

**CONSEQUENCE OF BIOGAS: A CASE STUDY OF
DHAIJAN VDC OF JHAPA DISTRICT, NEPAL**

A Thesis

Submitted to:

**Central Department of Rural Development
Tribhuvan University Kritipur, in Partial Fulfillment of the
Requirement of the Degree of Master of Arts in Rural Development**

Submitted By

Shambhu Dahal

Symbol No: 281576

Registration No: 6-3-28-1372-2008

**Faculty Humanities and Social Science
Central Department of Rural Development,
Tribhuvan University**

Kritipur, Nepal

February, 2016

LETTER TO RECOMMENDATION

It certified that **Mr. Shambhu Dahal** has completed his thesis on the topic **Consequence of Biogas: A Case Study of Dhaijan VDC of Jhapa District, Nepal** under my guidance and supervision. I recommend this dissertation for final approval and acceptance.

Approved by

Prof. Dr. Riddi Bir Singh

(Thesis Supervisor)

Central Department of Rural Development

Faculty of Humanities and Social Science

Trivhuban University, Kritipur, Kathmandu

Nepal

Date: 2072-10-28
(11 Feb 2016)

DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief. It contains no materials previously published or written by another person nor material which to substantial extent has been accepted for the award of any other degree of a university or other institutions of other higher learning expect where due acknowledgements is made in the acknowledgements.

Shambhu Dahal

ACKNOWLEDGEMENTS

This thesis has been prepared to fulfill partial requirement for the degree of Master of Arts in Rural Development of Tribhuvan University. For this, I would like to acknowledge Central Department of Rural Development for giving me such a valuable opportunity to use the theoretical knowledge in the practical field. I would like to express my gratitude to all those people who encouraged as well as helped me in completing this research work.

First of all, I am deeply indebted to my honorable teacher and thesis supervisor Prof. Riddi Bir Sing, for all the inspiration, valuable suggestions and proper guidelines that I received from him during the course of my study in general and this thesis work in particular. I particularly appreciate his student-friendly and cooperative nature without which this piece of work would have never been completed.

I would be selfish if I did not give full credit to all the honorable professors and lecturers who whole-heartedly contributed to building my sound academic career. My education would have been incomplete if I had not received proper guidance and direction from these distinguished and honorable people.

I thank all the non-teaching staff of the Central Department of Rural Development specially the library staffs, for all kinds of help and support they extended to me during the course of my study and thesis work. I heartily thank all staffs of the Dhajjan VDC, Jhapa, who provide me the valuable information's regarding to the thesis work and all the people who heartily participated in the process of the thesis work time and again despite of their hectic schedule.

I further acknowledge my gratitude to my respected parents (father Mr. Laya Prasad Dahal and mother Mrs. Gyanu Dahal), Sisters Gita Dahal, Radhika Dahal, Bimala Dahal, sister in law Bharat Khatiwada and my lovely wife Kabita Dahal and other members of the family, whose care and continuous support during my study encouraged and strengthened me to complete this work.

Last but not least, I would like to express my sincere gratitude towards my friends Madhav Ojha, Dayaram Khadka, Rahul Parajuli, Rabin Parajuli and Tej Raj Aryal for their help and support of different kinds to complete this thesis.

Shambhu Dahal

ABSTRACT

The study entitled 'consequence of biogas' is the study to find out the extent to which biogas has substituted the use of firewood and petroleum products in household use and the contribution of biogas to time saving through the qualitative information in Dhaijan VDC of Jhapa district. This study aims to examine the socio-economic and environmental impact of biogas on household use and also to calculate the payback period for the biogas installation..

The field work was based on structured questionnaire and focus on group discussion in Dhaijan VDC of Jhapa District among representative biogas households. Mostly the primary data was used for finding overall impact of biogas. The methodology also incorporated the processing and analysis of data..

Most of the households get benefits by installing the biogas plant and the major purpose of using biogas is for cooking. The non burning of fuelwood due to use of biogas provided an annual saving of NRs 8476 per household and similarly saving of NRs 2392.5 in terms of LP gas. Less time required for cooking food, smokeless technology for cooking , saving of 1.5 hour time and increase social status of the biogas households are noticeable benefits of biogas plant installation. Almost all biogas plants were operational and incurred less repair and maintenance cost, however the knowledge about appropriate use and not included bio-slurry calculation causing a high payback period of the biogas plant installation (7.91years).

Based on the study, the installation of biogas plant as an alternative energy source could be best option for rural community of Nepal . Slurry utilization prospects and use of biogas for lighting should be promoted to enhance beneficial aspect of biogas and reduce payback period of biogas installation.

TABLE OF CONTENTS

	Pages
Declaration	I
Letter of Recommendation	II
Approval Letter	III
Acknowledgements	IV
Abstract	V
Table of contents	VI-IX
List of Tables	X-XI
Abbreviations	XII-XIV

CHAPTER –I

INTRODUCTION	1-10
1.1 Background	1
1.2 Statement of the Problem	5
1.3 Objective of the Study	6
1.4 Significance of the Study	6
1.5 Limitations of the Study	7
1.6 Research Questions	7
1.7 Operational Definitions and Assumptions	8
1.7.1 Biogas Technology	8
1.7.2 Biogas Project	8
1.7.3 Description of GGC 2047 Model:	9
1.7.4 Potentiality of Biogas in Nepal	9
1.7.5 Summary of some operational assumptions used	10

CHAPTER –II **11-23**

LITERATURE REVIEW	11
2.1 Theoretical Review	11
2.2 Empirical Review	13
2.3 Traditional Biomass Fuels in Energy Use	18

2.4 Adverse Impact Related With Traditional Biomass Fuel	18
2.5 Benefits of Biogas	19
2.5.1 Benefits from Replacement of Firewood	19
2.2.2 Benefits of Biogas on Health and Sanitation	20
2.5.3 Time Saving and Workload Reduction	20
2.5.4 Benefits of Bio-slurry	21
2.5.5 Economic Benefit	21
2.6 GHG Reduction	21
2.7 CDM Approach	22
2.8 Investment Aspect and Payback Period	22
2.9 National Policies and Action Plan	23
CHAPTER –III	25-28
RESEARCH DESIGN AND METHODOLOGY	25
3.1 Research Design	25
3.2 Description of the Sample	25
3.2.1 Sample design	25
3.2.2 Sample Size	26
3.2.3 Sample and Population Distribution	26
3.3 Data Collection Procedure and Time Frame	26
3.3.1 Primary Data Collection	26
3.3.1.1 Household Survey	27
3.3.1.2 Focus Group Discussion	27
3.3.2 Secondary Data	27
3.4 Analysis Plan	27
3.4 Validity and Reliability	28
CHAPTER –IV	29-61
RESULTS AND DISCUSSION	29
4.1 Introduction of the Study Area	29
4.2 Socio-Economic Characteristics	30

4.2.1 Categorization of Ethnicity/Caste	30
4.2.2 Population Distribution of Household Heads by Ethnicity and Sex	31
4.2.3 Occupation of Household head by Ethnicity /Caste	31
4.2.4 Distribution of Households by Family Size	32
4.2.5 Educational Status of Sample Population	33
4.2.6 Total Income Distribution among Households by Ethnicity	34
4.2.7 Frequency Distribution of House Type by Ethnicity	35
4.2.8 Ownership of Physical Assets by Ethnicity	37
4.2.9 Distribution of Cattle among the Sampled Household	40
4.3 Landholding Pattern	41
4.3.1 Landholding Size by Ethnicity	41
4.4 Uses and Benefits of Biogas Plant	42
4.4.1 Reasons for Installing Biogas Plants	43
4.4.2 Motivating Factors for the Biogas Plant Installation	44
4.4.3 Size of the Plant	44
4.4.4 Use of Biogas	45
4.4.5 Saving of Firewood	46
4.4.6 Saving of LP Gas after Biogas Installation	52
4.4.7 Saving of Kerosene after Biogas Installation	52
4.4.8 Cooking Time	52
4.4.9 Cleaning of Vessels	53
4.4.10 Saving of Time in Collection of Firewood	54
4.4.11 Calculation of Payback Period	54
4.4.12 Perception of Biogas Household on Biogas	55
4.5 Discussions	56
4. 5.1 Impact on Household Activities	56
4.5.2 Environmental Impact	56

4.5.3 Social Benefit	57
4.5.4 Economic Benefit	58
4.5.5 Investment Aspect and Payback Period	58
4.5.6 Positive Impacts of Biogas	59
4.5.7 Negative Impacts of Biogas	60
4.5.8 Operation of Biogas Plant	60
CHAPTER-V	62-66
SUMMARY AND CONCLUSIONS	62
5.1 Summary	62
5.2 Conclusion	63
5.3 Recommendations	64

LIST OF TABLES

		Pages
Table 2.1	Substitution Effect of Biogas Produced from Various Plant Sizes	14
Table 3.1	Sample and Population Distribution of Households	26
Table 4.1	Composition of Sample Population by Ethnicity and Sex	30
Table 4.2	Sample Population Distribution of Household Heads by Ethnicity and Sex	31
Table 4.3	Occupation of Sampled Household Heads by Ethnicity	31
Table 4.4	Distribution of Households by Family Size	32
Table 4.5	Educational Status of Sample Population by Ethnicity	33
Table 4.6	Total Income Distribution among Households by Ethnicity	34
Table 4.7	Frequency Distribution of House Type by Ethnicity	35
Table 4.8	Status of Separate Animal Shed in the Sampled Households	36
Table 4.9	Ownership of Agriculture Tools by Sampled Households	37
Table 4.10	Ownership of Vehicles by Sampled Households	38
Table 4.11	Ownership of Telecommunication Instruments by Sampled Households	39
Table 4.12	Distribution of Cattle among the Sampled Households	40
Table 4.13	Classification of Cattle	40
Table 4.14	Landholding Status of Sample Population by Ethnicity	42
Table 4.15	Reasons for Installation of Biogas Plant	43
Table 4.16	Motivating Factors for the Biogas Plant Installation	44
Table 4.17	Different Sizes of Plant	45
Table 4.18	Use Pattern of Biogas	45
Table 4.19	Consumption of Firewood Before and After Installation of Biogas Plant	46
Table 4.20	Impact of Biogas on Firewood Consumption	47
Table 4.21	Ethnicity-Wise Saving of Firewood after Installation of Biogas Plant	48
Table 4.22	Saving of Firewood after Installation of Biogas Plant according to Land Holding	49
Table 4.23	Saving of Firewood according to Household Size	50
Table 4.24	Saving of Firewood after Installation of Biogas According to Number of Cattle	51

Table 4.25	Annual Saving of LP Gas after Biogas Installation	52
Table 4.26	Required Time for Cooking Before and After Installation of Biogas per Day	53
Table 4.27	Required Time for Cleaning of Vessels before and After Installation of Biogas per day per Family	53
Table 4.28	Calculation of Payback Period	55
Table 4.29	Perception of Biogas Households on Biogas	56

ABBREVIATIONS

AD	Anno Domini
ADB/N	Agriculture Development Bank
AEPC	Alternative Energy Promotion Centre
ARI	Acute Respiratory Infection
Avg.	Average
BDC	Biogas Development Committee
BGC	Biogas Companies
BSP	Biogas Support Programme
CBOs	Community Based Organization
CBS	Central Bureau of Statistics
CDM	Clean Development Mechanism
CDMA	Code Division Multiple Access
CER	Certified Emission Reduction
CES	Centre for Energy Studies
CF	Community Forest
CFC	Chloro Floro Carbon
CFUG	Community Forest User Group
CMS	Consolidated Management Services Nepal (P) Ltd
CO ₂	Carbon di Oxide
Consm.	Consumption
cu. m.	Cubic Meter
DCS	Development and Consulting Services
DDC	District Development Committee
Dev.Part.	Development Partners Consultancy (P) Ltd.
EDR	Eastern Development Region
e.g.	For example
etc.	Etcetera
ERPA	Emission Reduction Purchase Agreement
ESAP	Energy Sector Assistance Program
Exp.	Expenditure/Expenses
FY	Fiscal Year
g-C	Gram Carbon

GDP	Gross Domestic Product
GGC	Gobar Gas Company
GHG	Greenhouse Gas
GoN	Government of Nepal
ha	Hectare
HDI	Human Development Index
HHs	Households
HHH	Head of Household
HMG	His Majesty Government
hrs.	Hours
IEIA	Integrated Environment Impact Assessment
IoE	Institute of Engineering
inc.	Income
INGO	International Non Governmental Organization
kg.	Kilogram
km.	Kilometre
LDCs	Least Developed Countries
LPG	Liquefied Petroleum Gas
Ltd.	Limited
MDG	Millennium Development Goal
MoF	Ministry of Finance
MoST	Ministry of Science and Technology
m ³	Cubic Metre
NGO	Non-Government Organization
NHRC	Nepal Health Research Council
NLSS	Nepal Living Standard Survey
No.	Number
NPC	National Planning Commission
NRs.	Nepalese Rupees
PAF	Poverty Alleviation Fund
PRSP	Poverty Reduction Strategy Paper
REDP	Rural Energy Development Programme
REPPON	Renewable Energy Perspective Plan of Nepal
Rs.	Rupees

RUDESA	Rural Development Study Associates
RWEP	Rural World Energy Programme
SLC	School Leaving Certificate
SNV/N	Netherlands Development Organization in Nepal
sq.	squared
St.	Saint
TU	Tribhuvan University
TV	Television
US\$	United States Dollar
UNDP	United Nations Development Program
VDC	Village Development Committee
VER	Verified Emission Reduction
WB	World Bank
WECS	Water and Energy Commission Secretariat
WHO	World Health Organization
Yr.	Year