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Research Article

IMPACT OF BIOGAS ON DRUDGERY REDUCTION OF WOMEN IN RAJAPUR AREA PRATAPGARH DISTRICT IN UTTAR PRADESH

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Abstract: Biogas is a form of clean cooking mechanism. Being an established and extensively employed global energy source, it has gained popularity on a global scale. To understand its impact on drudgery reduction of women in rural settings, this study was conducted as the title of "Impact of Biogas on Drudgery Reduction on women in Rajapur area of Pratapgarh district in Uttar Pradesh. The research taken was based on primary source of data. The research findings highlighted the significant pertinence of biogas within rural, agriculture-centric communities. From the viewpoint of women, biogas was recognized to save time and resources, improve health and sanitation conditions, facilitate effortless and sustainable operation, and offer cost-effectiveness coupled with minimal maintenance requirements. The integration of biogas technology notably contributed to alleviating the demanding and unending household tasks that women typically shoulder, thereby easing their burden. Notably, the utilization of biogas plants played a pivotal role in relieving women from their ceaseless household activities and enabling a more balanced lifestyle. The respondents confirmed that biogas is their true friend due to its help to save time, to reduce work-load, to maintain health, and to make a job convenient so Biogas use can helpful to reduce drudgery of women.

Keywords: *Biogas, Rural, Women, Drudgery, Community*

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Introduction

Biogas is a blend of gas, primarily methane and carbon dioxide, produced by bacteria acting on organic materials in an oxygen-free environment. The gas exhibits a smoke-free combustible nature, characterized by a blue flame upon ignition, akin to the combustion properties of liquid petroleum gas [1]. Biogas technology has gained substantial acceptance, even in economically advanced nations like Japan. Additionally, burgeoning economies such as Brazil, India, and China have actively emphasized the significance of biogas technology deployment [2]. Worldwide, more than 1.1 billion individuals reside in areas where electricity remains inaccessible, and nearly 3 billion people are devoid of clean cooking amenities that pose lesser risks to both human well-being and the environment [3].Biogas is a viable source of energy. It is a boon for farmers due to its multiple uses in their livelihood. Through the provision of bio-slurry, a byproduct stemming from biogas generation that is rich in nitrogen content, it contributes to amplifying agricultural output and fostering the creation of numerous environmentally sustainable employment opportunities. It has no bias in terms of caste, class, gender, religion and ethnicity. The average 4m³ biogas systems requires 45 kg dung from four cows or two buffalos and an equal amount of water per day for its operation, and it provides enough biogas to cook for about 2.4 hours. The process of anaerobic digestion yields bio-slurry, a nutrient-rich organic material surpassing the fertilizer value of traditional dung. Singh (2022) [4] in his finding published that buffalo Dairy farms, contribute approximately 15 kg of dung per day per animal, conversely, in Gaushalas, predominantly cows, generate an estimated 10 kg of dung per day per animal. This bio-slurry serves as a valuable resource for crop fertilization, thereby elevating agricultural productivity. Biogas, a plant following an all-natural process called anaerobic digestion to turn waste into clean energy, is a sustainable energy source ideally used for cooking, lighting, heating and electricity generation with zero net greenhouse emissions. Biogas is an eco-friendly sustainable source of renewable energy.

The common conclusion of various reports related to biogas stated that clean cook stoves and fuels have the potential diminishing mortality resulting from illnesses associated with smoke exposure, addressing the impacts of climate change, and mitigating atmospheric pollution to reduce deaths from Smoke-related illnesses, mitigate climate change and lower air pollution. In the project locale, women, typically tasked with overseeing household duties in the kitchen, assume the central role as primary beneficiaries of the biogas utilization [5] .As stated on the official website of the Global Alliance for Clean Cook Stoves, clean cooking stoves and sustainable fuels offer the capacity to decrease fatalities stemming from illnesses associated with smoke exposure, alleviate the impacts of climate change, and diminish the levels of air pollutants in the environment [6].Another advantage is the timely accessibility of cooking fuel precisely when and where it is needed, which is referred to as fuel readiness [7].

Warnars and Oppenoorth (2014) [8] reported use of bio gas leads to augmented income derived from agricultural harvests, while the adoption of biogas technology creates avenues for the creation of women's microenterprises, encompassing ventures like the trade of compost fertilizers and horticultural products, among various other possibilities. Smith (2012) [9] in his project report submitted that the capability of compact biogas digesters to mitigate poverty and enhance the enduring sustainability of ecosystem services in sub-Saharan Africa. Judith Libaisi and Mary Njenga (2018) [10] reported many benefits of Biogas as a Smart Investment for Women's Empowerment and Livelihood Enhancement

Objective of Study

This study has three objectives was to assess the economic impact of the biogas on the household, to assess the health impact & to assess the drudgery-related & other impacts

Material and Methods

The study was taken with 40 households from 23 villages by BAIF Institute for Sustainable Livelihood and Development (BISLD) in the project area during the period from November 2021 to July 2022. This study was taken to explore the relevance of biogas in rural settings through women perspective of 126 biogas plants installed by BISLD. The primary data was collected through face-to-face interviews and observations. Data was collected with minute observations by the field functionaries involved in research. The collected data has been verified, coded, categorized and converted into a master data sheet. The cross-tabulation, simple average and cross-multiplication techniques are used to obtain the optimal number for different parameters.

Result and Discussion

The participants in the study exhibit a diverse range of education levels among the heads of the families who were interviewed. The majority of respondents, accounting for 16 (40%) of the total, have an educational background ranging from class 10 to 12. Following closely, 10 (25%) of the respondents have completed their graduation or hold higher degrees. Moreover, 9 (23%) of the heads of families interviewed are found to be illiterate, while 5 (13%) respondents fall within the education category of 5th to 9th class standard. This wide spectrum of education levels among the surveyed families provides valuable insights into the various educational backgrounds represented within the study. Singh and Ramchandra (2019) [11] in his study showed that the maximum 86.54, 80.28 and 75.68 per cent of respondents were literate of small, medium and large farmers respectively which are adopted non agroforestry system in Prayagraj district

Table-1 Education Level

Particulars	Frequency	Percentage
Illiterate	9	23
from 5th to 9th	5	13
from 10th to 12th	16	40
Graduate and above	10	25
Total	40	100

Indications from the data highlight that a significant portion of the surveyed households, totaling 25 (60%) of the respondents, fall within the Above the Poverty Line (APL) category. Subsequently, 14 (37%) households are categorized as Below the Poverty Line (BPL), while a minor fraction of 1 (3%) household belongs to the Antyodaya card holder category. This distribution underscores the predominant presence of households within the APL bracket, followed by those in the BPL category and the Antyodaya card holder category, thereby offering valuable insights into the economic strata of the respondent households.

Table-2 Economic Level

Particulars	Frequency	Percentage
under Antyodaya	1	3
under BPL	14	37
APL	25	60
Total	40	100

The analysis demonstrates that among the households examined, a considerable proportion of 20 (50%) belong to the general caste category. Subsequently, 18 (45%) households are classified under the Other Backward Class (OBC) category, with a smaller fraction of 2 (5%) coming from the Scheduled Caste (SC) category. This breakdown highlights the predominant presence of general caste households, trailed by those falling within the OBC category and the SC category, thereby providing meaningful insights into the caste composition of the surveyed households.

Table-3 Caste wise categorization

Caste category	Frequency	Percentage
General	20	50
OBC	18	45
SC/ST	2	5
Total	40	100

The research findings reveal that the average family size in the study area is 8 members per family. According to [Table-4], a significant majority of 17 (43%) households have a family size ranging from 5 to 7 members. Following closely, 14 (35%) households have a family size between 10 and 20 members. A smaller portion of 7 (18%) households consists of 2 to 4 members, while merely 2 (5%) households have 8 to 9 members within their families. This distribution underscores that a substantial number of households have family sizes between 5 and 7 members, followed by those with larger family sizes of 10 to 20 members and smaller family sizes of 2 to 4 members. Potdar, *et al*., (2020) [12] reported the average size of family in the sample was 7.66 persons with 4.12 male members and 3.53 female members. Around 48.08%, 47.88%, and 48.65% constituted households with a moderate family size (comprising 5 to 7 members) among small, medium, and large-scale farmers correspondingly, who have embraced non-agroforestry practices within the Prayagraj district.

Table-4 Family size of respondents

Nos. of family members	Frequency	Percentage
2 to 4	7	18
5 to 7	17	43
8 to 9	2	5
10 to 20	14	35
Total	40	100

The participants' reported data indicates that the average herd size per family is 4 animals. As depicted in [Table-5], a majority of 21 (53%) households possess animal herds ranging in size from 2 to 3. Subsequently, 13 (33%) households maintain herds with 4 to 5 animals, while a smaller subset of 6 (15%) households manages animal herds consisting of 9 to 12 members. This distribution underscores that a significant number of households have animal herds of 2 to 3 members, followed by those with herds of 4 to 5 animals and a smaller fraction with herds ranging from 9 to 12 animals. In study by Potdar, *et al*., (2020) [12] number of cows and buffaloes were owned by the farmers of Uttar Pradesh were 1.60 cows & 1.42 buffaloes

Table-5 Animal herd size

Nos. of animal	Frequency	Percentage
2 to 3	21	53
4 to 5	13	33
9 to 12	6	15
Total	40	100

The insights provided by [Table-6] unveil that a substantial 24 (60%) households have chosen agriculture as their primary means of livelihood. Following this, 9 (23%) households are engaged in shop-related activities, while 5 (13%) households are involved in laboratory work. Additionally, 2 (5%) households have taken up milk selling as their primary source of livelihood. Among the surveyed households, a significant 22 (55%) have not pursued any secondary source of livelihood. Among those who have, an equal number of 6 (15%) households have engaged in both agriculture and shop-related activities. Moreover, 4 (10%) households have turned to milk selling, and 2 (5%) households have adopted laboratory work as their secondary sources of livelihood. This distribution underscores the prominence of agriculture as the primary occupation for a majority of households, with various other livelihood options also being pursued to varying degrees.

Table-6 Source of livelihood

Source of Livelihood	Primary		Secondary	
	Frequency	Percentage	Frequency	Percentage
Agriculture	24	60	6	15
Milk selling	2	5	4	10
Laboratory	5	13	2	5
Shop	9	23	6	15
None			22	55
Total	40	100	40	100

Based on the findings in [Table-7], the data reveals that a significant proportion of 16 (40%) households fall within the income range of 50 thousand to 1 lakh. Following this, 11 (28%) households report an income level above 1 lakh. Moreover, 9 (23%) households have an annual income ranging from 27,001 to 50,000, while a smaller contingent of 4 (10%) households falls within the income range of Rs 10,001 to 27,000 per year. This distribution highlights that a substantial number of households have incomes between 50,000 to 1 lakh, with notable percentages falling into higher income brackets above 1 lakh and smaller income brackets of 27,001 to 50,000 and 10,001 to 27,000.

Vikram Singh (2019) findings show annual income of 84.62% respondents majority was found in the low category of (up to Rs. 25000) in small farmers group, 76.06% respondents majority was found in the medium category of (Rs. 26000 - Rs. 50000) in medium farmers group and 54.05% respondents majority was found in the high category of (above Rs. 50000) in large farmers group which are adopted non agroforestry system in Prayagraj district.

Table-7 Income range

Income range per annum (Rs)	Frequency	Percentage
< 10000	0	0
10001 to 27000	4	10
27001 to 50000	9	23
50000 to 100000	16	40
> 100000	11	28
Total	40	100

Significance of Biogas in Terms of Easing Women's Burden

Because of their direct and consistent involvement in biogas-related tasks, women tend to derive greater advantages from these activities compared to other members of the family. As per [Table-8], the data indicates that a significant number of 16 (40%) households previously allocated a meal preparation time of 1 to 1.5 hours. This was followed by 15 (38%) households dedicating 2 to 2.5 hours, and 9 (23%) households taking 3 to 4 hours for meal preparation before the installation of biogas systems. Prior to the biogas installation, none of the households were able to prepare food within the time frame of 0.5 to 0.7 hours. However, post the biogas installation, a considerable majority of 29 (73%) households now spend 1 to 1.5 hours per meal, with 7 (18%) households requiring 2 to 2.5 hours. No households take more than 2.5 hours per meal. The average time spent per meal per household has decreased from 2 hours before biogas installation to 1.3 hours after installation. This reduction in time has resulted in an average daily time saving of 1.4 hours (0.7 hours per meal) for each household.

Table-8 Time spent per meal on cooking before and after biogas

Time spent (in hrs)	Before Biogas		After Biogas	
	Frequency	Percentage	Frequency	Percentage
0.5 to 0.7	0	0	4	10
1 to 1.5	16	40	29	73
2 to 2.5	15	38	7	18
3 to 4	9	23	0	0

[Table-9] illustrates that the time saved is predominantly utilized by 21 (53%) women for engaging in other tasks, followed by 13 (33%) households who use it for relaxation, and 6 (15%) households allocate it to domestic chores.

Table-9 Use of time saved

Particulars	Frequency	Percentage
Domestic work	6	15
Relaxing	13	33
Other work	21	53
Total	40	100

Significance of Biogas in Terms of Women's Health

Prior to the installation of biogas, 33 percent of households reported instances of eye-related problems, while 2 percent of households mentioned issues related to the respiratory system. However, after the implementation of biogas, both types of issues were reported to have been completely eradicated according to the respondents.

Economic relevance of biogas

There is not a direct and immediate economic return from biogas plants; however, it yields indirect benefits for all the involved families in economic terms. The households that were interviewed used LPG cylinders and cow dung for cooking prior to installing biogas. Following the biogas installation, the average monthly savings on LPG cylinder expenses was Rs. 1278/- per household. According to [Table-10], the data indicates that 25 (63%) households managed to save within the range of Rs. 1100 to 1500 per month. Additionally, 11 (28%) households reported savings ranging from Rs. 500 to 1000, while 3 (8%) households saved within the range of Rs. 1600 to 2000. Furthermore, 1 (3%) household achieved savings of Rs. 2280 per month. This distribution demonstrates that a majority of households experienced savings within the Rs. 1100 to 1500 range, reflecting the economic advantage brought about by the use of biogas for cooking. In rural Kenya, among biogas users on average, expenditure on firewood declined from KES 384 to 112 (71%) per household per week equal to annual cost savings of €125 [13].

Table-10 Amount saved by using biogas

Amount saved (in Rs)	Frequency	Percentage
500 to 1000	11	28
1100 to 1500	25	63
1600 to 2000	3	8
2280	1	3
Total	40	100

Prior to the installation of biogas, the average annual expenditure to address health-related issues arising from cooking was Rs. 865/- per household for 15 (38%) households. However, this cost was completely eliminated after the installation of biogas. As shown in [Table-11], before biogas installation, 7 (18%) households reported expenses ranging from Rs. 400 to 600 to address health issues related to cooking. Furthermore, 5 (13%) households reported expenses in the range of Rs. 800 to 1200, and 3 (8%) households mentioned spending between Rs. 100 and 300 on such issues. Following the installation of biogas, no health-related issues due to cooking were reported by any household. This data illustrates the significant positive impact of biogas on improving health and reducing associated expenses among households.

Table-11 Amount saved which was spent to address health issues

Amount spent on health related issues per annum (Rs.)	Frequency	Percentage
0	25	63
100-300	3	8
400-600	7	18
800-1200	5	13
Total	40	100

[Table-12] provides insights into how the saved amounts were utilized by the households. The data shows that a majority of 17 (43%) households allocated the saved funds towards addressing various other family needs. Following this, 14 (35%) households utilized the saved money for saving purposes, while 5 (13%) households used it to deposit school fees. Additionally, 4 (10%) households directed the saved funds towards agricultural work. This distribution highlights the diverse ways in which the saved amounts were allocated, ranging from immediate needs to financial planning and educational support. Dohoo, *et al*., (2013) [13] reported reduced household expenditure on cooking energy.

Table-12 Utilization of saved amount

Particulars	Frequency	Percentage
Depositing school fee	5	13
Agricultural work	4	10
Saving	14	35
Other family needs	17	43
Total	40	100

Social relevance of biogas-

[Table-13] presents the respondents' feedback regarding the social relevance of biogas. The majority of respondents, comprising 29 (73%) individuals, agreed that the biogas system significantly reduced their workload and saved them time. This reduction in workload was particularly beneficial for women, who spent less time on cooking, creating dung cakes, cleaning utensils, and gathering firewood. This newfound free time enabled them to engage in social activities, enjoy entertainment, and stay informed through radio and TV programs. Consequently, the introduction of biogas technology indirectly contributed to the empowerment of rural women, as a significant number of them began to regularly watch TV and listen to the radio during their newly acquired leisure time, thanks to the installation of biogas plants in their households. Furthermore, according to [Table-13], 6 (15%) respondents described the biogas system as excellent in all aspects. This was followed by 3 (8%) households who found it comfortable throughout all seasons, and 2 (5%) households who appreciated the absence of the hassle of refilling LPG cylinders. This distribution highlights the overall positive perception and multifaceted benefits of the biogas technology as reported by the respondents [14].

Table-13 Social relevance of biogas

Particulars	Frequency	Percentage
Comfortable in all season	3	8
Excellent by all means	6	15
No headache of refilling of LPG cylinder	2	5
Reduced work load saves money & time	29	73
Total	40	100

Nearly all women respondents expressed that biogas has shielded them from the harmful effects of smoke, reduced the need for strenuous labor, and eliminated the necessity of making dung cakes. A significant majority of women acknowledged that the installation of a biogas system resulted in an increased frequency of social interactions. This increased interaction enabled women to allocate sufficient time for socialization and active participation in various social activities and meetings. Through their involvement in these activities, women gained confidence and became more assertive in expressing their thoughts and feelings to others. A majority of women respondents also highlighted that the heightened frequency of family interactions has helped them better comprehend their family's challenges and address them promptly. The extra time at their disposal has allowed them to motivate their children with their schoolwork, and they are able to spend more quality time with their family members. These findings underscore the manifold benefits that biogas has brought to women's lives, from improved health and reduced labor to enhanced social engagement and family dynamics.

Environmental Relevance of Biogas in India

In the current Indian context, biogas emerges as a crucial player in addressing pressing environmental challenges. With a burgeoning population and rapid urbanization, organic waste generation has surged, contributing to landfills and emitting harmful gases. Biogas technology offers a timely solution by converting this organic waste into a valuable energy resource while curbing methane emissions. This not only tackles waste management issues but also reduces the strain on landfills and the associated environmental risks. Additionally, in a country still heavily reliant on solid fuels for cooking, biogas provides a cleaner alternative, reducing indoor air pollution and deforestation. As India strives for sustainable development and a cleaner energy mix, the environmental significance of biogas remains undeniable, offering a dual benefit of waste reduction and renewable energy generation.

Conclusion

Women's direct involvement in biogas activities yields them greater benefits compared to other family members. This active engagement alleviates their burdens, significantly reducing their workload. This creates precious time for social pursuits like watching TV, listening to the radio, and interacting with neighbors. Furthermore, biogas adoption reduces smoky kitchen conditions, enhancing cleanliness and diminishing related health risks. The nutrient-rich slurry generated by biogas benefits farmland productivity and family nutrition. Biogas adoption also means economic savings by reducing expenses on fuels like LPG and firewood, enhancing financial stability and environmental care. Importantly, biogas positively impacts women's health, contributing to longer life expectancy by mitigating disease risks. It elevates living standards, creating a healthier and happier household atmosphere. This visible impact has inspired neighboring households to embrace biogas systems, illustrating its community-enhancing potential.

Application of research: Study of Impact of biogas on drudgery reduction on women and dairy farmers as a drudgery reduction programme

Research Category: Agricultural extension

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Study area / Sample Collection: Rajapur Area Pratapgarh District, Uttar Pradesh

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