

The Nepal Biogas Support Program:
A Successful Model of
Public Private Partnership
for
Rural Household Energy Supply



Written by:
Sundar Bajgain
Indira (Sthapit) Shakya
Edited by:
Matthew S. Mendis

**THE NEPAL BIOGAS SUPPORT PROGRAM:
A SUCCESSFUL MODEL OF
PUBLIC PRIVATE PARTNERSHIP
FOR
RURAL HOUSEHOLD ENERGY SUPPLY**

Written by:

Sundar Bajgain
Indira (Sthapit) Shakya

Edited by:

Matthew S. Mendis

The Nepal Biogas Support Program:
A Successful Model of
Public Private Partnership For
Rural Household Energy Supply

Written by: Sundar Bajgain
Indira (Sthapit) Shakya

Edited by: Matthew S. Mendis

Copyright 2005

ISBN: 99946-32-31-0

This publication has been prepared with financial support from the Ministry of Foreign Affairs of the Netherlands. The views expressed in this publication are entirely those of the authors and should not be attributed in any way to the Ministry.

Published by: * Ministry of Foreign Affairs. The Netherlands
* SNV-Netherlands Development Organisation
* Biogas Sector Partnership – Nepal

Printed in: Repro Vision Press Pvt. Ltd., Kathmandu, Nepal
e-Mail: repro@wlink.com,np

FOREWORD

Biogas in Nepal has had a long, eventful history. Started in the 1980s as a technological research project with a limited number of test models, it was expanded during the 1990s by the Biogas Support Program into a very successful market development program with the active involvement of the business community.

Over the last 13 years, more than 140,000 biogas installations have been built and the sector now comprises 62 local companies and employs about 11,000 people.

Just as important however, is the story of a woman who said that she had stopped cooking because she could not tolerate the smoke any longer, Now that she has installed a biogas system, cooking is no longer a problem, her house does not fill up with smoke and she can breathe normally 'while preparing food. The two hours or more women usually have to spend gathering firewood has been reduced to the time needed to feed the biogas system with animal dung, usually no more than fifteen minutes a day,

Not only the national economy and women have profited from the Biogas Support Program. The impact on the local and global environment has also been beneficial. Far fewer trees are being felled and each biogas installation avoids about 4.6 tonnes of CO₂ emissions a year, which helps to reduce the greenhouse effect,

The success of the Biogas Support Program is the success of a great variety of organisations in Nepal that have joined efforts: the government, business community, civil society organisations, financial institutions and the Netherlands Development Organisation (SNV) a partnership to be proud of. This success has prompted me to further expand the partnership idea to countries like Vietnam. Since early 2004, more than 12,000 installations have been built there and the conditions are right to ensure that the project is as successful as the one in Nepal. It is encouraging to see that people from Nepal are travelling to Vietnam to help during the setting-up of the program.

I am confident that the dissemination of biogas will expand even more in Nepal and the region.

Agnes van Ardenne

Minister for Development Cooperation

The Government of the Netherlands

FOREWORD

In 1992 the Government of Nepal together with the Netherlands Government engaged support activities to promote the use of biogas in Nepal. The Biogas Support Program (BSP) was initiated by the Netherlands Development Organisation, SNV, with the objective of promoting a wide-scale use of biogas as a substitute for fuelwood, agricultural residues, animal dung and kerosene that are generally used for cooking and lighting in most rural households. The rising demand for fuelwood, agricultural residues and dung, by the rapidly increasing population of Nepal, has accelerated the rate of deforestation, soil degradation and environmental decline in the densely inhabited areas of the country. In addition, use of biomass fuels and kerosene has significantly affected the health, welfare and safety, especially of women and children who are most often subjected to the smoke and toxic fumes associated with the use of these fuels and are also subjected to personal danger when alone collecting biomass fuels,

In the last decade, the promotion of biogas in Nepal has resulted in significant social and financial benefits. The technical adaptation of biogas systems, designed specifically for Nepalese conditions, has made remarkable progress during the past decade, and the outlook is excellent for continued improvements and expanded use. Biogas is making an increasing contribution in meeting the cooking and lighting energy needs of the rural population as well as enhancing agricultural output as a result of using the slurry from the biogas digester as fertiliser. The widespread adoption of biogas technology in Nepal is due to its modular and easy to construct design, its proven reliability, the immediate noticeable benefits and the long term financial incentives provided by the Government and donors, the Netherlands Government and the Federal Republic of Germany, to make the biogas systems affordable for the rural farmers. The early involvement and active entrepreneurship of the private sector has been crucial to the success.

The Alternative Energy Promotion Centre (AEPC) was created in 1996 to accord higher priority to the renewable energy resources; biogas is one of them. AEPC's mission is to help overcome the impediments and constraints in commercialising renewable energy technologies in Nepal. AEPC wishes to express its deep gratitude to the Netherlands Government for the ongoing assistance provided through SNV for the BSP in Nepal. Special gratitude is also extended to the Federal Republic of Germany for providing additional support through the German Development Bank (KfW) for the implementation of the third phase of the BSP. The success is clearly evident as more than 100,000 biogas systems have already been installed in various parts of the country, and as a result, the quality of life of the families in these households has significantly improved. The importance of the biogas sector is now present recognised at all levels of His Majesty's Government and a target is set to install 200,000 biogas systems during the Tenth Five Year Plan (March 2002 to 2007).

AEPC is grateful to all the persons associated with the BSP and to the biogas companies for their unrelenting dedication, without which the biogas program would not have been successful. AEPC also expresses sincere appreciation to all the persons, national and international, involved in the initiation of the biogas program.

This compilation of information on the accomplishments of the BSP has been presented in a comprehensive manner. We like to recommend this publication, issued by the Ministry of Foreign Affairs of the Netherlands and SNV/BSP for reading by a wider audience of organisations and individuals in the development community. We hope that the information presented in this document helps other organisations and individuals, involved in rural energy development to learn from the lessons of the BSP and we hope this helps in the overall development process,

Madan Bahadur Basnyat

Executive Director

Alternative Energy Promotion Centre

Ministry of Environment, Science and Technology

His Majesty's Government of Nepal

ACKNOWLEDGEMENT

This publication is based on the results and experiences of the Biogas Support Program initiated and supported by the Governments of Nepal, Germany and the Netherlands. Since the inception of the Biogas Program in 1992 the Netherlands Development Organisation, SNV has been supporting financially as well as technically. Their continuous and unrelenting support has today revealed significant social and financial benefits for the Nepalese rural population. Besides the multiple benefits accrued at each level of the program, the publication focuses upon the role of all the important stakeholders, in particular the biogas companies that have assisted in attaining the confidence of the users and donors. The lessons learned from this program are immense and have earned accolades both nationally and internationally. Undoubtedly, this Program can provide directions for other development activities in the country and abroad, it has been an honour as well as pleasure for us to bring out this valuable publication. This is also a moment to express sincere gratitude to all concerned organisations and individuals for the valuable support they have enthusiastically provided in various ways.

We are especially indebted to Mr. Huub Peters, Natural Resources Management Practice Leader from SNV/Nepal for the extensive collaboration in the course of editing this volume. Besides, we would also like to extend them to other persons at SNV/Nepal, Mr. Sjoerd Nienhuys, Senior Energy Advisor, Mr. Willem Boers, Biogas Advisor and Ms. Subarna Rai, Natural Resources Management Advisor, our sincere appreciation for their valuable contribution in synthesising the experiences and benefits of the Program.

Mr. Jan de Witte, former Director of SNV/Nepal, was very supportive of the BSP and was instrumental in the creation of the NGO, Biogas Sector Partnership, Nepal. He was also fundamental in illustrating the Biogas Program to the world as the best practice of Nepal. We therefore remain indebted to Mr. Jan de Witte for all his endeavours,

Last but not the least, we express our thanks to all the staff at the Biogas Sector Partnership-Nepal for their extensive assistance throughout the preparation of this publication.

Sundar Bajgain (author)
Indira (Sthapit) Shakya (author)

Matthew Mendis (editor)

EXECUTIVE SUMMARY

Biogas was first introduced to Nepal on an experimental basis in 1955. The initial experiences showed the feasibility of this technology for meeting a significant portion of rural household energy needs. The Nepal Biogas Support Program (the BSP) is a successful model of development cooperation, technological innovation, financial engineering and market development that have helped address some of the social, economic, energy and environmental needs of the rural areas of Nepal. The BSP also represents a working partnership between His Majesty's Government of Nepal (HMG/N), the Dutch Development Cooperation (DGIS), the German Financial Cooperation through the German Development Bank (KfW), the Agricultural Development Bank of Nepal (ADB/N), the Netherlands Development Organisation (SNV), the Gobar Gas Company (GGC), the private sector of Nepal and the rural farmers of Nepal. As a result, there are a number of lessons to be learned from the BSP that can be applied to other development assistance programs targeted at the dissemination of small-scale rural and renewable energy technologies,

The principal objective of the BSP is to promote the wide-scale use of biogas as a substitute for wood, agricultural residues, animal dung and kerosene that are presently used for the cooking and lighting needs of most rural households. The rising demand for fuelwood, agricultural residues and dung, by the rapidly increasing population of Nepal, has helped accelerate the rates of deforestation, soil degradation and environmental decline in the densely inhabited areas of Nepal. In addition, use of biomass fuels and kerosene has significantly impacted the health and welfare of especially women and children who are most often subjected to the smoke and fumes associated with the use of these fuels.

Within the three phases, the BSP has successfully constructed 111,395 biogas systems. This compares to only 6,000 units that were installed at the initiation of the Program in July 1990. With this number of systems installed it has provided benefits to 650,000 members of rural households. This substantial increase in the deployment of biogas systems has been accomplished while simultaneously reducing the costs and increasing the reliability and efficiency of biogas systems.

The BSP has helped open the market for the production and sale of biogas systems in Nepal. At the initiation of the Program there was essentially only one state-owned company, the Gobar Gas Company, producing biogas systems. At the end of Phase III in July 2003, as a direct result of the market Development program, 39 private companies besides GGC had entered into this business. All participating companies must meet strict production quality and service standards for their biogas systems to be eligible to receive the subsidy that is provided to farmers. As a result of the growing competition, technical design modifications and enforced quality control measures, the biogas systems have gained client satisfaction and become an example of a self-promoting technology.

One of the important features of the BSP has been its innovative financial engineering and judicious application of consumer subsidies to help develop the market for biogas systems. Working with the ADB/N, and more recently the Nepal Bank Limited (NBL) and the Rastriya Banijya Bank (RBB), a loan and subsidy program was structured that is targeted at supporting the small and medium-scale rural farmers. The financial support program has been a very critical element in developing the commercial market for bio-gas plants in Nepal. The subsidy, fixed at three levels (for the Tarai, Hill and Remote Hill Districts), at present represents approximately 35 percent of the total cost of the biogas system. As the amount of subsidy is fixed, its relative contribution to the total price of the biogas system is expected to decline with rising inflation in the economy of Nepal. The objective over the program period has been to eventually decrease the dependency of the biogas program on subsidy.

The program has also strengthened the Institutional support for the development of the biogas market. Specifically, it has helped HMG/N establish an apex body, the Alternative Energy Promotion Centre, to support biogas and other alternative energy applications in Nepal. Additionally, the establishment and activities of the Nepal Biogas Promotion Group (NBPG), an association of companies that produce biogas system, were supported. The BSP has also assisted in the formation of a NGO Coalition for Biogas and Alternative Energy Promotion. This coalition could be instrumental from their grass-roots access to rural farmers to help disseminate biogas systems to eligible farmers. With the support from its partners the BSP has provided technical backstopping; it has developed and implemented strict quality control measures and standards. Regular monitoring and evaluation of the biogas program, capacity building in coordination with key partners have been the strong backbone of the Program, Advisory and counselling for the biogas construction companies on good business practices, Institutional support, establishment of extension services and other related business have helped in the overall development of the Program. Some of the BSP's major activities are: strengthening the capacity of the biogas construction companies and collaborating with the private sector, to help provide subsidies and low-interest financing options so that poor farmers can afford to buy a biogas system, training for successful operation and maintenance of biogas system and guarantee of after sales service to ensure the success of biogas technology in Nepal.

Biogas systems provide multiple benefits at the household, local, national and global level. The key benefits are related to gender, environment, health and institutional strengthening. The monetary values of most of these benefits are not quantifiable. However, the financial and economic analysis of the costs and benefits that are quantifiable clearly demonstrate the value of biogas systems and the BSP. The Financial Internal Rate of Return (FIRR) for an average size (6-m³) biogas system is estimated at 21 percent in the Hills and 16 percent in the Tarai. The FIRR is very sensitive to the price of fuelwood, which is estimated to be NRs 2.0/kg in the Hills

and NRs 1.5/kg in the Terai, in the base case. The FIRR is reduced by 50 percent when the price of fuelwood is reduced by half and rises to nearly 100 percent when the price of fuelwood is doubled. The Economic Internal Rate of Return (EIRR) for the biogas system is 30 percent in the base case.

An economic analysis of the entire BSP I, II & III results in an estimated EIRR of 35 percent when only the benefits of fuelwood and kerosene savings are accounted for. If the benefits of saved labour are added, the EIRR rises to 41 percent. Adding the total value of the nutrients saved increases the EIRR to 53 percent. Including the conservative estimates for the health benefits of smoke reduction (US\$ 4.86/household/yr) increases the EIRR to 56 percent. Finally, adding the value of the reduced carbon provides an EIRR of 68 percent. It is clear that there is a strong justification for the limited subsidy provided for the biogas system and the grant support provided. Without the subsidy support for the biogas system, it is unlikely that the Nepalese farmers would have sufficient financial incentives to adopt the biogas system. Without the grant support for the BSP, it is certain that the standards, quality and dissemination rates for biogas systems in Nepal would not have risen,

The acceleration of biogas dissemination in Nepal will face a number of challenges such as developing a viable business plan with medium and long term vision, raising revenues to finance the management operations of the BSP, and seeking alternatives for subsidy support to ensure affordability and quality control. These include the need to further stimulate market demand for biogas systems, strengthen Nepalese biogas institutions, bolster the private sector biogas firms, maintain high quality standards and reduce the relative input of the financial subsidy given to farmers.

In conclusion, the BSP has been a very successful and beneficial endeavour for Nepal. The program has successfully commercialised and increased the use of an indigenous renewable and sustainable energy resource. The SNV/BSP has positively affected the lives of the poor and especially women and children in the rural areas. The SNV/BSP has improved the social and environmental conditions of thousands of rural families. Finally, the SNV/BSP has provided a number of important lessons regarding implementation for other alternative energy initiatives in Nepal and in other developing countries, in addition to these general points, one of the most important achievements of the SNV/BSP is the sense of ownership it has managed to generate amongst the stakeholders. This achievement cannot be minimised, as it is a key factor in the overall success of the BSP.

ACRONYMS

ADB/N	Agriculture Development Bank of Nepal
AEPC	Alternative Energy Promotion Centre
BCC	Biogas Coordination Committee
BMZ	Bundes Ministerium für Wirtschaftliche Zusammenarbeit und Entwicklung
BSP	Biogas Support Program
BSP-N	Biogas Sector Partnership-Nepal
CBS	Central Bureau of Statistics
CDCF	Community Development Carbon Fund
CDM	Clean Development Mechanism
CER	Carbon Emissions Reduction
CO	Carbon Monoxide
CO ₂	Carbon di Oxide
DA	Daily Allowances
DCS	Development and Consulting Services
DDs	Development Districts
DGIS	Directorate General for International Cooperation, (Ministry of Foreign Affairs, the Netherlands)
DoA	Department of Agriculture
HRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
FY	Fiscal Year
GDP	Gross Domestic Production
GGC	Gobar Gas Company
GHG	Green House Gas
GI	Galvanised Iron
HCHO	Formaldehyde
HDP	High Density Polythene
HH	Household
HMG/N	His Majesty's Government of Nepal
IAP	Indoor Air Pollution
ISO	International Standard Organisation
IUCN	The World Conservation Union
INGO	International Non Governmental Organisation
IEIA	Integrated Environmental Impact Assessment
KfW	Kreditanstalt für Wiederaufbau (German Development Bank)
Km	Kilometer
Km ²	Square Kilometers
kgoe	kilogrammes of oil equivalent

KVICI	Khadi and Village Industries Commission, India
LPG	Liquid Petroleum Gas
m ³	Cubic Metres
m.a.s.l.	Metres above sea level
M&E	Monitoring and Evaluation
MFI	Micro Finance Institute
MoF	Ministry of Finance
MoEST	Ministry of Environment, Science and Technology
NBL	Nepal Bank Ltd
N8PG	Nepal Biogas Promotion Group
NDP	National Development Plan
NGO	Non Governmental Organisation
NPC	National Planning Commission
NPK	Nitrogen Potash and Phosphorus
NRB	Nepal Rastra Bank
NRs	Nepalese Rupees
NTFP	Non-Timber Forest Product
O&M	Operation and Maintenance
QC	Quality Control
R & D	Research and Development
RBB	Rastriya Banijya Bank
RBCC	Regional Biogas Coordination Committee
REDP	Rural Energy Development Program
RET	Renewable Energy Technology
RSP	Respirable Suspended Particulate
SEP	Slurry Extension Program
SNV	Netherlands Development Organisation
SWAP	Sector Wide Approach
TA	Technical Assistance
†CO ₂ e	Tons of Carbon di Oxide equivalent
UMN	United Mission to Nepal
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value Added Tax
VDC	Village Development Committee
WB	World Bank
WHO	World Health Organisation

TABLE OF CONTENTS

Foreword	i
Foreword	II
Acknowledgement.....	iv
Executive Summary.....	v
Acronyms	viii
Chapter 1 Introduction to Biogas in Nepal	1
1.1. Geography and demography.....	2
Geography.....	2
Demography.....	4
1.2. Social and economic factors.....	4
Social	4
Economic	4
1.3. Nepals national / rural energy scenario	6
1.4. Biogas as rural renewable energy.....	7
1.5. Potentials of biogas in Nepal	8
Chapter 2 Key indicators of SNV/BSP's success	9
2.1. Client satisfaction	9
2.2. Number of operating systems	10
2.3. Principal uses of biogas (cooking, lighting)	12
2.4. Number of approved biogas construction companies	12
2.5. Number of operating appliance producers.....	13
2.6. Number of persons employed by the biogas sector.....	13
2.7. Capacity building	14
2.8. Awards and recognitions	14
Chapter 3 Principal success factors	15
3.1. Supportive government policy	15
3.2. Key elements of donor support	16
Long-term donor commitment	16
Technical assistance for institutional strengthening and product research and development.....	16
Credit support for financing the purchase of biogas systems by poor farmers.....	16
Subsidy support for making biogas systems affordable to poor farmers	16
3.3. Collaboration between international organisations.....	17
3.4. Implementation / institutional strategy.....	17
3.5. Technology design approach.....	19
Dissemination of biogas technology.....	21

	Institutional development and strengthening	21
	Provision of credit and subsidy	21
	Deliver quality product.....	22
	Training of users	23
	Guarantee of after sales service	23
	Participation fee collection	23
3.6.	Successful programme management during conflict.....	23
Chapter 4 The Role of key SNV/BSP stakeholders.....		25
4.1	The institutional framework.....	25
4.2.	Donors	26
4.3.	HMG/N ministries/agencies	26
4.4.	Finance institutions	26
4.5.	Implementing agencies	27
4.6.	Private sector / biogas companies & appliance producers.....	27
4.7.	NGO support for the Biogas Program.....	28
Chapter 5 Principal benefits of biogas systems		29
5.1.	Social benefits	29
	Health benefits	29
	Education	30
	Impacts on poverty.....	30
5.2.	Gender benefits and costs	31
5.3.	Environmental benefits	33
	Local environmental benefits.....	33
	National environmental benefits.....	33
5.4.	Global environmental benefits	34
Chapter 6 Financial and economic assessment.....		35
6.1	Benefits from reduced use of fuelwood	35
6.2.	Benefits from use of agricultural residue	35
6-3.	Benefits from reduced use of dung	36
6.4.	Benefits from reduced use of kerosene	36
6.5.	Benefits from reduced use of chemical fertilisers	37
66	Financial analysis	37
	Financial analysis of 6m ³ system in the Hills and Tarai	38
6.7	Economic analysis	39
6.3	Economic analysis of entire SNV/BSP	41
Chapter 7 Challenges and opportunities		43
7 1	Program challenges BSP-IV	43
	Reaching the poor and remote rural populations	44
	Monetising the GHG benefits for BSP-N	44
	Reducing costs and increasing benefits	45

	Promoting biogas in higher altitudes.....	45
7.2.	Maintaining quality standards	45
7.3.	Strengthening private sector biogas producers	46
7.4.	Accelerating market demand.....	46
7.5.	Financing the operations of BSP-IV	46
7.6.	Sustaining the BSP without donor support.....	47
7.7.	Transforming the BSP into a local operating agency	47
7.8.	Alternative options for subsidy support	47

Chapter 8 Lessons learned..... 49

REFERENCES 52

ANNEX - 1:	Chronology of biogas development In Nepal.....	53
ANNEX - 2:	Subsidy rates over the SNV/BSP period	54
ANNEX - 3:	Financial assessment of 6m ³ system.....	55
ANNEX - 4:	Data for financial and economic assessment of 6 m ³ System	56
ANNEX - 5:	Data on expenditure for TA and capital for SNV/BSP.....	57

List of tables

Table 1.1:	Main features of the three ecological regions of Nepal	2
Table 2.1:	Employment by category.....	13
Table 3.1:	Donor wise share on subsidy contribution	17
Table 5.1:	Time impact of a biogas system for a typical rural household.....	31
Table 5.2:	Total time saved in using biogas systems	32
Table 5.3;	Utilisation of time saved from biogas installation.....	33
Table 5.4:	Fuel and fertiliser savings from biogas systems	33
Table 5.5:	Impact of biogas on forest.....	34
Table 5.6:	Net GHG savings per system (tCO ₂ e/biogas system/year)	34
Table 6.1:	Financial benefits from fuelwood savings.....	35
Table 6.2:	Quantity of agro-residue savings	35
Table 6.3:	Financial benefits from dung savings	36
Table 6.4:	Financial benefits from kerosene savings.....	36
Table 6.5:	Financial benefits from chemical fertiliser savings	37

List of figures

Figure 1.1:	Sector wise contribution to the National GDP.....	4
Figure 1.2:	Landholding population by geographical region	5
Figure 1.3:	Traditional system of obtaining water, light and fertiliser	7

Figure 2.1:	Number of biogas systems installed annually in Nepal upto July 2003.....	10
Figure 2.2:	Biogas system installation by capacity, July 2003	11
Figure 3.1:	Flow of biogas subsidy.....	22
Figure 4.1:	Institutional set up of Biogas Program.....	25
Figure 6.1:	FIRR vs. fuelwood price	38
Figure 6.2:	FIRR vs. amount of subsidy	39
Figure 6.3:	EIRR for biogas system (6m ^J).....	40
Figure 6.4:	EIRR for changes in fuel saving alone	41
Figure 6.5:	EIRR for biogas system.....	42

List of charts

Chart 3.1:	institutional framework.....	19
------------	------------------------------	----

List of maps

Physical map of Nepal	3
-----------------------------	---

List of boxes

Box 2.1:	Opinion of a male farmer.....	9
Box 2.2:	Choice is biogas	9
Box 2.3:	Reason for selecting biogas	10
Box 2.4:	Social aspects: the withdrawal	11
Box 2.5:	Social aspect: the submission.....	11
Box 3-1:	Personal impressions	15
Box 3.2:	Schematic diagramme of biogas system.....	20
Box 4.1:	Experience of a poor farmer	27
Box 5.1:	User's view	30

List of photographs

Photo 1.1:	Fuelwood collection	6
Photo 1.2:	Biogas system.....	7
Photo 2.1:	Biogas stove	12
Photo 2.2:	Biogas lamp.....	12
Photo 2.3	Biogas components manufacturing unit	13
Photo 5.1:	Kitchen with biogas stove	29
Photo 5.2:	Children studying under the biogas lamp.....	30
Photo 5.3:	Woman operating the biogas system.....	31
Photo 6.1:	Farm growing vegetables using slurry from biogas digester.....	37

INTRODUCTION TO BIOGAS IN NEPAL

Biogas was first introduced, on an experimental basis, to Nepal in 1955 by the Reverend Saubolle. Subsequently, several organisations¹ became involved in promoting the technology including the Department of Agriculture (DoA) and the Development and Consulting Services (DCS) of Nepal, the United Mission to Nepal (UMN) and the Khadi and Village Industries Commission of India (KVICI). His Majesty's Government of Nepal launched the first official biogas program in 1974. Under this program, the Agricultural Development Bank of Nepal offered construction loans to potential customers. In 1977, the Government established the Biogas and Agricultural Equipment Pvt. Ltd. popularly known as Gobar Gas Company. The GGC, a state owned entity, was charged with the responsibility of advancing the development and promoting wide-scale dissemination of the biogas technology in Nepal.

The installation rate of biogas systems² prior to 1985 ranged between 100 and 300 units per year. The target for the Seventh Five Year Plan (1985/86 to 1989/90) was to construct 4,000 units or on an average 800 units per year. To meet this target, the Government provided the ADB/N with funds to support 25 percent subsidy on the capital cost and 50 percent subsidy for the interest payments on loans to install the biogas systems. In subsequent years the capital cost subsidy was increased to 50 percent. However, all subsidies were briefly suspended in 1990. This resulted in a virtual standstill in the construction program and a high number of complaints from biogas owners who were deprived of the Interest subsidies on their outstanding loan balances,

The initial experiences in Nepal with biogas systems helped demonstrate their feasibility for meeting a significant portion of rural household energy needs, primarily for cooking and in some cases lighting. In addition, it had the potential to help reduce the social, economic and environmental pressures caused by receding forest areas. However, the existing biogas systems and promotional incentives available in Nepal were falling to convince and motivate the majority of the rural farmers to adopt this technology as a primary source for household energy. It was evident to HMG/N and to others involved in the promotion of biogas that a new approach was needed. As a result, HMG/N, ADB/N and SNV jointly developed the proposal for a Biogas Support Program, which was submitted to the Directorate General for International Co-operation (DGIS) of the Government of the Netherlands in 1991. The formal signing of the agreement between the Ministry of Finance (MoF) on behalf of HMG/N and SNV on behalf of DGIS in 1992 marked the inception of the BSP³ in Nepal.

¹ A chronology of the development of biogas in Nepal is provided in the Annex-1.

² A system includes a digester, storage tank together with inlet and slurry outlet, gas delivery pipes, stoves and lamps.

³ BSP is the name of the program (Biogas Support Program) in which all actors co-operate; SNV/BSP is the name of the program office of SNV and represents just one of the actors in BSP; the HSP N is the name of the Independent Nepali NGO being transformed from BSP as of July 2003.

The observations and data presented in this book are based upon the activities conducted by SNV/B3P from July 1992 to July 2003 i.e. Phases I, II and III of the program. Chapter 1 outlines the geographic location, demography, economy, energy profile and biogas potential of Nepal. Chapter 2 presents the key indicators measuring the success of the biogas program in Nepal. Chapter 3 provides a summary of the key factors that have contributed to the success of the biogas program. Chapter 4 describes the roles of various stakeholders involved in the development of the biogas sector. The social benefits accrued from the program are discussed in Chapter 5 while the financial and economic benefits are presented in Chapter 6. The various challenges foreseen in implementing the program in the future and the opportunities available are discussed in Chapter 7. Lastly, the lessons learned and issues that require attention for more effective operation of the program are presented in Chapter 8.

1.1. Geography and demography

Geography

Nepal is a landlocked country with a total land area of 147,181 km². Roughly rectangular in shape, the land extends approximately 885 km east-west and 145 km at its narrowest to 241 km at its broadest, north-south. The country is bordered by China in the north and by India in the south, west and east.

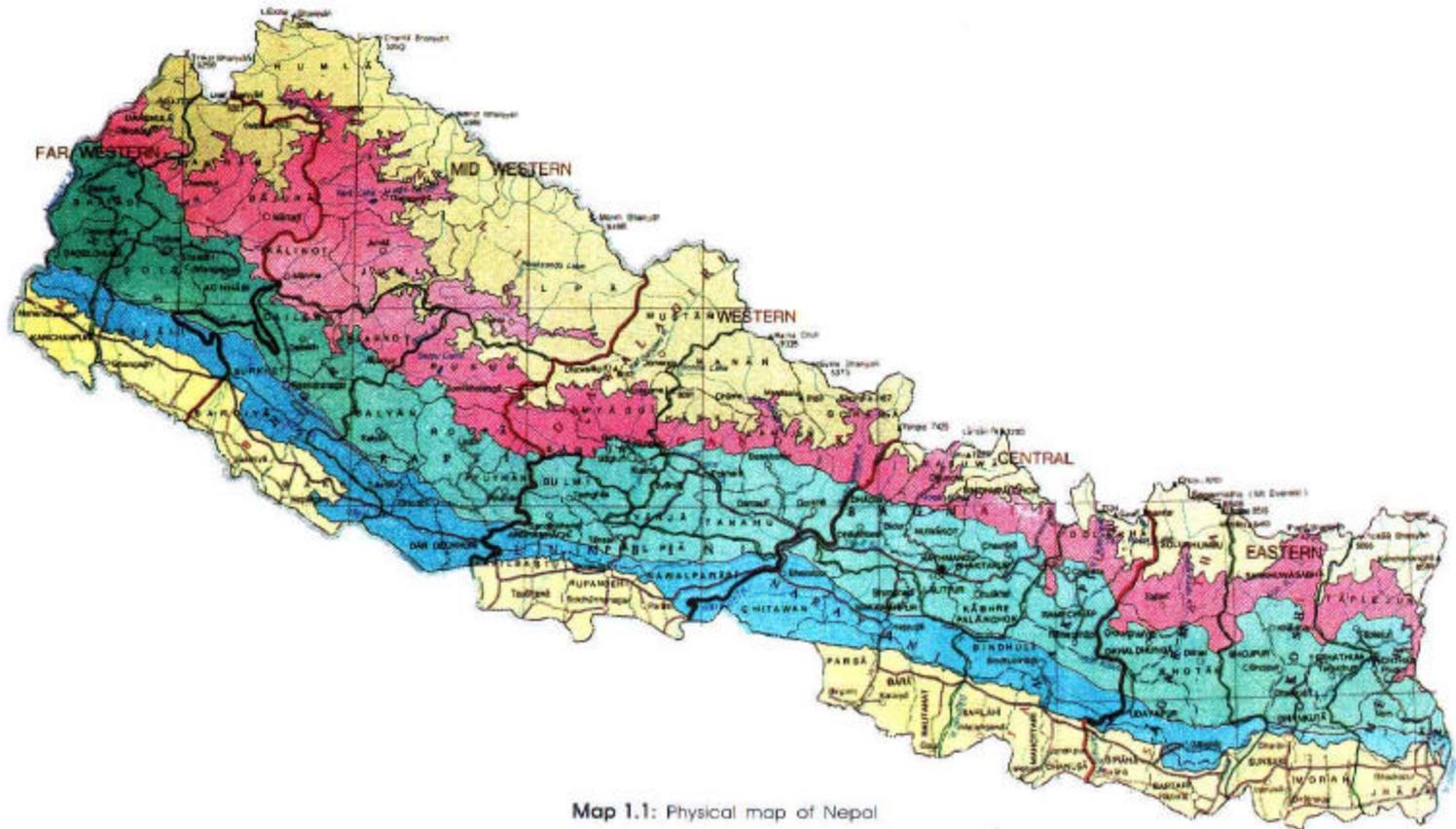
Nepal's territory is divided into three geographically different regions: Mountains, Hills and Tarai. The main features of these regions are given in Table 1.1.

Table 1.1: Main features of the three ecological regions of Nepal

Description	Tarai	Hills	Mountains
Area (km ²)	34,019	61,345	51,817
Percent of total area	23	42	35
Altitude (m.a.s.l.)	100-610	610-4,877	4,877-8,848
Width (kilometres)	25-40	60-80	25-60
Climate	Subtropical	Temperate	Tundra

Source: Central Bureau of Statistics, 2003

Administratively, the country is divided into five Development Regions and 75 Development Districts (DDs). The DDs are further divided into a large number of Village Development Committees (VDCs) and Municipalities as local units. Currently there are 3,915 VDCs and 58 Municipalities including one Metropolitan and four sub-metropolitan cities. Each VDC has 9 wards and there are 10 to 35 wards in a municipality. The boundaries for the regions and districts are generally demarcated with reference to watersheds and, therefore, may not necessarily fall wholly within one physiographic zone. For the sake of convenience in estimating energy features, each district has been classified into one of the three physiographic zones (Map 1.1).



Map 1.1: Physical map of Nepal

Demography

According to the 2001 Census, the population of Nepal was estimated at 23 million with an annual growth rate of 2.25 percent over the past decade. Approximately 86 percent of the population re-sides In rural areas and only 14 percent resides In urban areas, the population distribution in the Mountains, Hills and Terai are 7 percent, 44 percent and 49 percent respectively. The number of households was estimated at 4.25 million with an average of 5.44 persons per Household (HH) (CBS, 2002).

1.2. Social and economic factors

Social

Nepal is a multi-ethnic, multi-lingual, multi-religious country with subtle social diversity. There are over 10 specific language groups with Nepali spoken by the majority of the population. Hinduism is the dominant religion accounting for over 80 percent of the population, Buddhism is practiced by 11 percent of the population; Islam by about 4 percent and the remaining 5 percent constitutes followers of various religions like Christianity, Joinism, etc. The 2001 Census estimated the literacy rate at approximately 54 percent with male literacy at 65 percent and female literacy at 43 percent (CBS, 2002).

Economic

The agriculture sector, where over 85 percent of the people are engaged, is the mainstay of the economy, accounting for 39 percent of Gross Domestic Product, Industrial output accounts for 7.7 percent and the service sector for 53.5 percent of the remaining GDP of Nepal (MoF, 2004). Industrial activity mainly involves processing of agricultural products including jute, sugarcane, tobacco, and grain (see Figure 1.1),

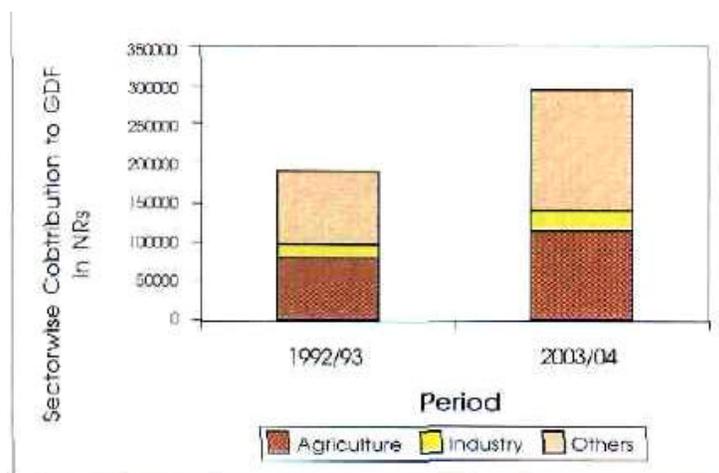


Figure 1.1: Sector wise contribution to the National GDP

The average per capita GDP is estimated at only US\$ 237 (CBS, 2003). However, there are still 38 percent of the population living below the poverty level of US\$ 1 per day (NPC, 2002] most of them in the rural and remote areas, with the lowest incomes in the Far Western Development Region. It is important to note that with the exception of agricultural activities, employment in other sectors is extremely limited in the rural areas.

Nearly 79 percent of the HH have landholding (CBS, 2002). With respect to location 93 percent in the Mountains, 80 percent in the Hills and 75 percent in the Terai have landholding of varying size. Of this population 53 percent in the Mountains have landholdings less than 0.5 hectare while in the Hills and Terai the population having landholdings of this size is 47 and 36 percent respectively. Similarly, 43 percent in the Mountains, 47 percent in the Hills and 46 percent in the Terai have landholdings between 0.5 and 1.0 hectare. The population having larger landholdings i.e., greater than two hectares is 4 percent in the Mountains, 6 percent in the Hills and 19 percent in the Terai (See Figure 1.2).

Livestock such as cattle, buffalo, poultry and smaller animals play an important role in the lives of landholding Nepalese farmers. The cattle are a source of milk as well as draught-power. The cow is a revered and sacred animal in Nepal. Veneration for the cow is intimately associated with all orthodox Hindu sects and to a large extent with the Buddhist population as well. Because the cow is regarded as the symbol of motherhood and sustenance, the killing of a cow, even accidentally, is regarded as one of the most serious of religious transgressions. Traditionally, the bulls provide draught power and cows provide milk. Cattle are well cared for, reared close to the farm and kept for a long period of time unlike non-Hindu countries where they are slaughtered at an early stage for food. This special position held by the cattle, unique to this part of the world, is an important element in the successful adoption of biogas systems as it helps assure a steady supply of cattle dung for the biogas system.

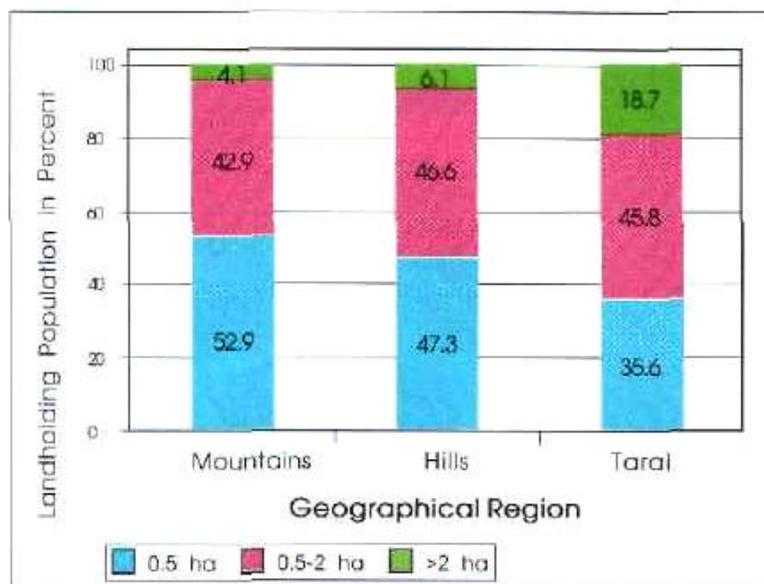


Figure 1.2: Landholding population by geographical region

Both Hindu and Buddhist religions have a very positive attitude about cattle. They attach no stigma or cultural inhibitions to the handling of dung coming from cattle or buffaloes. The cattle are highly valued and as a result, they are seldom sold. They are kept close to the farmhouse and in many cases are stable fed during prolonged periods when land grazing is not practical.

The conditions in which cattle are raised in Nepal are thus ideal for providing the animal dung, the feedstock necessary to fuel small farmer based biogas systems, Permanence of cattle and the family attending the cattle guaranties an adequate and a continuous source of feed for the biogas systems.

Only small size (4-10 m³) biogas systems, using cattle and buffalo dung, have been promoted to date in Nepal. The widespread ownership of cattle provides a good indicator for the potential of biogas in Nepal. Although some families have only one cattle, most small farmers have two cattle or buffaloes, which is the minimum number required for feeding the biogas systems of 4m³ capacity.



Photo 1.1: Fuelwood collection

1.3. Nepal's national/rural energy scenario

The per capita energy consumption in Nepal is about 336 kilogramme of oil equivalent (kgoe) (MoF, 2004). In the last five years, traditional energy (fuelwood, agricultural residues and animal dung) provided 86 to 90 percent of the total energy consumption (NPC, 2002) for the entire country, with most of this biomass energy being used for cooking.

In most of the rural areas the dependency on biomass is well over 95 percent, with some districts close to 99 percent. The biomass energy consumed comprises of 90 percent fuelwood, 6.5 percent dung and the rest agricultural residues such as corn stalks and chaff from rice. From the traditional energy forms, fuelwood is the major source, of which more than 95 percent is consumed in the rural domestic sector (Oli and Kharal, 2004).

The heavy dependence on fuelwood resources has a negative impact on the environment resulting in deforestation around villages and the deterioration of soil stability on the affected hillsides. In addition, the burning of dung reduces soil fertility.

With deforestation around villages, the daily labour required for collecting fuelwood increases impacting primarily women and children and leaving little time for education as well as for productive tasks. Additionally, the smoke emitted from the burning of the biomass has adverse health effects on women and children causing widespread eye and respiratory diseases, Figure 1.3 provides a schematic picture of the traditional process for supplying energy for fuel, light and fertiliser in the absence of intervention from improved energy forms or technologies in the rural areas.

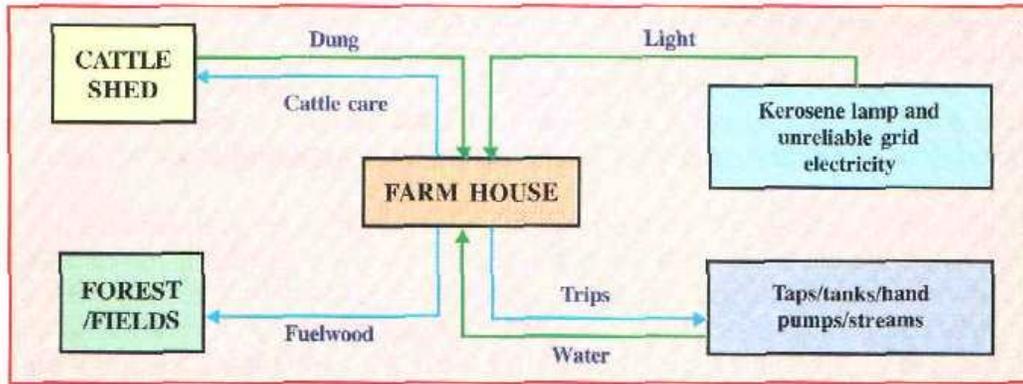


Figure 1.3: Traditional system of obtaining water, light and fertiliser

1.4. Biogas as rural renewable energy

Biogas is a mixture of gas produced by methane-based bacteria acting upon biodegradable materials in an environment that is lacking oxygen. Biogas is mainly composed of 50 to 60 percent methane, 40 to 50 percent carbon-dioxide and other gases. The gas is colourless and burns with a clean blue flame similar to that of Liquid Petroleum Gas (LPG) with virtually smoke-free combustion.



Photo 1.2: Biogas system

The biogas systems installed by the BSP are of the fixed dome type. The capacities of the systems presently promoted are of 4, 6, 8 and 10 m³, using cow and buffalo dung and water as the main feed materials. The popular sizes are 4 and 6 m³ sizes. A 6 m³ system requires 36 kg of dung and an equal amount of water per day in the hilly areas to burn a stove for 3.5 hours.

Biogas can be used for cooking, lighting, refrigeration as well as operating machines. However, to date biogas is popularly used in Nepal for cooking. Used for cooking, biogas has to a large extent helped in reducing the use of fuelwood and hence conserve the forests, In replacing kerosene for cooking and lighting, biogas has helped reduce expenses on imported fuel. The slurry from the digester is also used as fertiliser in the fields. This has enhanced agricultural production and replaced the use of chemical fertiliser. This technology has social implications such as health benefits from reduced indoor pollutions and livelihood enhancement from income generation opportunities such as masonry available in this sector. In recent years this technology has also indicated potentials as a source of national income through carbon trading under the Clean Development Mechanism (CDM).

1.5. Potentials of biogas in Nepal

Livestock plays an important role in the Nepalese farming system. According to the Agriculture Sector Census of 2001/02, the total cattle population in Nepal was estimated to be 2.2 million heads, while 1.6 million heads of buffaloes were registered. Based upon a study of the technical and geographic feasibility, it is estimated that a total of 1.9 million biogas systems can be installed in Nepal: 57 percent in Tarai, 37 percent in Hills and 6 percent in Mountain regions (BSP, 2004). When taking economic factors into consideration, the potential of the smaller fixed dome design (4 and 6 m³) in Nepal is estimated at about half a million units. With innovative financing (subsidy structures, co-operatives) and delivery structures (self help building), the potential can be doubled to one million units. Besides the above small domestic biogas systems, there is huge potential of cold climate, industrial as well as municipality systems.

The current small fixed dome design works well at altitudes up to 1500m. However, during the winter months the gas production decreases, especially above the 1500m. When the fixed dome design is built at altitudes of 2000m or higher, special adjustments to the design are required such as thermal insulation and warm water feeding to maintain gas production during the winter.

Chapter 2

KEY INDICATORS OF SNV/BSP'S SUCCESS

The SNV/BSP has installed 111,395 biogas systems throughout Nepal in the period July 1992 to July 2003, It has achieved this level of market development in spite of the significant economic, social, institutional and geographic barriers that challenge this complex rural development task, This Section summarises a number of key indicators that demonstrate the success of the SNV/BSP. The indicators are separated into two categories;

1. Survey data estimates of client satisfaction and use;
2. factual data measurable and recorded data of sales, producers. Installations , etc.

Both sets of data are presented to illustrate the reasons for success to date and the future potential of the biogas sector in Nepal.

2.1. Client satisfaction

The most Important factor to measure the success of any product or service is client satisfaction. Client satisfaction is linked to the level of utility, comfort and value received by the end-user. The more utility, comfort and value a product provides, the higher the reported satisfaction of the end-user.

In SNV/BSP, client satisfaction is regularly measured through consumer surveys, analysing a cross cutting sample of all biogas users and comparing them with non-biogas users. The findings from these surveys are processed to further improve biogas system designs, train installers and increase product quality. For example, when many farmers noted increased mosquitoes after construction, procedures were developed to avoid mosquito breeding in the slurry outlet. The client surveys have also indicated that the neighbours of most biogas users are very impressed with the benefits of the biogas systems and as a result are interested in obtaining biogas systems for their own use. Thus, client satisfaction has been an important factor for growth in sales.

An important reason for client satisfaction is the high reliability of the biogas systems. Survey data indicates that 97 percent of the SNV/BSP Installed biogas systems are fully operational. The few owners that reported problems or failure of components in their systems also stated they wanted the problems repaired, also indicating their general satisfaction with the technology.

Box 2.1: Opinion of a male farmer

"I, myself, encourage my wife to attend her regular meeting. When she is out, I myself take care of my two children. I even make food for them and for my wife on our biogas stove. I know she will be hungry when she is back."

Guru Prasad Bajgain
Nayagaun, Kavre

Box 2.2: Choice is biogas

"The comfort that we experienced from using it while in our parental home was very impressive. Hence, when we moved to our separate house, my wife and myself decided that we must have one of our own."

Gyan Bahadur Rai
Paanchkhal, Dhulikhel

Box 2.3: Reason for selecting biogas

"We decided to install a biogas system on seeing the comfort enjoyed by our neighbours. They no longer go to collect the fuelwood, the house is clean and the women folks have an easier life. The installation process is also easy."

**Sannani Danwar and
Bhim Bahadur Rai**

Another important reason for the high client satisfaction with biogas systems is related to the reduction of approximately three hours per day of labour per HH required for collecting of fuelwood. In addition, lighting of a biogas stove is simple, fast and convenient. The use of biogas completely eliminates the noxious smoke in the kitchen caused by the use of fuelwood as well as its detrimental effects such as eye infections and respiratory diseases.

While the resulting savings of labour time and reduction of noxious smoke can be measured, the social and health benefits (including reductions in eye infections and respiratory diseases) associated with these positive aspects of the biogas system are difficult to measure.

The satisfaction level of the farmers is based primarily on their personal feelings and perceptions about the effect of cooking on biogas. The workload reduction and increased comfort are very important factors in this respect⁴. Besides, light available during the night has provided extended hours for education. While toilet attached to the digester has significantly improved the sanitation in the vicinity of the homes with accompanied health benefits.

2.2. Number of operating systems

As of July 2003, 111,395 biogas systems are recorded as installed by the BSP. Figure 2.1 illustrates the growth of the annual installations of biogas systems during three phases of SNV/BSP. As indicated earlier, 97 percent of the installed biogas systems are fully functional (East Consult, 2004). The data clearly indicate the rapid growth in installed biogas systems after the initiation of the SNV/BSP.

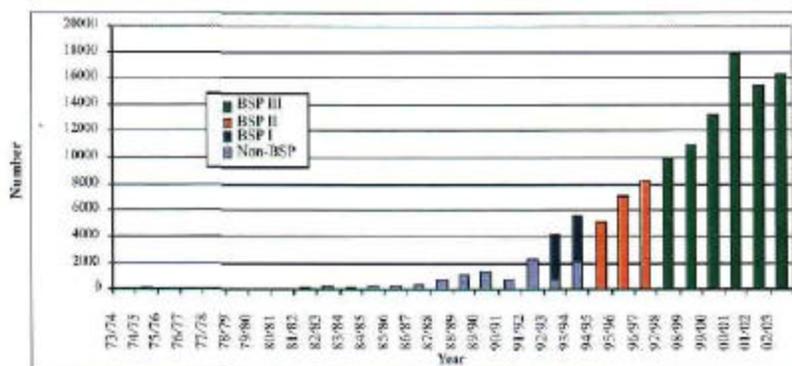


Figure 2.1: Number of biogas plants installed annually in Nepal upto July 2003

⁴Detailed numbers and analysis can be obtained from the document Integrated Environmental Impact Assessment (IEIA). basic document submitted to Commission for Environmental Impact Assessment, Netherlands.

The distribution of biogas systems by topographic regions is presented in Figure 2.2. It illustrates that 55.1 percent is installed in the Hill region and 44.9 percent in the Terai region.

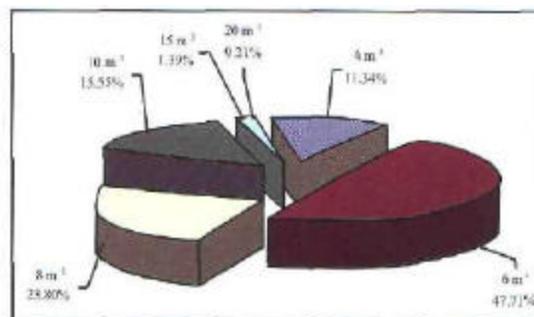


Figure 2.2: Biogas system installation by capacity, July 2003

In addition to the growth of installed biogas systems, the BSP has actively promoted the capture and use of human nightsoil for increasing biogas production for households. This was a particularly challenging objective, as it required overcoming long-standing cultural and social taboos associated with human nightsoil. The success in overcoming these taboos is demonstrated by the fact that 72 percent of the installed biogas systems now have attached toilets to capture the human nightsoil, [BSP-N, 2004). The 5NV/BSP used two important measures to overcome these taboos. The first was designing an attached toilet system to eliminate any handling or contact with the nightsoil. The second was an information and outreach program to educate consumers about the cleanliness of the resulting biogas.

The majority of the people in Nepal perceive the kitchen to be a sanctified place. This arises from the practice of offering prepared meals to religious deities. Thus, it is considered sacrilegious to prepare the food using unclean fuels such as biogas derived from nightsoil. However, the SNV/BSP has been successful in creating an awareness of the cleanliness of the resulting biogas fuel to overcome this cultural inhibition. As a result, there has been a significant rise in the number of requests to connect the toilet to the biogas systems.

In addition to the benefit of additional biogas production from the use of human nightsoil, the connected toilets significantly improved the

Box 2.4: Social aspects: the withdrawal

"My relatives or neighbours never eat the things cooked in my house, because they do not like the foodstuff cooked on the gas produced from night soil."

Sita Regmi

Ghari, Tanahu District

Box 2.5: Social aspects: the submission

"My mother refused her meals since the day the biogas digester was connected to the toilet. Strong religious beliefs led her to this hunger strike. This had us very much worried. However, she was persuaded to forego her reservation on being told that the cow-dung was considered to be rather sacred and sanctified the nightsoil. The acceptance of this argument by an elderly and staunch religious person not only had the family biogas system in operation but also encouraged other hesitant villagers to accept the system."

Chaudhary

Chitwan

sanitary habits and conditions around households with resulting positive health benefits for all household and village residents.

To make the biogas system more attractive for farmers with only a small number of cattle, small sized biogas plants were promoted by the BSP. The 4 m³ units can be operated with two cattle, the 6 m³ units with four cattle and the 8 m³ units with six cattle, etc, The subsidy program was adjusted in BSP-III to apply principally to the smallest systems, thereby favouring the poorest farmers. This trend is continued during phase BSP-1V, reducing the overall average size to around 6 m³. Of all the plants installed by the end of BSP-III, July 2003, 11 percent are of the 4 m³, 47.71 percent of 6 m³ and 23.8 percent of the 8 m³ capacities, Figure 2.2. Nearly 17 percent comprises of the larger size systems of 10, 15 and 20 m³ capacities,

2.3. Principal uses of biogas (cooking, lighting)

Ninety-five percent of Nepal's rural energy consumption is derived from fuelwood and agricultural waste products and is mainly used for cooking. The use of biomass for cooking, especially given the traditional stoves and kitchens of Nepal, has adverse effects on the health of its users, primarily women and children. Biogas technology has been promoted in Nepal for both cooking and lighting. However, according to the most recent Biogas Users Survey, 97 percent of the users in the Terai and 95 percent (sample of nearly 600 households) in *the Hills* use their biogas systems only for cooking [East Consult, 2004]. However, on a national level only 20 percent use biogas systems for both cooking and lighting.

2.4. Number of approved biogas construction companies

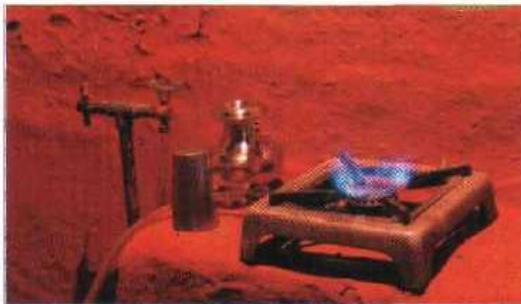


Photo2.1: Biogas stove

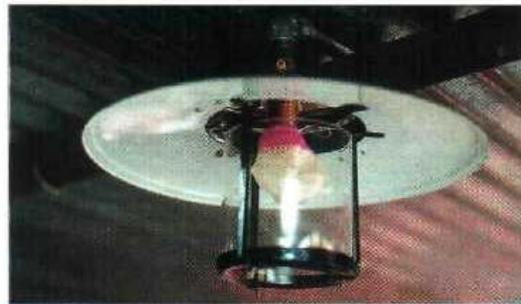


Photo 2.2: Biogas lamp

An operating principle of the BSP has been to strengthen the local capacity and collaborate with the private sector to implement and achieve its objectives. As a result, the SNV/BSP technically and financially supported the creation and certification of a number of private Biogas Construction Companies (BCCs). To work with the BCCs, clear procedures for contracting, Installation, quality control, service, repair and maintenance were developed. Programs were conducted to train the technicians and operating staff of the BCCs. The certification of the BCCs was based upon the standards of the work delivered by them. Prior to 1992/93, there was only one recognised BCC, the Gobar Gas Company. The number of approved BCCs increased to 11 in 1993/94, to 23 in 1995/96, to 36 in 1996/97 and to 49 in 2000, It has declined to 39 in July 2003 as a result of a number of marginal firms dropping out of the business.

Besides construction of the biogas systems, the certified BCCs must provide after sales service. The BCCs are required to provide each customer, at no cost, three maintenance/service calls over a three-year period. In case the constructed system has any problems the BCCs must also repair the system free of cost during this guarantee period.

2.5. Number of operating appliance producers

The SNV/BSP has encouraged local manufacturers to produce appliances as per SNV/BSP specified standards. These include gas stoves, gas lamps, gas valves, slurry mixers and water drains. There are 15 biogas appliance-manufacturing companies distributed across the various regions in Nepal as of July 2003.



Photo 2.3: Biogas components manufacturing unit

2.6. Number of persons employed by the biogas sector

It is estimated that approximately 11,000 persons are directly involved in the biogas sector. This includes the staff from the BCCs, appliance manufacturers, suppliers, supporting financial institutions (i.e. lending banks) and the SNV/BSP⁵. Besides this figure, 400 masons are trained every year. On an average, one mason can install three biogas systems in a month. Assuming that he works only for eight months in a year, one mason can install a total of 24 plants. The development of local masons is not only giving employment but also assuring the services on plant and promoting the technology more efficiently.

The SNV/BSP has generated employment in different categories both at the field and in-house.

Table 2.1: Employment by category

Category	Numbers
Technical	6,000
Administrative	1,700
Financial	1,000
Local Promoters	800
Suppliers	1,500
	11,000

⁵ The figure has been arrived at after compilation of the information provided in the contract between SNV/BSP and the Biogas companies.

2.7. Capacity building

Since its inception, the SNV/BSP has played a key role in developing and strengthening the technical and institutional capacity of all the key partners associated with the biogas sector in Nepal. Training programs conducted by the SNV/BSP have been critical in establishing and strengthening the capacity of among others the BCCs, the lending banks, the biogas inspectors, the SNV/ BSP support staff and even biogas end-users (i.e. farmers and female-users). More than 126,000 persons have so far been trained in various aspects of biogas technology.

Technical training including mason training, supervisor training and Junior biogas technician training are conducted through different regional training centres. The SNV/BSP provides training to the instructors of these regional training centres, who in turn provide training to the various biogas industry participants. Training for biogas users is provided by both BCCs as part of the biogas installation process as well as by the SNV/BSP to promote specific end-user practices such as increasing biogas production and safe biogas operation and maintenance.

High quality technical training is considered an important input to guarantee the quality of the digester, which is the main component of the biogas system. As a result, the SNV/BSP instituted a training and certification program for the staff and masons of the BCCs. All these trained technical staff are registered with the SNV/BSP and their performance in constructing and providing problem-free biogas systems to consumers is closely monitored. Thus, the SNV/BSP is able to identify BCC staff that may require additional training or whose certification should be extended or revoked.

2.8. Awards and recognitions

The SNV/BSP has been an outstanding success. Its success lies not only its presence, recognition and popularity in the 65 of the 75 districts of Nepal. It is fully established itself as service oriented partnership. It has received accolades even internationally. This is illustrated by:

- award from Gasbedrijf Central Nederland (Central Gas Company, the Netherlands) in 1995;
- the World Climate Technologies Award in 1999;
- a registration at the World Exposition 2000 in Hannover, Germany and
- the ISO 9001:2000 Certificate for holding adequate quality management systems.

In summary, the capacity building initiatives of the SNV/BSP have been a critical component in the overall establishment and success of the biogas industry in Nepal.

Chapter 3

PRINCIPAL SUCCESS FACTORS

There are several important reasons why the SNV/BSP has succeeded in accelerating the adoption of biogas in Nepal. Prior to the elaboration on these factors it is important to understand that there are a number of factors unique to Nepal that has also contributed to the success. Biogas systems fit very well into the Nepalese integrated farming system, which combines crop production and animal husbandry. Most rural households rear some cattle and as a result have dung that can be collected to feed into the biogas digesters. The handling of cattle dung is not a taboo in the context of the Hindu culture. Finally, the increasing difficulty of obtaining fuelwood in Nepal provides a strong incentive to look for alternative cooking fuels like biogas. Other factors contributing to the success of biogas in Nepal are briefly discussed below.

3.1. Supportive government policy

HMG/N has a long tradition, dating back to 1974, for promoting the use of biogas in Nepal. This support, manifested by provision of interest free loans and subsidies for biogas systems, is indicative of the Government's commitment to promoting this technology.

In the Seventh Five-Year Plan, 1984-1989, a target for installation of biogas systems was, for the first time, incorporated into the national plan. In 1984-86, a policy for providing a 50 percent interest subsidy on loans was introduced. Subsequently, this preferential policy was extended to provide a 25 percent subsidy on the installation costs of biogas systems.

The Eighth Five-Year Plan, 1992-97, defined the Government's institutional framework for developing Nepal's alternative and decentralised energy resources. As a result, AEPC was established under the Ministry of Environment, Science and Technology (MoEST). The objective of AEPC was to:

- recommend policies to HMG/N for promotion, development and dissemination of Renewable Energy Technologies (RETs) in Nepal;
- promote the development of appropriate rural energy technologies and establish a strong partnership between industry, people and the Government;
- establish a database, test station, information centre and library related to RETs;
- supervise, monitor and evaluate alternative energy programs and set performance standards of RETs;

Box 3.1: Personal impressions

The Biogas Program is one of the most successful RET projects in Nepal. The experiences gathered from this project provide crucial elements that can be extended to other projects as well. The chief factor contributing to the overall success of the SNV/BSP no doubt lies in the long-term commitment bestowed by the donor agencies and the supportive policy of the Government of Nepal.

Dr. M. B. Basnyat,
Executive Director of AEPC

- conduct research and development on RETs as well as conduct RET training programs and develop training manuals; and
- facilitate partnership between companies, Non-Government Organisations (NGOs) government institutions, banking sector and donors.

The Ninth Five-Year Plan, 1998-2003, set a target for establishing 90,000 biogas systems by the end of 2003. To help achieve this target, HMG/N exempted the Value Added Tax (VAT) on biogas systems and all accessories in the year 1998/99.

3.2. Key elements of donor support

Long-term donor commitment

An important factor in the success of the SNV/BSP has been the dedicated vision of its principal donor the Netherlands Directorate General for International Cooperation through SNV, SNV, jointly with the Government of Nepal, formally requested DGIS for funding to support the implementation of the biogas program in Nepal. The DGIS support for the SNV/BSP was initiated in 1992. The SNV/BSP program office was set up under the management of SNV/ Nepal. Over the past 11 years, SNV/BSP has worked closely with private construction companies and manufacturers as well as NGOs to successfully promote the use of biogas in Nepal. In line with its objectives the SNV/BSP has encouraged institutional, technical and financial capacity building at all levels of the program. In particular, the concept of sustainability was introduced.

Technical assistance for institutional strengthening and product research and development

The involvement of SNV in the biogas sector of Nepal was initiated in 1989 with the posting of a SNV staff to the GGC. The primary objective was to provide GGC with technical assistance to help improve their product and reduce its costs. In early 1990, a second SNV expert was posted to the Research Unit of GGC with the objective of helping in the Research and Development (R & D) efforts to make biogas systems of lower cost and thereby increase the affordability for a broader segment of the rural population. This initial partnership between SNV and the GGC was the foundation for the successful launching of the BSP.

Credit support for financing the purchase of biogas systems by poor farmers

In 1990 it was realised that major reductions in production costs were not possible without adversely affecting the life expectancy, performance and reliability of the biogas system. The options for reducing costs to consumers were through financial measures such as investment subsidies, credits and by increasing the market that could lead to economies of scale. Credit is being provided through Micro Finance Institutions (MFIs) for farmers who do not have money to pay upfront for the system ,

Subsidy support for making biogas systems affordable to poor farmers

Subsidies for biogas systems have been provided since 1992. The support for subsidies have been provided from three sources; HMG/N; the German Government through the KfW and DGIS. The subsidy support provided to date is estimated at Euro 10.83 million and the donor-wise contribution is summarised in Table 3.1.

Table 3.1: Donor wise share on subsidy contribution

Donor	92-97	97	98	99	00	01	02	03	Average share
	Percent								
HMG/N	1	10	12	14	16	18	20	20	15.7
KfW	-	79	77	78	76	74	72	72	75.4
DGIS	99	11	11	8	8	8	8	8	8.9

Source: BSP-2004

The subsidy support has helped biogas promotion in Nepal by making the capital and interest payments on loans needed to finance the costs of the biogas systems affordable to poor farmers. The amount of the subsidy, which is linked to the size of the biogas digester and the geographical location. Is designed to encourage farmers to install the more appropriate smaller sized system. The subsidy for smaller sized systems (4 to 6 m³) is higher than that for larger sized plants. The 15 and 20 m³ systems were deemed to be too large for household use and only affordable to wealthy farmers and, therefore, removed from the subsidy scheme in July 1999. Under this system of subsidies, the average capacity of the digesters was gradually reduced to 5.84 m³, The smaller systems also indicates that more poor farmers are being served with biogas.

Besides supporting farmers for purchasing biogas, the administration of the subsidy provides an opportunity to enforce strong quality control measures. In order to receive the subsidy payments, participating biogas companies are required to certify that they have met the quality control standards set by the SNV/BSP. Companies failing to meet the quality standards set by the SNV/ BSP are denied the subsidy payments and consistent violators are prevented from participating in the SNV/BSP. Thus, besides making biogas systems more affordable for poor farmers, the subsidy is also used to ensure good quality biogas systems for these farmers,

3.3. Collaboration between international organisations

The collaboration between HMG/N, DGIS, and Bundes fvllnisterium fur Wirtschaftliche Zusammenarbeit und Entwicklung (BMZ)/Kredltanstalt fur Wiederaufbau (German Development Bank) (KfW) in the financing of BSP Phase 111 is an important contributing factor to its success, This collaboration materialised with growing confidence within BMZ/KfW in the capacity and management demonstrated by the BSP during Phases I and II,

3.4. Implementation/institutional strategy

Another key success factor has been the SNV/BSPs implementation strategy of working in close institutional partnerships to develop and support the growth of the biogas sector in Nepal. The key partners of the SNV/BSP program include:

- **Biogas consumers** - these are the rural farmers who must be first convinced of the value of owning biogas systems and then must get involved in the contracting, financing, construction and daily operation and maintenance of the biogas systems. It is critical that they are fully informed, trained and supportive of owning, operating and maintaining biogas systems. The biogas consumers represent the largest stakeholder group in the BSP.
- **Biogas construction** - companies and appliance manufacturers. This is the second largest stakeholder group associated with the Program. It includes the owners and employees of the BCCs and appliance (stoves, lamps, tools) manufacturers, It is critical that these partners are also informed, trained and comply with the goals, objectives and standards.
 - **Finance and banking officials** - at both the national and local level, officials of the rural finance and banking institutions involved in providing loans to rural farmers for biogas systems are also the key partners in the BSP. The role of ADB/N has been very instrumental. It is critical that these individuals are also involved in the decision-making and implementation.
- **National government officials** - at the national level the following ministries are involved: Ministry of Finance, Ministry of Environment, Science and Technology, National Planning Commission and Alternative Energy Promotion Centre.
- **District government officials**- at the district government level, key SNV/ BSP partners include the district offices of the Ministries of Forests and Soil Conservation (soil conservation and forest user groups), Water and Energy and Agriculture and Livestock (cattle, veterinary services). At each district or provincial level the local administration and municipalities may be influential partners in the area of promotion, control and operation of municipal installations.

The careful orchestration of the support and inputs of these key partners has been a critical factor in the success of the BSP. The key implementation and support activities undertaken by the SNV/BSP include:

- technology development;
- biogas promotion;
- information dissemination;
- institutional development and strengthening;
- project financing;
- subsidy management;
- construction training and standards;
- gender mainstreaming and
- program monitoring and evaluation,

Chart 3.1 presents this strategic approach adopted in the promotion of biogas in Nepal. It presents the responsibilities and the co-ordination between various stakeholders of the sector.

3.5. Technology design approach

The SNV/BSP was instrumental in helping identify, design and develop an appropriate, cost-effective and reliable biogas system for Nepal. To achieve

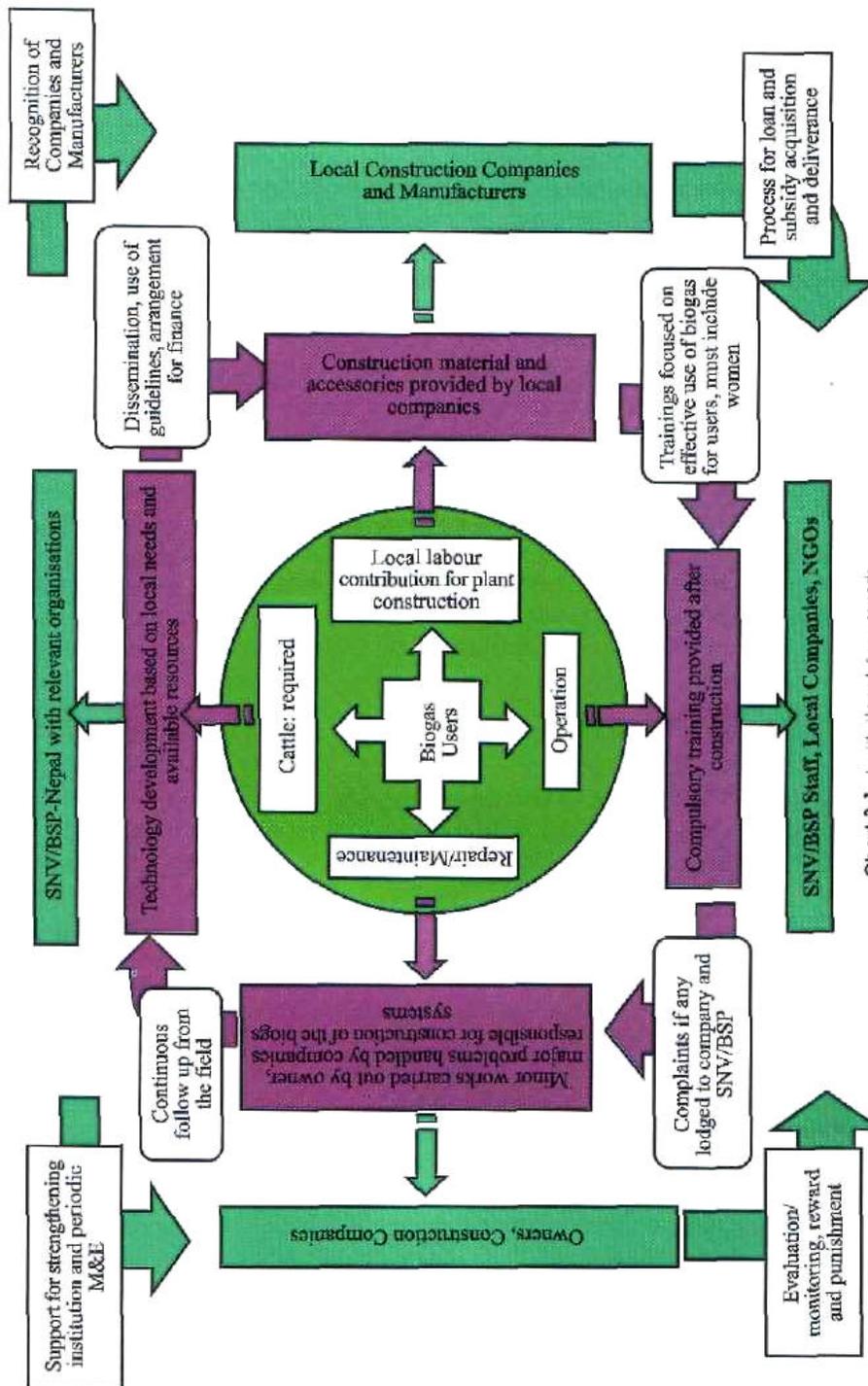
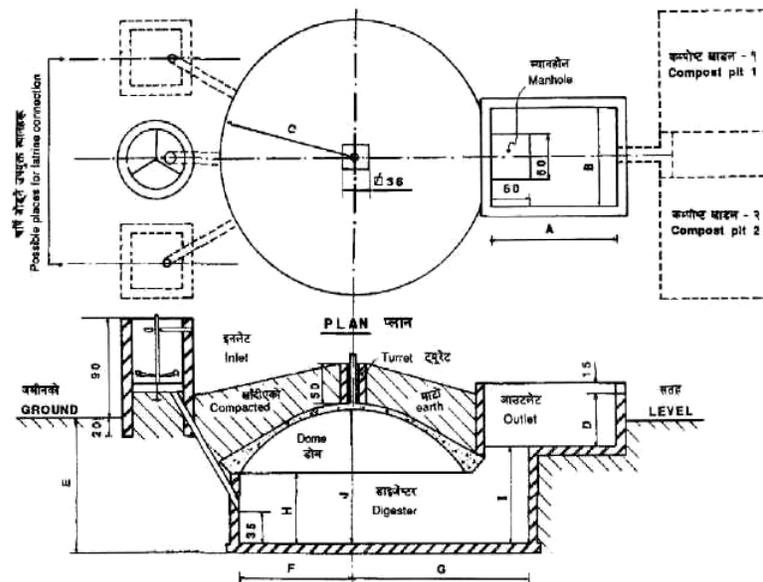


Chart 3.1: Institutional framework

this objective, the SNV/BSP initially worked in association with GGC to conduct its research and development. In the process, strict standards for quality and design were established that all biogas producers were required to follow, Since its inception in 1992, the SNV/BSP has strategically developed and promoted a uniform technology - the fixed dome biogas digester (Box 3.2). This design is suited for both the Terai and Hill regions and has received wide acceptance. The uniform design approach has made it more practical for increasing production and quality control.

The uniform design was initially imposed on clients. However, the information on the successful demonstration of resulting SNV/BSP designed technology was widely disseminated through various media. The result was a consumer demand for the SNV/BSP designed technology, The most effective means for promoting the design was customer satisfaction leading to users informing relatives and hence farmer-to-farmer promotion to friends and neighbours about the benefits of the technology.

The toilet attachment was included in the basic fixed dome design but not a required addition due to possible religious sensitivities associated with the use of nightsoil. A second inlet pipe for possible future attachment, however, was made compulsory, Again, the demonstration that the use of nightsoil is safe has helped alleviate the reluctance of many rural families to consider attached toilets and the current trend is for most biogas systems to be ordered with the toilet attachment,



Box 3.2: Schematic diagram of biogas system

Dissemination of biogas technology

To accelerate the dissemination and adoption of biogas technology in Nepal, a number of specific actions have been implemented. The most important element is first to ensure satisfied customers by accurately informing customers of what to expect from a biogas system and thereby not creating any false expectations. Satisfied customers are then encouraged to convince their neighbours to get one too. In addition, the respective companies give the local masons, employed by companies, commissions when they refer new customers. Promotion activities are also undertaken in association with other organisations including banks, NGOs and rural development agencies.

One of the most important elements of the promotion program is the investment subsidy. The flat rate two-tier subsidy structure (three-tier from 1996/97 onwards) made biogas technology attractive to small and lower-income farmers and to more farmers in the Hill districts. A summary of key statistics to demonstrate the impact of the subsidy is given in Annex 2. The data clearly indicates that the subsidy program is successful in extending the market for biogas systems to the smaller, lower income and more isolated farmers including farmers in the Hill districts.

Institutional development and strengthening

AEPC co-ordinates all alternative energy development programs in Nepal and hosts the Biogas Co-ordination Committee. Working in close partnership with APEC and key financial institutions, qualified private sector firms, responsible government agencies and active NGOs, the BSP has successfully commercialised biogas systems in Nepal.

The program helps train and strengthens the management of companies that are active in biogas production, in addition, the NBPG has been established to co-ordinate the activities of certified companies biogas production companies. The NBPG is an industrial association that has the overall objective of representing the interests of the biogas producers in the development of the biogas market in Nepal.

Provision of credit and subsidy

Affordable financing is a key element in the promotion of biogas technology. The average cost of a biogas system amounts to NRs 19,000-30,000 depending on system size and location. The actual cost of a plant varies depending upon the construction site and availability of local construction material. The loan needed for a biogas system ranges from NRs 7,200 to 17,600 with subsidy and NRs 15,000 to 23,600 without subsidy. To assist poorer farmers, the SNV/ BSP is working in close association with the ADB/N to help provide affordable financing to farmers. The Figure 3.1 indicates the current subsidy flow for biogas.

The ADB/N provides loans at 17 percent annual interest and a 7-year repayment term. Within Phases I & II, 76 percent of the Installed plants were constructed with loan financing and 24 percent were financed by farmers on cash basis. The ADB/N has a reported repayment record for biogas loans of

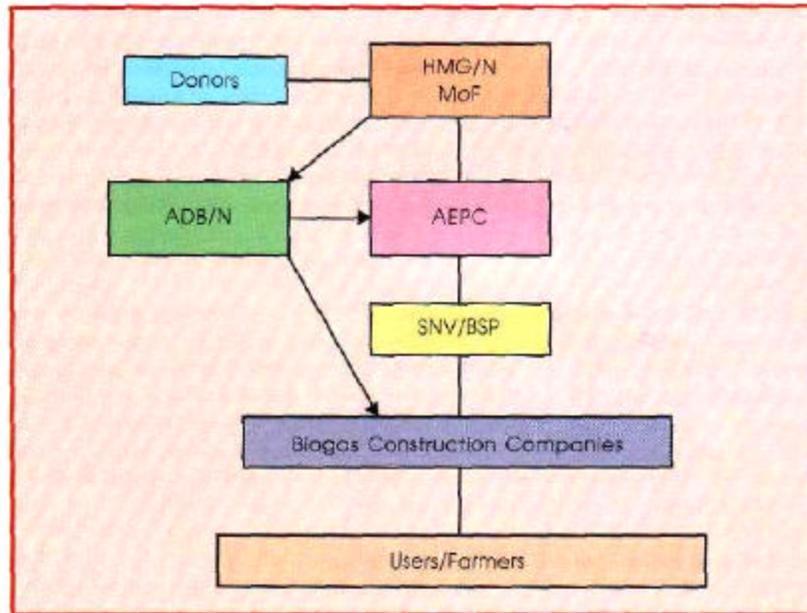


Figure 3.1: Flow of biogas subsidy

87 percent while its overall loan repayment rate for all ADB/N loans is only 67 percent. Phase III surprisingly saw an annual decline in the loans versus cash ratio for biogas construction. On an average only 37 percent of the plants constructed in this period were financed by loans and 63 percent on cash basis while the repayment rate stood at 72 percent.

During BSP II, other development banks were encouraged to participate in the program. As a result, the Nepal Bank Ltd, (NBL) and Rastriya Banijya Bank (RBB) started lending to farmers for biogas systems. Phase Hi witnessed the opening of a Biogas Credit Fund within AEPC, which started funding biogas, loans through MFIs. By the end of this period (July 2003), 59 MFIs were involved with disbursement of biogas credit,

Deliver quality product

An important factor in the successful promotion of biogas technology in Nepal is strict enforcement of carefully defined quality and design standards. Private companies are invited to participate on the basis of main-training the quality and standards set by the SNV/BSP. These terms and conditions are part of agreements signed between the SNV/BSP and the participating companies at the beginning of each fiscal year (16 July to 15 July of the following year). In total, there are 73 quality standards that relate to design, size, construction materials, construction of inlet, digester, dome, turret, outlet and compost pits, toilet attachment, appliances and fittings, fitting and layout of the gas pipes, training of masons and after sales service, Enforcement of the quality standards is achieved by imposing penalties for non-compliance observed during inspection of b percent of the installed systems. The strict enforcement of the quality standards has been Instrumental in achieving the relatively high ratio, 97 percent, of successfully operating biogas systems.

Training of users

The successful operation and maintenance of biogas systems is the common responsibility of the owner, the constructing company and the SNV/BSP. The constructing company is responsible for providing the user with on-site training in the use and maintenance of a biogas systems. The company staff accomplish this at the time of plant construction. A simple illustrated booklet on operation and maintenance is provided to the user during commissioning. In addition, users are given a one-day group-training on the operation and maintenance by the staff of the construction companies. About 63,962 (nearly 85 percent female users) have been trained on the operation and maintenance of plants. Additional advice on the optimal functioning of the biogas systems is provided as part of the yearly maintenance visits paid by technicians of the companies. As a result, most users have reported that it is easy to operate a biogas system. It was nevertheless observed that users needed further information, promotion and extension for the proper use of digested slurry as a fertiliser for agricultural production.

Guarantee of after sales service

To ensure the success of biogas technology in Nepal, participating companies are required to follow an after sales service program including;

- one year guarantee on pipes, fittings and appliances;
- three years guarantee on the structure of the plant;
- an annual maintenance visit in the last five years of the guarantee period (from 1996/97 onwards reduced to the last two years); and
- a response visit after the owner has lodged, in writing or verbally, a complaint at the office of the company valid for a period of six years (reduced to three years for units installed after 1996/97),

Participation fee collection

A sum of 500 Nepalese Rupees (NRs) LJS\$ 6.76 (exchange rate for the year 2003: 1US\$ = 74 NRs) is collected from the farmers as participation fee. This sum is deposited into the account of AEPC. The purpose of this approach is to ensure the availability of fund for activities of the biogas sector such as training, research and promotion of the technology.

3.6. Successful programme management during conflict

The ongoing political conflict has created problems in the continuation of several development programs in the country. The SNV/BSP too has fallen into the clutches of this unfavourable situation. However, with the help of certain measures the program has been able to continue successfully even in conflict areas. The measures opted among others are;

- assessing local security situation in the project areas for mobilising concerned fields staff for construction and regular monitoring and evaluation activities;

- regular information dissemination to the Companies on security situation areas for conducting biogas activities;
- co-ordination with security personnel; and
- proper management of construction materials and opting for High-Density Polythene (HDP) pipes instead of the Galvanised Iron (GI) pipes.

Above oil the realisation of the benefits of biogas has helped to gain the confidence from the dissidents as well. Another beneficial factor has been the transparency in the implementation of the program.

Chapter 4

THE ROLE OF KEY SNV/BSP STAKEHOLDERS

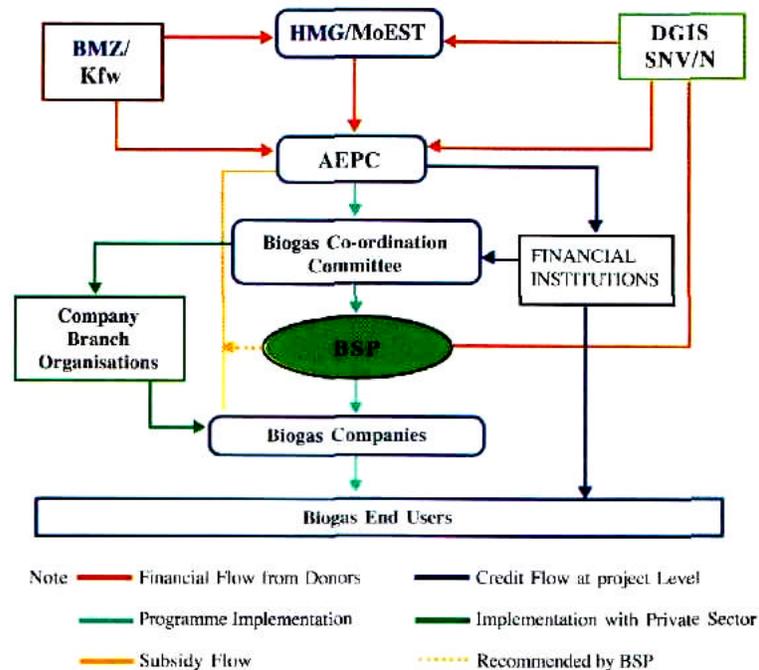
4.1. The institutional framework

The success of the SNV/BSP in Nepal is due, in part, to the active, supportive and coordinated roles of the six key partners. Their role and impact evolved with the implementation of the SNV/BSP and provides an important insight into the foundations of the BSPs success. The six key partners are:

- **donor agencies:** DGIS and BMZ;
- **HMG/N ministries/agencies:** MoF, MoEST and AEPC;
- **finance institutions:** KfW, ADB/N, other participating Banks and MFIs;
- **implementing agencies:** SNV;
- **private sector:** companies involved in biogas construction, service, and maintenance and the manufacture of biogas appliances (stoves, lamps, valves, etc.) and
- **end users:** active Involvement is necessary for successful contracting, financing, construction, operation and maintenance of the biogas systems.

The interactive framework of these key stakeholder groups is presented in Figure 4.1. A brief discussion of the key roles of each of these stakeholder groups follows.

Figure 4.1: Institutional set-up of Biogas Program (SNV/BSP was implementing until BSP III)



4.2. Donors

The donor agencies have supported through financial as well as technical contribution. The two donor agencies are:

- **The Netherlands Government, Directorate General for International Co-operation:** DGIS is one of the main donors of the Biogas Support Program in Nepal. DGIS has been providing financial support to the SNV/BSP since 1992. The financial support is in two parts: (1) support for SNV/BSP program management and (2) subsidy support for the installation of biogas systems. The unwavering long-term commitment of DGIS has been an important factor in the success of the SNV/BSP.
- **Bundes Ministerium für Wirtschaftliche Zusammenarbeit und Entwicklung:** The Government of Germany, through KfW has been supporting the BSP since 1997. The BMZ support targets two areas; (1) subsidy for purchase of biogas systems and (2) credits for purchase of biogas systems. The credits are available either through the ADB/N, which channels the credits/loans through its field offices to the biogas end-users, or through AEPC, which channels the credits/loans through qualified MFIs to the biogas end-users. The support of the BMZ for credits has had a major impact on increasing the access to banking and low-interest loans mainly for potential low-income biogas end-users.

4.3. HMG/N ministries/agencies

HMG/N has played a very supportive role in the success of the SNV/BSP. HMG/N has consistently provided finance for part of the subsidy available for biogas systems. In addition, it has allowed tax exemptions for biogas appliances and materials and has supported the development and promotion of successful biogas technologies in Nepal. The specific HMG/N agencies involved include MoEST and AEPC.

- **Ministry of Environment, Science and Technology:** MoEST is the line ministry for the biogas program. All policy matters related to biogas program have to be approved by MoEST, which has consistently supported the development and promotion of biogas systems for Nepal.
- **Alternative Energy Promotion Centre:** APEC was established in 1996 by HMG/N. The principal role of AEPC in support of the biogas program includes formulation and promotion of supportive policies for biogas, coordination of involved Government and donor agencies, monitoring the progress of the biogas program, channelling biogas credits to end-users through MFIs and promoting tax exemptions for biogas appliances, in addition, AEPC provides subsidy management and administration for a number of renewable energy applications.

4.4. Finance institutions

Both national as well as inter-national financing agencies have contributed in the investment process of the program and in the provision as well as disbursement of credit. The origin and roles of these institutions are described below:

Kreditanstalt für Wiederaufbau: KfW the German Development Bank has provided Nepal with subsidy amount of nearly 8.8 million Euro and credit support of 6 million Euro for biogas promotion since 1997. During the Phase III period the subsidy component provided by KfW covered nearly 75 percent. The KfW subsidy is pooled with the subsidy support from DGIS and HMG/N.

Agricultural Development Bank, Nepal and other commercial banks:

The ADB/N has been the leading bank for biogas loans since the inception of the biogas program. The ADB/N was also initially responsible for channelling the available subsidies to eligible end-users. It accomplished this through its field offices by combining the subsidy with its loans. Later on the subsidy was channelled through the central ADB/N office directly to the biogas companies. Two other commercial banks, the RBB and the NBL were also involved in providing loans to farmers for the installation of biogas systems, but their role has not been as significant as the ADB/N. With branch offices in rural areas, the ADB/N was much better placed to provide loans to interested farmers.

Micro Financing Institutions: Besides the banks, MFIs have also participated since 2000 in providing credits to end-users for biogas systems. These MFIs are organised by the local community and mostly located in rural areas. The primary role of the MFIs has been to provide loans for agriculture based activities and other social needs. Since 2000 they have expanded to consider loans for installation of biogas systems. SNV/BSP together with AEPC is supporting these MFIs in their biogas activities through training and advisory assistance.

4.5. Implementing agencies

SNV/Nepal initiated the BSP in 1992. Since then it has consistently provided technical, managerial as well as financial support to strengthen and grow the SNV/BSP. As a result, the SNV/BSP has, in the course of the three phases, contributed significantly to the development of the biogas sector in Nepal.

SNV/BSP has provided technical backstopping, developed and implemented strict quality control measures and standard, monitored and evaluated the progress of the biogas program, trained 4users (mainly female) promoted and coordinated the key biogas partner, advised and counselled the biogas companies on good business practices, institutional support, lobby at government and donor level, establishment of extension services and other related business development activities.

4.6. Private sector/biogas companies & appliance producers

The private sector biogas companies and biogas component manufacturers have played a significant role in supporting the success of the biogas program in Nepal. Since 1992/93 there has been a significant growth in the number of private sector biogas companies. In 1992 there was essentially only one biogas company, the GGC. Presently, there are over 39 approved biogas companies. These private sector companies are involved with the construction and installation of the biogas systems as well as providing after sales service. In addition, there has been a growth in the number of private sector companies that manufacture biogas system components such as slurry mixers, gas pipes, water traps, and gas valves, stoves and lamps. Currently 39 biogas companies and 15 component manufacturers have been recognised by the SNV/BSP for installation and supply of biogas appliances

Box 4.1: Experience of a poor farmer

"I could never have thought of a biogas installation if I had to do it on my own. With the help of the Women's Organisation I approached the Micro Finance Institute - Tinpipale, Banepa. Here I received information on biogas technology and financial support. Today I am a proud owner of this clean technology."

Ms Sannani Danwar
Dhulikhel

respectively. As a result the systems, mainly of the fixed dome types, have been installed in 65 districts of the country.

Nepal Biogas Promotion Group: me NBPG was established in 1995 as a formal branch organisation of the biogas companies. It was established as a result of the growing Interest of institutional and private sector in the biogas market. With the support of SNV/BSP-Nepal, NBPG assisted in improving quality control of biogas systems, import of the main gas valves and distribution to the biogas companies, technical publications and some promotional activities.

Regional Biogas Coordination Committee (RBCC): SNV/BSP has also encouraged biogas companies to establish RBCC. The purpose of this committee is to consolidate their effort in biogas promotion, marketing, promotion of slurry utilisation and coordinating with local stakeholders. Eventually, four Regional Coordination Committees in Itahari (East), Bharatpur (Central), Pokhara and Butwal (West) were established. These committees are mainly involved in biogas promotion, slurry extension program and regulating biogas marketing within their working areas.

4.7. NGO support for the biogas program

The SNV/BSP has encouraged the involvement of local NGOs and INGOs in the promotion of biogas in Nepal. Specifically, the SNV/BSP has helped to formulate a coalition of NGOs active in biogas activities. The Chairperson of the Coalition was nominated as a member of Biogas Coordination Committee. Several interaction programs have been organised with farmers through this coalition. Altogether 35 local NGOs are members of the coalition. These NGOs are mainly involved in providing information on biogas, identifying demand for biogas systems and bridging relations between biogas companies and biogas users.

Chapter 5

PRINCIPAL BENEFITS OF BIOGAS SYSTEMS

Biogas technology provides multiple benefits at household, local, national and global levels with major impacts on gender, poverty, health, employment and environment. Communities that adopt biogas systems quickly realise the social, economic, development and environmental benefits for their households. In order to assess these benefits, average values have been compiled from recent studies conducted by East Consult in 2002/2003 and SNV/BSP in 2003⁶

The average amount of gas produced in the Terai region is 1,430 litres per day per system and an average of 915 litres in the Hill region. All the systems are 100 percent dung fed, 59 kg for the Terai and 39 kg for the Hill region. Using these values, an analysis of the various benefits derived from the 111,395 systems, installed as of June 2003 (SNV/BSP, 2003), is described below.

5.1. Social benefits

Health benefits

Indoor air pollution and smoke exposure, from the use of fuelwood, dung cakes and agricultural residues for cooking and heating, in rural Nepal is amongst the worst in the world. It is one of the major causes for acute respiratory infections among women, infants and children (Pandey, 2003). This, in turn, is one of the most important causes of child mortality in the country. The use of biogas significantly improves the indoor air quality. Since women and female children are the ones predominantly involved in cooking, they are the first beneficiaries in terms of improved health.



Photo 5.1: Kitchen with biogas stove

Moreover, since the combustion of biogas is relatively clean, it reduces eye ailments associated with smoke from ordinary fuelwood stoves. In addition, dung management and sanitary toilets attached to biogas digesters lead to better hygienic conditions. It helps keep the areas surrounding households clean and reduces the chances for the spread of infectious and other diseases,

By July 2003, the biogas program has contributed to improved health for 111,395 families. The primary benefit is due to reduced indoor smoke and air pollution resulting in reduced respiratory diseases. With the attachment of 80,000 toilets to the biogas digesters, improving hygiene and health in these rural households has lead indirectly to savings on other health-related expenses. Indoor-air-pollution from

⁶ The benefits have been analysed with respect to the overall impact from SNV/BSP-III Program with 111,395 biogas systems and valued of fuelwood, kerosene, dung, agro-wastes and fertilisers saved are based on the findings of Biogas Users Survey, 2003/2004, by East Consult

cooking fires in rural Nepal, expressed in Respirable Suspended Particulates (RSP), carbon monoxide (CO) and formaldehyde CHCHO), are major causes for acute respiratory infections in women and children. This in turn is, among the most important cause of child mortality in Nepal. A case study on the introduction of smokeless fuelwood stoves in a rural Hill Region of Nepal found such stoves to have a significant beneficial effect on the levels of RSP exposure and a considerable effect on CO and HCHO concentrations, Biogas stoves, because of its relatively clean combustion characteristics, have even more pronounced beneficial effects than smokeless fuelwood stoves.

Eye ailments are commonly associated with smoke-filled rooms. The use of biogas stoves is expected to significantly reduce eye ailments associated with smoke from fuelwood stoves. Many biogas users have reported improved eye health. However, smokeless rooms are not always considered a benefit. Smoke is traditionally used to ward off insects. Some users of biogas stoves have indicated that the stoves fail to keep away insects and especially mosquitoes.



Photo 5.2: Children studying under the biogas lamp

Improved sanitation and dung management leads to better hygienic conditions. Toilets are attached to 72 percent of all systems constructed- Attached toilets not only improve the hygienic conditions in and around the farmyard but also offer privacy. The net result is a cleaner environment and a decrease in the opportunities for the spread of diseases.

Education

The time saved from the use of biogas has enabled female children to attend school, which previously was not possible as they were involved with household chores as well as collection of fuelwood and water. 20 percent of the households use biogas lamps for illumination, This has provided convenient means for reading or study even in the evenings.

Impacts on poverty

The primary impact of biogas systems on poverty alleviation has been to reduce the financial costs expended on fuel for cooking and lighting. Although most of the adopters of biogas technology have been among the larger and medium-scale farmers, smaller-scale farmers have been increasingly attracted to the use of biogas. The policy of a flat rate subsidy favours smaller system sizes and smaller-scale farmers more than larger-scale farmers. In addition, the increasingly active involvement of local NGOs in the promotion, organisation, financing and construction of biogas systems on the basis of self-help has the added benefit of bringing biogas systems within the reach of smaller

Box 5.1: User's view

"Before the installation of the biogas system I used to go to the jungle every day to collect the fuelwood. But now I go only once a week to collect fuelwood. I have indeed saved a lot of time. In addition to the time spent and the drudgery of carrying fuelwood, the procurement of fuelwood from protected areas meant facing the risk of getting caught by forest guards. Those days are now over."

Phul Kumari Sigdel
Ghari

farmers with fewer cattle. However, biogas does not benefit those farmers without cattle who generally represent the poorest strata of society. Cattle-less, landless and marginal farmers may benefit only indirectly, from increased employment opportunities and greater availability of fuelwood.

The BSP has provided employment for 11,000 persons and, as mentioned in Chapter 2, indirectly supported more than 65,000 persons⁷. As less than 10 percent of the potential users of biogas systems (i.e. cattle farmers) have been reached by the SNV/BSP, this employment figure can be expected to increase further or be maintained for a prolonged period of time. Thus, the BSP has contributed directly in poverty alleviation by generating employment in different development sectors: manufacturing, construction, financing, services, quality control and administration,

5.2. Gender benefits and costs

The biogas systems have been able to meet both the practical and strategic gender needs.

Women and female-children are responsible for preparing and processing food and working in the kitchen. Biogas systems have provided a direct benefit to the women and female children by reducing the drudgery and danger to personal safety related with procuring fuelwood. Less fuelwood has to be collected which results in saved labour. It is reported that using biogas saves 3 hours per day for a woman as a result of the reduction in time used for collecting fuelwood, chopping them into smaller sizes, reduced time for cooking meals and, to a lesser extent, in time required for cleaning cooking utensils (see Table 5.1). As a result of the user-friendly nature of biogas stoves, the traditional role of cooking is changing to where it is now reported that male members of the family are increasingly engaged in cooking.



Photo 5.3: Women operating the biogas system

Table 5.1: Time impact of a biogas system for a typical rural household

Activities	Change in Time Spent		
	Before	After	Time
Collection of fuelwood*	156.7	91.28	66
Dung collection*	3.07	1.73	1
Agro-residue collection*	2	1	1
Cooking**	198	112,8	86
Cleaning of utensils**	88.8	51	38
Water fetching (for household use and		1.98	-2
Mixing dung with water**		10	-10
Total time saved			180 (3 hrs)

Source: *East Consult, 2004; **Dahal 2000

⁷ Cumulative result arrived as per the information provided in the contract between the companies and the BSP

After the installation of biogas systems, it is reported that the kitchen is increasingly used as a drawing or family room because it is now free from smoke exposure and is better lighted. In many cases, members of the family now gather in the kitchen and discuss internal household and external community matters. The biogas system, by providing female members of the family opportunity to take part in the discussion, has fulfilled some strategic gender needs as well.

On the cost side, biogas systems require some time for the collection of water and mixing of dung and water to keep the system operational. Time required for collection of dung, herding, collection of fodder and application of dung to the fields is not affected by the operation of a biogas system. An estimate of the average positive and negative time impacts of a biogas system is presented in Table 5.1 while Table 5.2 indicates an average time saving of approximately three hours per HH per day when a biogas system is installed, i.e. an annual saving of nearly 1,095 hours per HH per year. Actual savings per HH may vary according to the availability of fuelwood, dung and water. With 111,395 plants installed by the end of Phase III, the time saved amounts to an overall labour time saving of approximately 37,000 persons per year, considering a 10-hour working day. This time can be invested in income generating activities.

Table 5.2: Total time saved in using biogas systems

Time saved per HH per day	3 hrs.
Time saved per HH per year	= 3X365 = 1,095 hrs
Total Number of HH with Biogas systems	= 111,395
Approximately total time saved	= 111,395/3 = 37,000 wo(man) hours

Studies conducted by Dahal 2000 and East Consult 2004 have also highlighted the women's contentment with the technology. The main reasons for this satisfaction are:

- smokeless nature of the biogas fuel;
- cleaner utensils requiring less effort to clean;
- less attention required at the fireplace to keep it burning; and
- time available for other household activities even while cooking.

Introduction of biogas did not necessarily change entrenched traditional patterns in the division of labour. In the Nepalese context, reduction of workload is to be considered as a pre-condition to make opportunities available for women to earn additional income, organise and attend meetings, increase awareness, achieve literacy and gain financial security. Table 5.3, The SNV/BSP has contributed to the fulfilment of several of these objectives.

Table 5.3: Utilisation of time saved from biogas installation

Income generating activities (Women)	Other activities (Women)
Vegetable Farming	Household activities such as child care, cleaning and washing
Retail shops	Visiting friends
Tailoring	Gardening
Service	Religious and social works
Agriculture	Education

Women own about twenty percent of all biogas systems. Female members have contributed as labourers in the construction of biogas systems; however, their participation in institutions like biogas companies, banks and NGOs is low.

5.3. Environmental benefits

The introduction of biogas technologies in Nepal has significantly contributed to the improvement of the local, national and global environment.

Local environmental benefits

From a local perspective, the use of biogas has helped significantly improve the indoor air quality of homes employing biogas stoves in place of wood stoves. In addition, installation of biogas systems has resulted in better management and disposal of animal dung and nightsoil. This fact alone has helped improve the sanitary conditions in the immediate vicinity of 111,395 rural homes using biogas systems.

National environmental benefits

From a national perspective, biogas systems have helped reduce deforestation. This in turn has important implications for watershed management and soil erosion. In addition, biogas systems, where the slurry is collected and returned to fields, have helped reduce the depletion of soil nutrients. This in turn reduces the pressure to expand the area of land cleared for agriculture, the principal cause of deforestation in Nepal.

A total of 111,395 biogas systems have been installed under SNV/BSP I, II & III. It is estimated that more than 97 percent of these biogas systems are currently operational and are used on a regular basis producing about 55 million cubic metres of biogas annually. The operational biogas systems are estimated to displace the use of 222 thousand tonnes of fuelwood, 3.6 million litres of kerosene and replaces chemical fertilisers with 189 thousand tonnes of bio-fertiliser annually (Table 5.4). The savings in fuelwood help to slow the rate of deforestation in rural Nepal, while the savings from kerosene and fertiliser reduce expenditure of foreign currency.

Table 5.4: Fuel and fertiliser savings from biogas systems

Particulars	Saving per system per	Total annual saving
Fuelwood (tonnes per year)	2.00	222,790
Kerosene (litres per year)	32.00	3,564,640
Bio-Fertiliser (tonnes per year)	1.70	189,372

Source: BSP-N, 2004

With the installation of biogas systems, the annual reduction of fuelwood per HH is 2 tonnes. Following the assumption that 32.7 metric tonnes of fuelwood is harvested per hectare per annum (IUCN, 1995), the notional impact of using biogas on the protection of forest is as follows: using 111,000 systems, there is a protection of 6,790 ha of forest land and a total of 9 million trees (Table 5.5).

Table 5.5: Impact of biogas on forest

Particulars	Nepal	Remarks
Total number of systems installed	111,395	
Annual Savings (tonnes per HH per year)	2.00	
Total fuelwood saving (tonnes of fuelwood)	222,790	
Equivalent Forest area Protection at present (Ha)	6,790	1 Ha grows 1,350 fully grown trees*
Number of Trees Saved	9,165,137	

Source: * Dutta. S et. al, 1997, pp53

5.4. Global environmental benefits

Biogas fuel helps reducing greenhouse gas emissions by displacing the consumption of fuelwood and kerosene. The biogas used in a sustainable basis assures the CO₂, associated with biogas combustion will be reabsorbed in the process of the growth of the fodder and food for the animals. All the CH₄ and CO₂ emissions that are associated with the combustion of fuelwood can be accounted as being displaced when replaced by a biogas system. According to recent studies⁸ the available carbon reduction per year per system from the displacement of fuelwood, agricultural wastes, dung and kerosene is nearly 4.6 tonnes of carbon equivalent (this computation excludes GHG saving from forest use). The net CO₂ emission savings available from the use of biogas as against the use of fuelwood and kerosene is presented in Table 5.6.

Table 5.6: Net GHG savings per system (tonnes of CO₂ equivalent/biogas system/year)

Size of System	Tarai	Hills	Mountains
4m ³	2.56	2.68	2.77
6 m ³	5.85	3.92	4.00
3m ³	7.56	4.59	4.70
10 m ^a	5.98	3.67	3.37
Average size	4.60		
Total GHG savings is - 111,395 X 4.6 = 512,417 tCO ₂ e/year			

Source: Winrock & Eco Securities et. al, 2004

Accounting for the operational biogas systems, a net reduction of approximately 510,600 tCO₂ e/year is derived from the displacement of the use of fuelwood and from the reduced consumption of kerosene, Assuming the value equivalent to US\$ 4.5 per tonne, CO₂ would result in a national economic value of US\$ 2.3 million per year for the greenhouse gas displaced by the biogas units in Nepal.

⁸ CDM Baseline Study, Winrock & Eco Securities et. al, i!U04, The Netherlands and Winrock International Nepal. 2002.

FINANCIAL AND ECONOMIC ASSESSMENT

This section provides an insight to the financial and economic benefits from the use of biogas. The analysis has been carried out for both the plant level and project level. The computations are based on the data available for July 2003, for the total of 111,395 numbers of systems.

6.1. Benefits from reduced use of fuelwood

The use of biogas directly results in reducing the household consumption of fuelwood. The decrease in fuelwood consumption has three principal benefits. First, it provides a financial gain for households by continuing to get for free from the forest practice. Second, it reduces health costs (discussed later in this section) by significantly improving indoor air quality. Third, it contributes significantly to reducing Green House Gas (GHG) emissions, which result from burning of non-sustainable fuelwood and inefficient cook stoves.

With an average of 2 tonnes of fuelwood saved per HH, as shown in Chapter 5, there is annual saving of more than 222 thousand tonnes of fuelwood. This saving is worth nearly, NRs 355 million (4.8 million US\$) considering average costs of fuelwood per kg to be NRs, 1.6 per kg. Table 6.1.

Table 6.1: Financial benefits from fuelwood savings

Particulars	Average
Change in the use of fuelwood (tonnes/HH/year)	2,00
Cost of fuelwood (NRs) per tonne	1,60
Annual financial saving (million NRs)	355
With 1 US\$ = @ NRs 74, The total savings is 4.8 million US\$	

Source: East Consult, 2004

6.2. Benefits from reduced use of agricultural residue

In case of agricultural residue formerly used as fuel for cooking, there also have been significant reductions after the installation of the biogas systems. The average estimated decrease in the use of agricultural residue is about 2.7 kg per HH per day when a biogas system is installed. The primary economic benefit from the reduction in the use of agricultural residues stems from the organic value these residues have when allowed to be ploughed back into the soil. The net annual saving amounts to 109,390 tonnes, Table 6.2.

Table 6.2: Quantity of agro-residue savings

Change in the use of agro residue	Amount
Total saving kg per system per day	2.70
Total saving kg per system per year	985.5
Total number of systems	111,395
Total annual Saving tonnes per year	109,779

Source: East Consult, 2004

6.3 Benefits from reduced use of dung

Similarly, changes have been observed in the use of dung. Prior to adoption of a biogas system, the dung was dried and used as a household fuel for cooking and heating. With a biogas system, it is used to feed the biogas system. There is an average reduction in the use of dried dung of nearly 0.7 kg per HH per day. This amount to an annual reduction of 28.461 tonnes, Table 6.3. This reduction leads to reduction in the burning of dung cake for sustained production of gas and the conversion of dung cake into bio-slurry. This has twofold benefit: preservation of forest resources and restoration of organic matter balance of the soil through the return of the biogas slurry.

Table 6.3: Financial benefits from dung savings

Change in the use of dung	Amount
Total Saving kg / day / system	0.07
Total Saving kg / year / system	255.5
Total number of systems	111,395
Total annual saving tones / year	28.461

Source: East Consult, 2004

This substantially reduces the emission of GHG and is a principal contributor with the biogas systems. Moreover, the dung is not lost as it is used as fertilizer after it has been digested in the biogas system. Thus, a majority of the Nitrogen, Phosphorus and Potash (NPK) content of the dung is recycled and will improve soil condition and agricultural output, enhancing a farmers own sustainability (East Consult, 2004).

6.4 Benefits from reduced use of kerosene

The average reduction in the use of kerosene is of the order 0.19 litres per HH per day. Thus, at the national level there is a net annual foreign saving of 7.7 million litres of kerosene, contributing to decreased expenditures and increased comfort and safety for the households. The estimated annual foreign exchange saving are NRs. 153 million (US\$ 2 million) associated with the expenditure for kerosene, Table 6.4.

Table 6.4: Financial benefits from kerosene savings

Change in the use of kerosene	Amount
Saving kg / system / day	0.19
Saving kg / system / year	69.35
Total number of systems	111,395
Total annual saving million litres / year	7.70
Total annual financial (million NRs)	154
With 1 US\$ = @ 74, the total savings is 2.08 mission US\$	

Source: East Consult, 2004

6.5. Benefits from reduced use of chemical fertilisers

The rural farmers in Nepal have begun to rely and use more chemical fertilisers. With the introduction of biogas, the composted bio-slurry can reduce the need for chemical fertilisers. With the use of slurry from the digester, declines in the use of chemical fertilisers have been observed when farmers have a biogas system. It is estimated that there is an average annual saving of 39 kg nitrogen, 19 kg phosphorous and 39 kg potash per HH using slurry as manure in the vegetable farms (East Consult, 2004). This reduction translates into an annual financial saving of NRs 1,530 (US\$ 20.70) per HH, At the national level this amounts to an annual saving of 562 tonnes of nitrogen, 274 tonnes of phosphorous and 563 tonnes of potash resulting in an annual financial savings of NRs 22 million (US\$ 298,350), (Table 6.5).



Photo 6.1: Farm growing vegetable using slurry from biogas digester

Table 6.5: Financial benefits from chemical fertiliser savings

Particulars	N	P	K
Fertiliser saved kg/HH/year	39	19	39
Number of systems	111,395		
Number of HH using slurry as fertiliser 13 percent of 111,395 (East Consult 2004)	14,430		
Annual saving of fertiliser	562,770	274,170	562,770
Price of fertiliser NRs/kg	15	21	14
Total annual saving NRs	8,441,550	5,757,570	7,878,780
Total fertiliser saving (NRs)/year	22,077,900		
Total saving per year in US\$ (1 US\$=74 NRs)	298,350		

Source: East Consult, 2004

6.6. Financial analysis

The financial attractiveness of the SNV/BSP is viewed from the perspective of the individual end-user or customer while the economic analysis is assessed from the program or national perspective. In the economic analysis, all subsidies and taxes are eliminated, border prices are used for kerosene and other imported goods and opportunity costs are used for fuelwood, fertiliser and other commodities. Subsidies provided for the biogas systems are considered as a cost in the economic analysis. The assessment is based on determining the financial internal rate of return for the customer and the economic internal rate of return for the program. Only a representative analysis is presented in this paper to illustrate the financial and economic attractiveness of the SNV/BSP.

Financial analysis of 6 m³ system in the Hills and Terai

The financial analysis is based on a biogas system built in the Hill and Terai districts with capital cost of NRs 23,113 (US\$ 312) and 21,411 (US\$ 289) respectively and the applied subsidy rate of NRs 6,500 (US\$ 90) for the Terai and NRs. 9,500 (US\$ 128) in the Hills. The basic data for the financial analysis are presented in Annex 3.

The benefits associated with the use of the biogas system are derived primarily from the savings in expenditures for fuelwood and kerosene, The base price per kg of fuelwood is assumed to be NRs 2 (US\$ 0.03 per kg) for the Hills and NRs 1.5 (US\$ 0.02 per kg) in the Terai and the base price for kerosene is 20 NRs per litre (US\$ 0.27 per litre), The value of the saved labour and the recovered nutrients in the biogas slurry are assumed to be zero.

Assuming a life span of 20 years, the base analysis, which included only the saving of fuel like fuelwood and kerosene, gives a Financial Internal Rate of Return of 21 and 16 percent in the Hills and Terai respectively. Adding to this the benefits due to subsidy, NRs 9,500 (US\$ 128) in the Hills and NRs 6,500 (US\$ 90) in the Terai the FIRR increase to 37 and 24 percent in the Hills and Terai respectively, For the same life span of 20 years, base price of fuelwood (US\$ 0.02 per kg in the Tarai; US\$ 0.3 per kg in the Hills) and including subsidy and the savings on NPK from the use of slurry as manure, the FIRR increases to 48 and 35 percent in the Hills and Terai respectively. This indicates that the resulting FIRR is extremely sensitive to the subsidy and savings on nutrients in both regions.

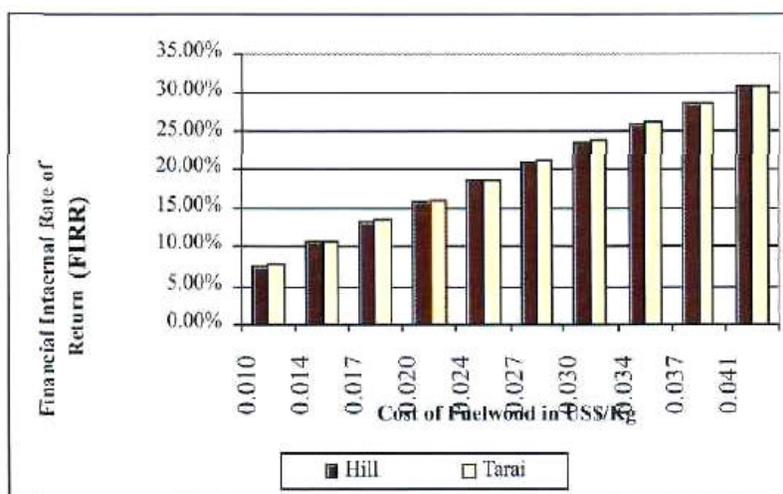


Figure 6.1: FIRR vs. fuelwood price

Figure 6.1 presents the results of a sensitivity analysis with respect price variations of fuelwood. The reduction in fuelwood cost to NRs 1 (US\$ 0.01 per kg) in the Hills the FIRR reduces to 10 percent while doubling the cost of fuelwood to NRs 4 per kg (US\$ 0.05 per kg) the FIRR changes rises to 40 percent. Similarly in the Terai when the fuelwood cost is halved to NRs 0.75 per kg (US\$ 0.01 per kg) the FIRR reduces to nearly 8 percent and doubling the cost to NRs 3 per kg (US\$ 0.04 per kg) FIRR raises to 40 percent. The actual price of fuelwood in Nepal varies considerably from

one area to another. The perception of the rural farmer is that the price of fuelwood is near zero since fuelwood can be collected by household labour, which is not valued highly by the farmer.

A sensitivity analysis on the amount of the subsidy provided is presented in Figure 6.2. The base data for subsidy of US\$ 128 and US\$ 90 in the Hills and Terai respectively indicates that the FIRR is 37 percent and 24 percent respectively. In case of the Hills a subsidy rate of US\$ 64 gives an FIRR of 36 percent. On doubling the subsidy per biogas unit the Hills to US\$ 256, the FIRR is nearly 160 percent. In the Terai the FIRR is 28.51 percent when the subsidy is reduced to US\$ 44, however, it rises to 62 percent when subsidy is doubled to US\$ 176.

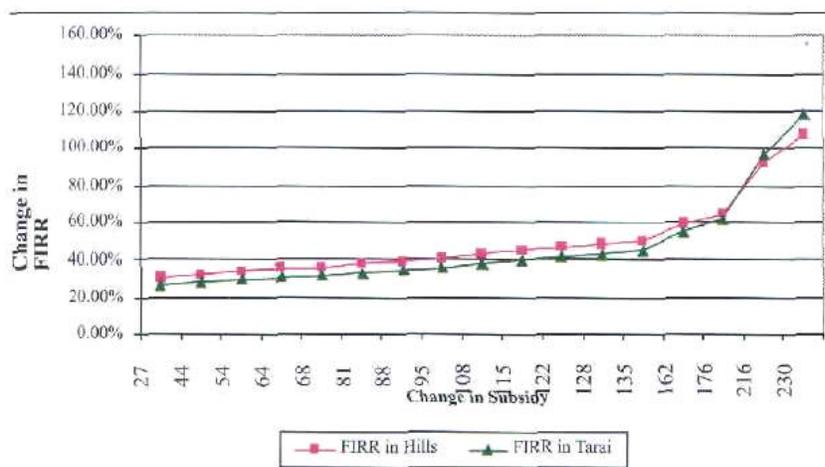


Figure 6.2: FIRR vs. amount of subsidy

The financial analysis for both the Hill and Terai districts indicates that the present level of subsidy is generally sufficient to attract potential farmers while not being significantly excessive as to result in relatively high FIRRs for the farmer. The actual FIRR realised by the farmer is largely dependent on the local cost of fuelwood.

6.7. Economic analysis

An economic analysis of both a representative 6 m³ biogas system built in a Hill district and of the entire program was undertaken to assess the benefits to society of the use of biogas systems and of the grant support provided to the operation of the BSP. The values are based on the prices of 2003. Due to the limited scope of this paper, the economic analysis relies heavily on data presented in an evaluation of the BSP carried out for DGIS (Mendis and Van Nes, 1999). This data provides a reasonable basis for the economic analysis.

Several assumptions were necessary to carry out the economic analysis. The principal assumptions relate to the conversion from financial prices to economic prices for both the costs and benefits associated with the biogas systems and the biogas program. A summary of the conversion factors and resulting economic prices for the costs and benefits associated with the analysis is presented in Annex 4. Economic benefits resulting from improved sanitation through toilet attachment and

employment generation were left out of consideration. The analysis is based on calculating the Economic Internal Rate of Return (EIRR) for the net annual benefits associated with either the representative biogas system or the entire BSP,

The economic analysis for the biogas system was carried out assuming a system life of 20 years, All capital costs for the system are assumed expended in the first year, Operation and Maintenance (O&M) costs and all resulting benefits were assumed to be constant over the 20-year life of the system. A summary of the resulting EIRR for the 6 m³ representative biogas system built in the Hill district is presented in Figure 6.3.

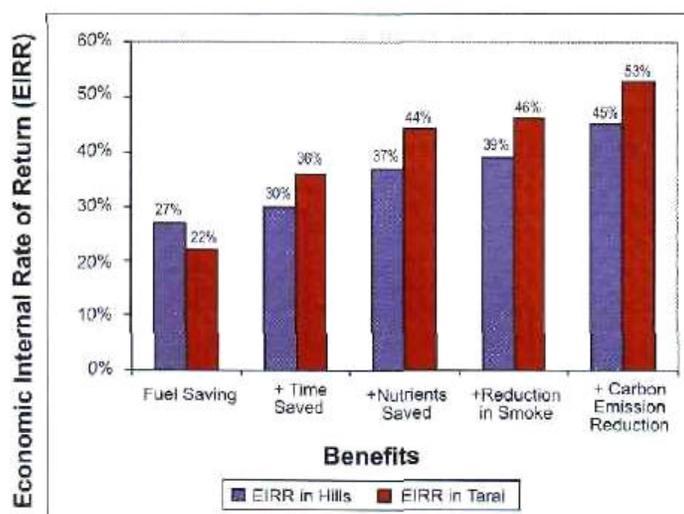


Figure 6.3: EIRR for biogas system (6m³)

Working with the base economic price for fuelwood of NRs 1.5 (US\$ 0.02), the EIRR achieved is 27 and 22 percent in the Hills and Terai respectively, Adding a saving in time (three hours a day of domestic labour) valued at NRs 2.0 per day (US\$ 0.03) results in increasing the EIRR to 30 and 36 percent in the Hills and Terai respectively. Assuming an annual saving of value of NRs 1,547 (US\$ 21) for the nutrients in the dung that are saved and returned to the land as a result of the biogas system, the EIRR increases to 37 percent in the Hills and 44.14 percent in the Terai. When the economic value of smoke reduction is added at NRs 400 per year (US\$ 5.4) equal to US\$ 4.32 per system per year for the 20 year life of the biogas system, the resulting EIRR increases to 39 percent in the Hills and 46.11 percent in the Terai. Finally, if the reduced carbon emissions associated with the use of a biogas system are valued at an annual rate of US\$ 20 per tonne, the resulting EIRR increases to 45 and 53 percent in the Hills and Terai respectively.

6.8. Economic analysis of entire SNV/8SP

The results of the economic analysis of the costs and benefits of the entire BSP I, II and III are presented in Figure 6.4. The analysis was carried out for a period of 20 years to account for all the costs and benefits associated with the biogas systems installed over the twelve-year implementation period. An attrition rate of two percent per year was assumed for the installed biogas systems with the remaining systems retired after 15 years. The expenditures for technical assistance and capital were disbursed over the first five years in accordance with the Technical Assistance (TA) expenditures and capital expenditures associated with the number of units constructed in the same five years period. The annual O&M costs and associated benefits were calculated based on the rate of system constructions. A summary of the TA and capital expenditures of the program is presented in Annex 5.

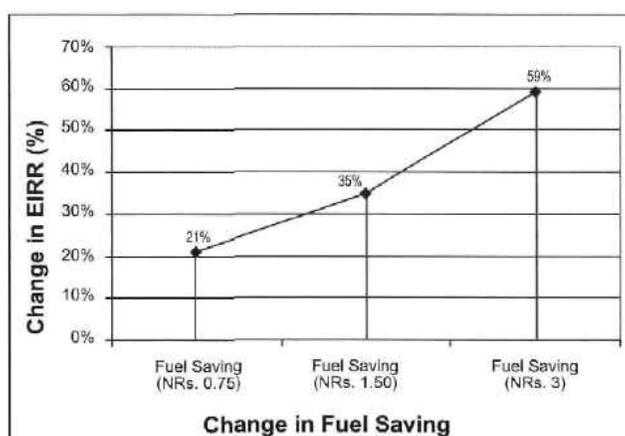


Figure 6.4: EIRR for changes in fuel saving alone

The EIRR is 35 percent when accounting for just the programs savings of fuelwood and kerosene. For this base case, fuelwood is valued at NRs 1.5 per kg (US\$ 0.02 per kg) and that of kerosene is NRs 25 (US\$ 0.34). When fuelwood is valued at NRs 0.75 per kg (US\$ 0.01 per kg), the EIRR is only 21 percent. Alternately, when it is valued at NRs 3 per kg (US\$ 0.4 per kg), the EIRR is 59 percent (Figure 6.4). This indicates that with the rise in the cost of fuelwood the benefit of the BSP increases.

Taking the base case value of fuelwood of NRs 1.5 per kg (US\$ 0.02 per kg) and adding the benefits from saved domestic labour results in an EIRR of 41 percent. Adding the total value of the nutrients saved by the SNV/BSP increases the EIRR to 53 percent. Including the conservative estimates for the health benefits of smoke reduction (US\$ 4,86 per HH per yr) increases the EIRR to 56 percent. Finally, adding the value of the reduced carbon provides an EIRR of 68 percent, Figure 6.5.

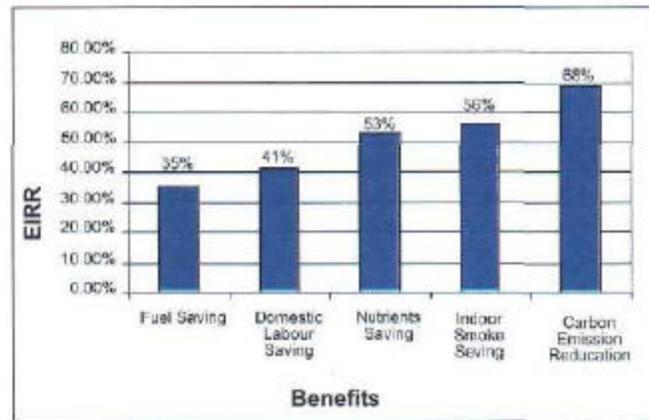


Figure 6.5: EIRR for biogas system

Given the above analysis, there is an economic justification for the limited subsidy provided for the biogas systems and the grant support provided for the BSP. Furthermore, it is unlikely that without the subsidy the Nepalese farmers would have sufficient financial incentives to adopt the biogas systems. The earlier financial analysis clearly indicated how sensitive the farmers' FIRR is to the price of fuelwood. As most farmers do not directly purchase fuelwood, their perception is that the price of fuelwood is at or near zero. As a result, their perceived FIRR is negative. Alternately, if the economic value of fuelwood is NRs 1.5 (US\$ 0.02) and NRs3 (US\$ 0.04) per kg, then the resulting EIRR for the biogas system is 35 percent. When the other principal non-market benefits of the biogas system are added, the EIRR rises to nearly 42 percent. This provides an additional justification for the subsidy for the biogas systems. The EIRR of the net benefits reach higher than 60 percent when the principal non-market benefits are accounted for in the analysis. This latter number is once more a clear indication of the economic justification of the grants.

Chapter 7

CHALLENGES AND OPPORTUNITIES

The BSP has had to overcome a number of technical, social, institutional and financial barriers to reach its present status. These barriers are compounded by the challenging geographical features of the country, the broad range of climatic conditions and the poor economical status of the rural districts. For the past decade, this program has had the support of Government and donors (principally DGIS and KfW) for operational costs and consumer subsidies to help overcome many of the barriers. However, the continuation of this support is uncertain. The consumer subsidy is scheduled for phase-out by 2009 as will the operational support of DGIS by the same period. Thus, the BSP faces the challenge of continuing its successful growth without its traditional sources of support. The future will depend on its ability to operate "on a commercial basis. This presents both challenges and opportunities. A significant opportunity on the horizon is the potential commercial value of the GHG mitigation benefits of biogas systems. The CDM of the United Nations Framework Convention on Climate Change, (UNFCCC) Kyoto Protocol presents the opportunity to convert the avoided GHG emissions that result from biogas systems into saleable Carbon Emission Reduction (CERs) credits. A growing market for CERs currently exists in most developed countries. The revenues derived from the sale of the CERs can provide a basis for replacing the declining Government and donor support and thereby sustain the growth of biogas program in Nepal.

7.1. Program challenges BSP-IV

The principal objectives of BSP-IV are:

- coordinating the construction of 200,000 biogas systems in six years;
- realising the commercial value of GHG emission reductions that result from the use of biogas systems;
- reducing the costs while increasing the benefits for biogas users;
- establishing a viable business plan; and
- instituting an ISO quality control program in which the end-user is the focal point.

In addition, the BSP needs to continue to comply with the original development objectives:

- reach the poor and remote rural populations;
- develop and promote a reliable biogas technology for the higher altitude rural districts;
- develop new biogas products to enhance the overall market; and
- manage the overall development of the BCCs and finance for their services.

Reaching the poor and remote rural populations

To date, the biogas program has targeted areas that are comparatively easy to access and users that are economically better off than the average villager. The targeted users own cattle and land and are generally in the upper income bracket of rural farmers. However, it is estimated that less than a quarter of this targeted group have adopted biogas. Many potential farmers with cattle are not able to afford the initial cash payments, nor do they have access to financing to make these payments. For farmers that fall in this category and those that reside in the accessible areas, new financing solutions that address the initial cost constraints must be developed to increase the adoption of biogas in these areas.

Farmers living in remote areas where access is difficult due to lack of roads and rugged terrain face even higher costs for biogas systems. As a rule, these farmers are also poorer on average than their counterparts in the more accessible districts. The challenge to reach the remotest farmers in the Hills is compounded by the declining subsidy policy⁹ of the Government and the increase in delivery cost due to their remote locations. To develop this market will require both innovative financing models as well as continuation of the subsidy supports. This in itself will not be sufficient if biogas manufacturers are not willing to extend their services to these remote districts due to the limited profit margins associated with this market. In these instances, NGOs and other non-profit organisations may have a role to play.

Monetising the GHG benefits for BSP-N

The MoF intends to reduce subsidy for biogas in the future. This will reduce the number of farmers who can afford biogas systems while also taking away the incentive used to ensure that BCCs maintain their quality control. Increasing construction cost will also reduce the number of applicants who can afford new biogas systems.

The issue of reducing or eliminating the subsidy must be carefully evaluated since there are many economic, social and environmental benefits that result from the use of biogas which are not captured in the associated financial transactions. A strong case can be made for continuing the level of subsidy on the basis of the estimated value of national and global environmental benefits that result from the use of biogas systems. The value of the global environment benefits may be derived in the future from the sale of the CER benefits of the program through the proposed CDM of the UNFCCC Kyoto Protocol.

A Project Design Document for selling CERs associated with the BSP has been prepared by Eco-Securities and Winrock International Nepal for submission to Community Development Carbon Fund (CDCF) of the World Bank (WB). At this initial phase, WB is willing to purchase one million tonnes of CO₂ under this fund. The crediting period will be 10 years. Fund thus generated will be deposited in the account of AEPC and will be utilised for further development of biogas and other RETs. Emission Reduction Purchase Agreement between AEPC and World Bank is to be finalised in 2005.

⁹The level of subsidy based on QDA will be reduced gradually and will be phased out by 2009.

Reducing costs and increasing benefits

Reducing the construction and maintenance cost of the biogas system and yet maintaining its quality can be achieved by addressing delivery methods. This does not call for alternative designs, but requires R&D in the area of group or cluster contracting, material transport and purchase methods, marketing of farm produce and assisted self-help construction. These new techniques require collaborating with existing cooperative organisations.

Increasing the cash benefits of the biogas system is possible by providing information to the farmer on how to better utilise the slurry and to productively use the time saved as a result of having biogas. If the farmer is convinced that the time gained and the income received will be far more positive than the cash outlay for buying the system, the farmer will decide to purchase the biogas system, even if it requires paying off a medium term loan. This means that information to the farmer should be complete and financial structures should be available to allow the purchase when the business plan indicates a positive balance.

Promoting biogas in higher altitudes

A small percentage (estimated at 27 percent) of the rural population live in areas above 2,000 meters. In general this population is significantly poorer than their lowland compatriots. However, a segment of this population does own cattle and would have sufficient dung to support the operation of a biogas system. The challenge is providing this segment of the population with a biogas system that will operate effectively at high altitudes and in cold climates.

The bacteriological process inside the system requires a temperature range from 10 to 35 degrees Celsius for fermentation. As a result, the biogas technology is only feasible in areas where this system temperature can be maintained. Biogas systems that are installed in areas where the temperatures fall below 10 degrees Celsius must be adapted with thermal insulation and warm water feeding. This adds to the costs of the biogas systems resulting in the plants being more costly to rural populations in the high altitudes. There is a necessity for R&D to address these issues under a pilot project.

7.2. Maintaining quality standards

The BSP developed and monitors the quality and after-sales service programs for all its partners. In May 2003, it obtained an ISO 9001-2000 certification as a result of this practice. To achieve and maintain its ISO certification, the SNV/BSP provides a broad base of training programs for its key partners. The overall objective is to deliver good, reliable and consistent quality products for biogas end-users. To enforce its quality standards, subsidy payments are made only for biogas systems that meet the established standards.

7.3. Strengthening private sector biogas producers

Private sector biogas producers expanded from one dominant company, the GGC, to the pre-sent level of 39 certified companies. Of these 39 companies, only eight of these are presently capable of producing more than 500 biogas systems per year. Many of the companies are financially weak. They require additional training and support to become significant players that are capable of producing more than 500 biogas systems per year. More efficient biogas producers are needed in order to achieve the target of 200,000 biogas systems by the end of BSP-IV.

7.4. Accelerating market demand

The demand for new biogas systems needs to increase from about 12,000 systems per year (in 2002) to over 30,000 systems per year in 2005 if the goals of BSP-IV are to be met. This can only be achieved under an active program stimulating the demand for biogas systems. One option is to engage the support of local, national and International NGOs, Government and media to promote biogas use. Another very important option is to draw on the support of the over 100,000 satisfied biogas users to spread the information about the benefits of biogas. This could be achieved by providing financial and other incentives to bio-gas users for identifying and contracting new customers for the BCCs. It is very important that the BCCs are encouraged to actively market their products rather than just waiting for the customer to approach the producer.

7.5. Financing the operations of BSP-IV

A detailed operational and business plan is currently under development that will allow the BSP-N to continue operating beyond the financing for its management and operational expenses available for the next six years through DGIS. The KfW will provide the subsidy support for purchasers of biogas systems during this period. During this transition phase that has donor support, the BSP-N must accomplish the following challenging tasks;

- realise through support to the BCCs the construction of 200,000 new biogas systems in the coming six years (from 2003 onwards). This requires more than doubling the annual production by the BCC;
- develop new and innovative finance structures in order to allow access to a larger group of farmers and subsistent farmers in the existing areas where biogas already has a reasonable coverage;
- develop new delivery structures that lower delivery cost for rural poor and remote farmers;
- document and demonstrate the positive impact of the rural biogas development on the people, their economy and the local environment;
- maintain its ISO 9001-2000 certificate and eventually develop ISO 9014 and
- capitalise on the GHG mitigation benefits of the biogas system through the CDM and utilise the expected financial revenues to support the management, operational and subsidy expenses associated with the promotion of biogas In Nepal.

The biogas sector has the potential of eventually providing access to biogas for about one million farmers. However, for other large groups of farmers and citizens new products must be developed to address their energy needs. A few illustrative examples of future challenges for the BSP-N are listed below;

- develop an affordable biogas system that can be easily transported to very remote and difficult to access areas;
- develop an affordable biogas system for farmers living in high altitude rural Nepal;
- develop commercial biogas systems for industries and municipalities;
- develop smaller biogas systems for common household and kitchen waste for both urban and rural households and
- promote and market other RETs through the biogas network, thus enhancing the financial turnover of the BSP-N and the BCCs and strengthening their economic viability.

7.6. Sustaining the BSP without donor support

Since its inception, the BSPs management and operational expenses have been provided by DGIS through the SNV. This support is scheduled to terminate in 2009. The ability to sustain the operations of the BSP beyond 2009 is an important challenge and will require the following activities:

- developing a viable business plan with medium and long term vision;
- deriving revenues to finance the management operations of BSP and
- seeking alternatives for subsidy support to ensure affordability and support quality control.

7.7. Transforming the BSP into a local operating agency

After careful consideration of a number of possible options SNV decided to convert the BSP into a NGO. The options that were considered and rejected included: Government agency; private corporation; cooperative and association of cooperatives. The NGO option allows the BSP-N to maintain its community and consumer service orientation and non-profit status. Also the BSP-N social development objectives could be maintained whereas a private corporation would focus on its profit-making objective at the possible expense of the BSP-N. The BSP-N was registered as a NGO in Nepal in March 2003.

7.8. Alternative options for subsidy support

The subsidy support provided for biogas systems has played a very important role in making biogas systems affordable to most poor rural farmers and at the same time allowing the SNV/BSP to enforce its quality control program with the BCCs. With the expected termination of the subsidy support from SNV and KfW after Phase-IV, alternative options for raising the finances for this subsidy support must be considered. A number of possible options that are currently being considered include:

- capitalising, through the CDM, on the value of avoided GHG emissions (i.e., carbon credits) that result from the use of biogas to supplement declining Government and donor subsidies. Current discussions with the World Bank are based on the payment of USD 5 per year per new biogas system. For the coming ten years this will be USD 50 or NRs 3,500 per system or about 50 percent of the current subsidy;
- monetising health benefits. The economy and comfort that will be derived from a

better health and less health expenses is not always clearly expressed. Because of the strong reduction in Indoor Air Pollution (IAP), funding sources may be tapped from health conscious agencies. Health studies are difficult to realise, but many World Health Organisation (WHO) studies indicate the obvious and significant health improvements through reduced IAP. These include in better physical resistance, lesser eye infections, less cancer or chronicle lung diseases;

- monetising reduced deforestation benefits, Available time can be utilised in education and in productive activities such as Non Timber Forest Products (NTFP) and those products can be marketed. Because of the saving of about 3 tonnes of fuelwood per year by each biogas user, that biomass constitutes in growth of other forests and better access to biomass for non-biomass users. The better exploitation of the large forest resources in Nepal may generate many millions of US\$ worth in timber and timber products. Monetising the additional farm produce realised through better farm management. For remote people this requires the organisation of cooperatives to market the produce or to dry the crops for longer shelf life and reduced transport costs.

Chapter 8

LESSONS LEARNED

The BSP has convincingly demonstrated that biogas technology positively affects the lives of farmers and especially women and children in the rural areas, The social and environmental conditions of more than a hundred thousand rural families are improved and another two hundred thousand will be improved under BSP-IV. A large number of economic benefits are generated making the BSP a good example of a successful and positive donor intervention to expand on a sound technology that has social, health, economic and local and global environmental benefits, As a result of the successes and experiences of the BSP, there are a number of important lessons that emerge regarding the design and implementation of rural energy services that can ultimately be applied to not only biogas programs in other developing countries but also other rural energy service options (i.e.. improved cook stoves, solar home systems, micro hydro, etc.) in Nepal and other developing countries. The principal lessons learned from the BSP are summarised below:

Working in a positive political framework - During the early years (1990) of the biogas development, the Nepalese Government received various types of aid from a wide collection of donors and was open to new initiatives from these donors. The donor organisations were able to influence decision making related to aid funding and positive development objectives were incorporated in the National Development Plans (NDPs). Although the Government of Nepal did not contribute during these first years in staff, cash or implementation, the mere fact that the SNV could freely develop demonstration projects was an important facilitating circumstance.

Understanding the end-user/market needs and concerns and designing a product that meets the needs and addresses the concerns - One of the first tasks undertaken by the SNV was to carefully assess the needs and capabilities of the end-user while at the same time assessing available biogas technologies to determine the suitability of these technologies for Nepali conditions. Based on this information, the SNV/BSP selected the fixed dome biogas technology and embarked on a process to adapt this technology to the needs of the Nepali users.

Identifying the most appropriate and cost-effective design for the product before launching a wide-scale dissemination program – The BSP carried out a targeted research and development effort and an iterative pilot demonstration program to first adapt the biogas technology to local conditions. The resulting biogas system has a number of important features that contributed to its relatively low cost of construction, user friendliness and high reliability. Wide-scale dissemination program was launched only after establishing a suitable biogas system. It continues to learn and improve on the design of the biogas units so as to lower costs, improve output and increase reliability.

Establishing and enforcing design, quality and service criteria that will ensure the reliable and cost-effective operation of installed systems - The design was developed in collaboration with farmers (users) and construction staff of the BCCs and manufacturers. The high participation level in the design phase ensured a consumer friendly and reliable product. To ensure the implementation of the quality and design standards, a training program for biogas producers was launched to train their masons and staff. A certification process and financial incentives were introduced to ensure that the biogas producers meet the quality and design standards.

Improving and diversifying the original design - The development of a single design proved essential at the outset to ensure uniform quality and performance. The implementation of stringent monitoring and evaluation of the single fixed dome design allowed the detailed development of the entire Implementation package with contracts, manuals, subsidies and training. In the later stage of BSP-III however, it has become evident that the single design will not serve the purpose especially in the high altitudes. Thus, other technical designs are required to reach populations in high altitude and remote locations. The BSP has built on its original designs while maintaining the principles of uniformity to meet the needs of these new markets.

Identifying the key institutional partners and assisting in strengthening the capacity of these players to effectively carry out their respective roles - A key success factor has been its ability to identify and work closely with key institutional partners in Government, banking, the private sector and NGOs. Specifically, the BSP has worked in association with AEPC to secure Government and donor support and to promote the use of biogas in Nepal. It has worked in partnership with the financial and banking institutions both internationally and domestically to design and implement affordable consumer credit schemes to allow rural farmers to buy biogas systems. Working very closely with the private sector BCCs and biogas appliance vendors providing them with technical and management training has helped ensure that these firms were able to meet the strict standards, control costs and increase production capacity with the growing demands for biogas. Collaborating with various NGOs to promote and the dissemination of biogas and most recently to process an application to the CDM has resulted in CER credits associated with the biogas program in Nepal.

Securing the commitment and support of financial institutions to work in close partnership for the dissemination and financing of the product - A very important partner of the BSP has been the financial institutions, especially those with extensive rural access such as the ADB/N, NBL and RBB. The ADB/ N had, in 1998, over 700 branch offices located in the rural areas of Nepal and had established long-term relationships with the farmers of Nepal. Working in close association with the financial Institutions to develop loan criteria and portfolio risk mitigation schemes has fostered necessary support for these Institutions to secure low-interest credit lines for their biogas portfolio from willing donors, specifically the KfW,

Successful demonstrations are key building blocks - The successful demonstration of a biogas system by Father Saubol and the GGC led to the interest of the SNV in promoting biogas in Nepal, The successful demonstration of impact of BSP-I attracted the participation of the KfW in co-financing biogas in Nepal, The demonstration of the positive impacts improved human health, increased employment and reduced deforestation led the HMG/N to include the biogas program in its Renewable Energy Policy. Finally, the visible positive impacts on the health and livelihood of rural families utilising biogas have led their neighbours to seek biogas systems as well.

Maintaining flexibility of financial incentives to stimulate market development - The initial subsidy package reduced capital investments for the first farmers, but farmers reacted by selecting oversized digesters because of the higher subsidy provided for large digesters. Adjusting the subsidy scheme in BSP-III improved access to lower Income farmers and increased while simultaneously providing more appropriately sized systems.

Linking subsidy and credit finance to quality control - Establishing a tight relationship between the disbursement of subsidies and the certification of performance of the biogas systems, thereby has ensured a quality control on all aspects of the production and delivery cycle for biogas systems.

Periodic independent consumer surveys to assess customer satisfaction and identify areas for improvement - Through the contracting of external survey organisations (by the BSP and AEPC) that processed hundred of questions, covering a balanced cross section of the user population, important feedback from the users and their neighbours was obtained. This feedback was used to assess impacts and improve product and services.

Designing and applying subsidy financial incentives in a uniform, transparent manner - The uniform, transparent and careful administration of subsidies has been an important factor In convincing farmers to purchase biogas systems. Administering the subsidy program In a manner that ensured all formers were equally and fairly treated added to the credibility of the BSP.

Attitude can be changed if people perceive benefits - Despite the cultural and religious taboos relating to nightsoil from toilets, more than 70 percent of the households now connect toilets to the biogas system. Educating the farmers on the direct (less fuelwood, labour or smoke) and Indirect benefits (better health, education, food production) of biogas systems is an important factor in motivating them to adopt biogas systems, This also applied to Government officials, who responded by including biogas development in the overall National Development Plan. The resulting political support was an important factor in the success of biogas In Nepal.

REFERENCES

- BSP-N, 2004: Biogas Nepal 2003, Kathmandu, Nepal. BSP-N, 2003: Biogas Nepal 2002, Kathmandu, Nepal.
- CBS, 2002: Population Census 2001, National Report, Central Bureau of Statistics, NPC/HMG/N, Kathmandu, Nepal.
- CBS, 2003: Statistical Yearbook, Central Bureau of Statistics, NPC/HMG/N, Kathmandu, Nepal.
- CBS, 2004; National Sample Census of Agriculture, Nepal 2001/02 (National, Mountains, Hills, Tarai), Central Bureau of Statistics, NPC/HMG/N, Kathmandu, Nepal,
- Dahal, C, 2000: Impact of Biogas on Household Activities in Rural Communities of Tanahun District, Nepal , Flensburg, Germany.
- Dutta, S, et. al, 1997: Biogas, the Indian NGO Experience, A FPRO-CHF Network Program, New Delhi, India.
- East Consult, 2004; Biogas Users Survey, 2003/04: Final Report, Submitted to Alternative Energy Promotion Centre, HMG/N, Kathmandu, Nepal.
- IUCN, 1995, EPA of Bara Forest Management Plan, Kathmandu, Nepal
- Mendis and J van Nes, 1999: The Nepal Biogas Support Program: Elements for Success in Rural Household Energy Supply, DGIS, The Hague, The Netherlands.
- MoF, 2004: Economic Survey, Fiscal Year 20G3/2004, Ministry of Finance, HMG/N, Kathmandu, Nepal.
- NPC, 2002: Tenth Five-Year Plan, 2002-2007, HMG/N, National Planning Commission, HMG/N, Kathmandu, Nepal,
- Oli, B. and D. K. Kharal. 2004: Nepal Energy Status; An Estimate (Nepali), Monthly Jeevan, No. 4, Vol. 19 June 2004.
- Pandey, M. R, 2003; Health Effects of Indoor Air Pollution, In Glow, A Publication of the Asia Regional Cookstove Program ARECOP, Vol. 29, February 2003, Indonesia.
- Reid, H. F, et al: Indoor smoke exposures from traditional and improved cook stoves; Compa-rison Among Nepali Women, Mountain Research and Development Vol. 6, no.4, 1986.
- SNV/BSP, 2003: Integrated Environmental Impact Assessment of the Biogas Support Program, SNV/BSP Phase III, Basic document submitted to Integrated Environmental Impact Assessment (IEAE), Kathmandu, Nepal.
- SNV/BSP, 2004: Final Report on Biogas Program Phase III, March 1997-June 2003, Kathmandu, Nepal.
- Winrock & Eco Securities: Nepal Biogas Program, simplified PDD, Dec. 2004, Kathmandu, Nepal.

ANNEX 1: CHRONOLOGY OF BIOGAS DEVELOPMENT IN NEPAL

Year	Organisation/Individual	Event
1955	Reverend Father Saubolle, St Xaviers School. Nepal	Installation of a demonstration biogas system in Godavari school, Kathmandu
1968	Khadi and Village Industries Commission, India	Constructed a biogas system for exhibition
1974/75	Department of Agriculture, Nepal	Initiated a program to install 250 floating drum design biogas system
1974	Agricultural Development Nepal	Provision of interest free loan for Installation of biogas systems
1977	Development Consulting Services, Nepal	Built four floating drum type (KVIC design) biogas system
1977	United Mission to Nepal, Agricultural Development Nepal Fuel Corporation and DCS	Biogas and Agriculture Equipment Development Company Pvt. Ltd.
1980	GGC	Modified Chinese fixed dome design introduced
1990	GGC	Present fixed dome system recognised as the appropriate for Nepal
1991	HMG/N, ADB/N and GGC	A proposal under the name of Biogas Support Program was submitted to the Directorate General for International Co-operation of the Netherlands Government.
1992	HMG/N and DGIS	Formalisation and initiation of SNV/ BSP in Nepal HMG/N - Subsidy component DGIS - Financial Support SNV - Managerial, technical and advisory service
1997	KfW	Provision of subsidy and credit support

ANNEX 2: SUBSIDY RATES OVER THE SNV/BSP PERIOD

July 1992-June 1996			
	Tarai	Hills	
4 to 20 m ³	NRs. 7,000	NRs. 10,000	
July 1996-June 1999			
	Tarai	Hills	Remote Hills
4 to 20 m ³	NRs. 7,000	NRs. 10,000	NRs. 12,000
July 1999-June 2001			
	Tarai	Hills	Remote Hills
4 to 6 m ³	NRs. 7,000	NRs. 10,000	NRs. 12,000
8 to 10 m ³	NRs. 6,000	NRs. 9,000	NRs. 11,000
July 2001 - June 2003			
	Tarai	Hills	Remote Hills
4 to 6 m ³	NRs. 6,500	NRs. 9,500	NRs. 11,500
8 to 10 m ³	NRs. 5,500	NRs. 8,500	NRs. 10,500

ANNEX- 3: Financial assessment of 6m³ system (all cost are for 2003/2004)

Cost break down

Costs NRs	Hill		Tarai		Remarks
	NRs	US\$	NRs	US\$	
Capitol Costs	23,113	312	21,411	289	
Annual Maintenance	300	4	300	4	
Subsidy	0	0	0	0	
Net Cost	23,113	312	21,411	289	
Down Payment	2,311	31	2,141	29	10%
Loan Amount	20,802	281	19,270	260	
Annual Loan Payment	5,303	72	4,913	66	17% Interest, 7 years term

Annual	Savings per system				Total saving				Remarks	
	Hill		Tarai		Hill		Tarai		NRs	US\$
	NRs	US\$	NRs	US\$	NRs	US\$	NRs	US\$		
Fuelwood (kg)	2,190.00	29.59	2,017.00	27.26	4,380.00	59.19	3,025.00	40.88	NRs 2/kg for Hills	0.03/kg
Kerosene (Litres)	36.00	0.49	36.00	0.49	900.00	12.16	900.00	12.16	NRs 1.5/kg for Tarai NRs 25/litre	0.02/kgg 0.34/litre
Nitrogen (kg)	39.00	0.53	39.00	0.53	597.00	8.07	597.00	8.07	NRs 15.32/kg	0.21/kg
Phosphorous (kg)	19.00	0.26	19.00	0.26	391.00	5.28	391.00	5.28	NRs 20.62/kg	0.28/kg
Potash (kg)	39.00	0.53	39.00	0.53	597.00	8.07	597.00	8.07	NRs 15.32/kg	0.21/kg

ANNEX - 4: Data for financial and economic assessment of 6m³ system (all cost are for 2003/2004, 1 US\$-NRs 74)

Cost/Benefit breakdown

Costs	Financial				Economic factor		Economic			
	Hills		Tarai		Shadow Value		Hills		Tarai	
	NRs	US\$	NRs	US\$	NRs	US\$	NRs	US\$	NRs	US\$
Cement	5,432	73.41	4,550	61.49	0.6	0.01	3,259.2	44.04	2,730	36.89
Materials	6,129	82.82	6,118	82.68	0.75	0.01	4,596.375	62.11	4,588.5	62.01
Labour	4,680	63.24	4,680	63.24	0.75	0.01	3,510	47.43	3,510	47.43
Appliances	7,288	98.49	7,288	98.49	0.9	0.01	6,559.2	88.64	6,559.2	88.64
Fees and Charges	1,250	16.89	1,250	16.89	1	0.01	1,250	16.89	1,250	16.89
Total Capital Cost	24,779	334.85	23,886	322.78		0.00	19,175	259.12	18,638	251.86

Costs	Financial				Economic factor		Economic			
	Hills		Tarai		Shadow Value		Hills		Tarai	
	NRs	US\$	NRs	US\$	NRs	US\$	NRs	US\$	NRs	US\$
Annual Maintenance Cost	300	4.05	300	4.05	0.75	0.01	225	3.04	225	3.04
Benefits										
Fuelwood savings	2,700	36.49	2,700	36.49	1	0.01	2,700	36.49	2,700	36.49
Kerosene Savings	900	12.16	900	12.16	1	0.01	900	12.16	900	12.16
Nutrient Savings	0	0.00	0	0.00	1	0.01	1,547	20.91	1,547	20.91
Domestic Labor Savings	0	0.00	0	0.00	0.75	0.01	563	7.61	563	7.61
Reduced Carbon	0	0.00	0	0.00	1	0.01	1,531	20.69	1,531	20.69
Indoor Smoke Reduction	0	0.00	0	0.00	1	0.01	400	5.41	400	5.41
Total Annual Benefits	3,600	48.65	3,600	48.65		0.00	7,640.5	103.25	7,640.5	103.25

**ANNEX 5: DATA ON EXPENDITURE FOR TA AND CAPITAL FOR SNV/BSP
(DERIVED FROM INFORMATION PROVIDED BY SNV/BSP) (IN US\$)**

Year	Cash plants	Loan plants	TOTAL plants	Loon amount (Loan + Subsidy)	Subsidy amount	Capital expenses	TA expenses	Exchange Rate NRs - US\$
1992							202,297	42.60
1993	192	3,126	3,318	1,007,776	579,988	1,587,76	46,845	49.00
1994	571	2,935	3,506	766,443	617,914	1,384,35	166,102	49.11
1995	1,366	3,943	5,309	1,069,792	1,269,998	2,339,79	288,911	50.45
1996	2,342	5,023	7,365	1,407,040	775,627	2,182,66	399,805	56.25
1997	3,361	5,058	8,419	1,336,916	1,310,126	2,647,04	568,698	56.75
1998	4,133	5,784	9,917	1,283,332	1,263,565	2,546,99	601,578	67.60
1999	4,693	6,168	10,861	1,357,594	1,357,755	2,715,34	548,429	68.15
2000	9,035	5,156	14,191	1,098,580	1,705,298	2,803,87	530,996	70.40
2001	12,451	4,700	17,151	944,407	1,959,350	2,903,75	516,604	74.65
2002	11,664	3,755	15,419	721,653	1,589,770	2,311,42	535,255	78.05
2003	12,784	3,155	15,939	603,943	1,635,867	2,239,81	536,201	78.36

TA cost includes

Promotion and marketing
Subsidy administration
Quality control
R&D/Standardization
Training
Extension
Monitoring and evaluation
Institutional support
Program management
External evaluation

ABOUT THE AUTHORS AND EDITOR

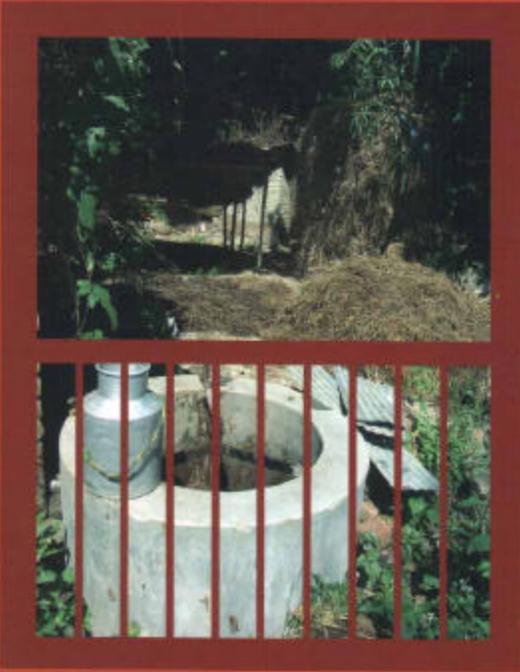
Authors

Sundar Bajgain is the Executive Director of the Biogas Sector Partnership, Nepal (BSP/N). He has been involved in the promotion of biogas since 1996 and has made notable contributions in the success of biogas in Nepal. He has played a crucial role on institutionalising the biogas program and developing biogas as a first carbon financing project in Nepal. Mr Bajgain is a Nepali national.

Indira (Sthapit) Shakya is the Executive Board Member of the Biogas Sector Partnership, Nepal (BSP/N). She is affiliated with the Royal Nepal Academy of Science and Technology (RONAST). Besides active involvement with the development, dissemination, policy formulation and gender mainstreaming of other renewable energy technologies, she has also been engaged in monitoring, evaluation and gender issues of biogas technology since the year 2000. Dr. Shakya is a Nepali national.

Editor

Matthew S. Mendis, is Corporate Vice President and Director of the Energy and Environmental Management Division for International Resource Group, Ltd. (IRG), based in Washington, DC, USA. He has more than 30 years of experience in rural and renewable energy and project development and finance. He has helped develop, implement and assess renewable energy projects in over 40 developing countries. Prior to this publication he was also associated with the publication of The Nepal Biogas Support Program: Elements for Success in Rural Household Energy Supply. Mr. Mendis is an engineer and economist by training who was born and raised in Malaysia. He now resides in the US.



Published by:

 Ministerie van Buitenlandse Zaken
Ontwikkelingssamenwerking
Ministry of Foreign Affairs, The Netherlands

 SNV
Netherlands Development Organisation

 BSP
Biogas Sector Partnership-Nepal

