustard stalks, cotton stalks primarily in rural household to meet the energy demands of rural community. Indeed, traditional fossil fuels, renewable energy resource are locally and globally used to fulfill the energy requirements. Safe, secure, environment friendly, easily accessible energy sources are necessary requisite for sustaining digital and modern life in society.

In light the above discussion, it is crucial to estimate the potential of biogas in context of district Jhajjar of Haryana to meet the future energy demands from domestic animal waste as viable, cheap, clean, green and alternative renewable energy option. Primarily households in rural Haryana are having major population of large animals mainly cows and buffalos for self support and rural income. Livestock manure of large animal's cows and buffalo is primary source for biogas generation if tapped properly. Usually, biogas generation potential depends upon the livestock statistics and surplus availability of residue actually collected from domestic animals.

4. Methodology

In this investigation, the domestic animals population of 20th livestock census-2019 report available from department of animal husbandry and dairying, Govt. of Haryana in context of district Jhajjar is referred. It is used to compute large and small animal's manure as well as for estimation of equivalent biogas potential and fuel for district Jhajjar as depicted in Table 1. [3] (Department of Animal Husbandry & Dairying, Government of Haryana http://pashudhanharyana.gov.in). It is also valuable in identifying and assessing biogas potentials to devise a self sustainable energy solution for rural Haryana. In the present study, it is assumed that 1 kg of animal manure produce 0.036 m^3 of biogas. Further, it also assumed that 0.8 m^3 of biogas is needed to generate 1 kW of electricity [11-12]

Table 1: Manure energy potential of different livestock [3]

Livestock	Type	Population	Manure/day (kg/day)	Total dung (kg)	Biogas yield (m^3/day) (0.036)
Large animals (Cattle & Buffalos) (10–20 kg/day	Cattle	62593	10	625930	22,533.48
	Buffalos	180527	15	2707905	97484.58
Small animals (Sheep & Goats) (2-4kg)	Sheep	9396	1	9396	338.256
	Goats	7837	1	7837	282.13
Total		**260,353**	**27**	**3,351,068**	**120638.45**

After a brief overview of methodology adopted in present investigation, the forthcoming section focuses on result and discussion.

5. Result and Discussion

On analyzing the available population of livestock, it is observed that district Jhajjar has livestock population of 260353 domestic animals. It includes 62593 cattle, 180527 buffalo, 9396 sheep and 7837 goats. The highest population of large animal buffalo implies that district Jhajjar has largest biogas potential from large animal buffalo which is also a wide milk production support in National Capital Region of Delhi. Hence, it plays a vital role to raise the income of rural population of district Jhajjar. The above estimated animal manure of 3,351,068 kg results in 120638.45 $m^3$of biogas and 150798 kW of electricity.

6.1 Addressing Energy Crisis: Community Owned Community Operated Basis

Energy in diverse form is the primary requirement for human survival in rural Haryana. Mostly farming activities and livestock sector depends directly or indirectly on energy in one or other form. Presently, traditional fossil fuels are mainly used for generation of energy in state of Haryana. In present study, it is proposed to devise self driven energy village from livestock resource for self-sustainable development as decentralized energy source in district Jhajjar. No doubt, massive deployment and use of family size small biogas plants as standalone renewable energy source among rural massive across state play an indispensible role to address energy scarcity and to increase the income of farmer. The deployment of community owned community operated decentralized energy solution in each village of district Jhajjar at each panchyat levels has a promising future for penetrating the deployment of same at grass root level in state. It is most effective and efficient solutions for sustainable waste treatment and management [13].

6.2 Equivalent quantity of different fuel types of effective heat for 1 m^3 of biogas

It is obvious from the literature survey and related work in context of present study that 1 m^3 of bio-gas is having energy content corresponding to 0.62 liter of kerosene oil or can be comparable with 0.43 kg of LPG, can be equivalent to 3.474 kg of firewood, 12.296 kg of cow dung cake 1.17 m^3 of coal gas and alike 4.698 kWh of electricity. The district Jhajjar has a potential of generating manure 351,068 kg/day which results in

120638.45 $m^3$of biogas [9-10]. The estimation of correspondence of biogas production potentials with other fossil fuels is presented in the **Table 2.**

Table 2: Equivalence of Biogas Potentials with other Fossil Fuels [9-10]

Kerosene Oil 0.62 liter	**Electricity (4.698 kWh)**	**Wood (3.474 kg)**	**LPG (043 kg)**
74795.83 liter/day	566759.438 kWh/day	419097.97 kg/day	55493.68/day

7. Conclusion

Indeed, district Jhajjar has vast untapped prospective of cheap, green biogas energy from domestic animals residue. The present study is very valuable and helpful in planning, assessing and mapping of existing potential of available animal waste as resources for utilization in generation of bio-energy and for devising a framework to increase the income of rural population of district Jhajjar. The use of standalone biogas resource will certainly ensure rural energy demands in context of present area of study.

Following inference is drawn from the present study:

- It is evident from the present study that district Jhajjar has potential of animal manure of 3,351,068 kg which results in 120638.45 $m^3$of biogas and 566759 kWh/day of electricity.
- It offer significant employment opportunities and create awareness about the features, and benefit of renewable biogas energy from perspective of households and society as a whole. The mapping of existing potential will certainly reveal numerous waste treatments, social, energy, agricultural, economic and environmental benefits. Undoubtedly, utilization of animal manure as raw material in generation of renewable biogas energy has a positive impact and offer huge opportunity to convert waste into wealth.
- The mathematical computation shows that the 120638.45 $m^3$of estimated biogas production is comparable to and can save 55493.68 kg/day of LPG, alike to 74795.83 liters/day of saving of kerosene oil, equivalent to 419097 kg/day of saving of firewood, equivalent to 566759.438 kWh of electricity.

Thus, utilization of biogas energy offer multitude of benefits leading to decrease in fuel wood consumption and use of bio-fertilizer. The use of bioenergy in cooking and heating as well as vehicle fuel replacing petrol/diesel offer multiple benefits.

Reference

1. Role of Livestock in Indian Economy, retrieved on July 3, 2021 from https://vikaspedia.in/agriculture/livestock/role-of-livestock-in-indian-economy
2. Livestock Population in India by Species, National Dairy Development Board, India retrieved on July 3, 2021 from https://www.nddb.coop/information/stats/pop.
3. About Us, Department of Animal Husbandry & Dairying, Government of Haryana, India, retrieved on July 3, 2021 from http://pashudhanharyana.gov.in
4. Biogas Utilization Programmes in Haryana, Haryana Renewable Energy Development Agency (HAREDA) Akshay Urja Bhawan, Institutional Plot No.1, Sector-17, Panchkula retrieved on July 3, 2021 from https://hareda.gov.in/document-category/bio-gas-program/
5. Detail of Institutional Biogas Plants Installed In Haryana, retrieved on July 3, 2021 from https://hareda.gov.in/document-category/bio-gas-program/
6. Manisha, Institutional Biogas Plants-Present Scenario, Available Capacity and Future Possibilities: A Case Study of Sonepat District in Haryana, DU Journal of Undergraduate Research and Innovation, vol. 3, no.1, pp 43-59, June 2017.
7. Biogas, National Biogas and Manure Management Programme (NBMMP), Biogas Technology Development Division, Ministry of New and Renewable Energy, http://164.100.94.214/biogas
8. Ministry of New and Renewable Energy, Government of India, retrieved on July 3, 2021 from https://mnre.gov.in/
9. Biogas: A fit option for rural energy retrieved on 13th August 20201 https://web.iitd.ac.in/~vkvijay/files/Biogas%20technology.pdf
10. Frequently asked question on biogas technology, Biogas Development and Training Centre, Udaipur College of Technology And Engineering https://www.ctae.ac.in/images/editorFiles/file/CTAE-2017/Biogas%20FAQ_English.pdf.

11. Priyanka Anand, Sarbjeet Kaur Bath, Mohammad Rizwan, "Feasibility analysis of solar-biomass based standalone hybrid system for remote area", American Journal of Electrical Power and Energy Systems, vol 5, pp. 99-08, 2017.
12. Priyanka Anand, Sarbjeet Kaur Bath, Mohammad Rizwan, Design of Solar-Biomass-Biogas based hybrid system for rural electrification with environmental benefits, International Journal on Recent and Innovation Trends in Computing and Communication, vol. 5, no.6, pp. 450 – 456, 2017.
13. Haryana Bio-energy Policy 2018, Haryana Government, New & Renewable Energy Department, Notification, 9th March, 2018 retrieved on July 3, 2021 from https://hareda.gov.in/document/haryana-bio-energy-policy-2018/haryana-bio-energy-policy-2018.