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Nepal Biogas Support Program (BSP): Cooking With Clean and Affordable Energy in Rural Areas

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Methodology and Goals

This report summarizes parts of two main documents that detail the Nepalese experience implementing biogas technology at scale for cooking needs in rural areas:

- *Making energy markets work for the poor: Large-scale dissemination of biogas plants in Nepal, 2012* (Case Study 4), published by the United Nations Development Programme (UNPD).
- *The Nepal Biogas Support Program: A Successful Model of Public and Private Partnership for Rural Household Energy Supply*, 2005, written by Sundar Bajgain and Indira (Sthapit) Shakya and published by Ministry of Foreign Affairs (The Netherlands); SNV (Netherlands Development Organization) and the Biogas Sector Partnership – Nepal.

This report was prepared to be used as a case study example for teaching. Therefore, it does not aim to be exhaustive and does not reflect the goals of the documents on which it is based.

Keywords: biogas; cooking fuels; renewable; energy; Nepal; government

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1. Background

Nepal is a multi-ethnic, multi-lingual, religiously diverse country with a population of 28.7 million people and a life expectancy of 70 years. Forty-six percent of the Nepalese population lives below the poverty line, and per capita income is US$730 (World Bank, 2015). Rural areas account for 81.4% of the population, and agriculture employs 72.9% of the workforce. The Human Development Index ranks Nepal at 144 out of 188 countries (UNDP, 2015).

Nepal has experienced rapid political change during the last two decades. The Nepalese Civil War in the 1990s and early 2000s resulted in the proclamation of a republic in 2008, ending the reign of the world's last Hindu monarchy. The Constitution of Nepal, adopted in 2017, establishes it as a federal democratic republic divided into seven states.

2. Nepal's National and Rural Energy Scenario

Back in 1992 only 40% of the population had access to electricity, partly due to the mountainous nature of the country, and rural electrification stood at 29%. Although Nepal has the world's second-highest hydroelectricity potential, hydropower accounted for just 1% of the primary energy supply. Traditional fuels represented the main energy source – 68% wood, 15% agricultural wastes and 8% dung – with fossil fuels such as petroleum and coal accounting for the remaining 8%. Some 88% of the population relied on traditional biomass fuels for cooking and heating.

The difficult geographical terrain in hilly and mountainous areas, socio-economic underdevelopment and a sparsely distributed population all represented difficult challenges in providing modern energy solutions, particularly in rural and remote areas of the country.

Given the increasing deforestation in Nepal, distances between fuelwood sources and households were increasing, forcing women to spend more time on wood procurement or, if fuelwood was bought, to incur higher expenditures. Heavy reliance on biomass, most often burnt in inefficient stoves and in poorly ventilated kitchens, was causing serious health problems in rural populations, particularly among women and children, who were most exposed to indoor air pollution. Livestock such as cattle, buffalo and poultry played an important role in the lives of Nepalese farmers. The cattle were a source of milk and draught-power and in particular the cow was a revered and sacred animal for orthodox Hindu sects and to a large extent for the Buddhist population. For these reasons, cattle were raised close to the farm, well cared for and kept for a long time. These were ideal conditions to guarantee a continuous provision of animal dung, the feedstock necessary to fuel small farmer-based biogas systems

Most Nepalese small farmers owned two cows or buffalo, which is the minimum number required for feeding a household-scale biogas systems with a capacity of $4m^3$. Unfortunately, the high cost to buy and install even a small biogas system – unbearable for the large majority of low-income small farmers – was one of the main barriers to its adoption.

3. The BSP

With these challenges and opportunities in mind, in 1992 SNV launched the Biogas Support Program (BSP), a donor-supported program, with the goal of constructing and disseminating household-scale biogas plants in rural Nepal as a mainstream renewable energy source.

3.1 Biogas as Rural Renewable Energy

Biogas is a blend of gas, primarily methane and carbon dioxide, produced by bacteria acting on organic materials in an anaerobic environment (an oxygen-free environment). The gas is a smoke-free combustible that burns with a blue flame, similar to that of liquid petroleum gas (LPG).

The average 4m³ biogas system promoted by the program requires dung from two cows (or buffalo) and an equal amount of water per day for its operation, and it provides enough biogas to cook for about 2.4 hours. Moreover, the biogas generated can be used for lighting, particularly important in the mountains where other fuels for lighting are unavailable, and the anaerobic digestion process produces bio-slurry, a manure with a higher fertilizer value than dung, which can be used to fertilize crops, enhancing agricultural production.

3.2 Biogas Support Program – Overview

BSP allows rural households to purchase biogas plants from private suppliers through a combination of subsidies and loans. Subsidies are provided through biogas companies, while wholesale loans are provided to microfinance institutions (MFIs), which in turn lend to households. Disadvantaged groups can benefit from additional subsidies.

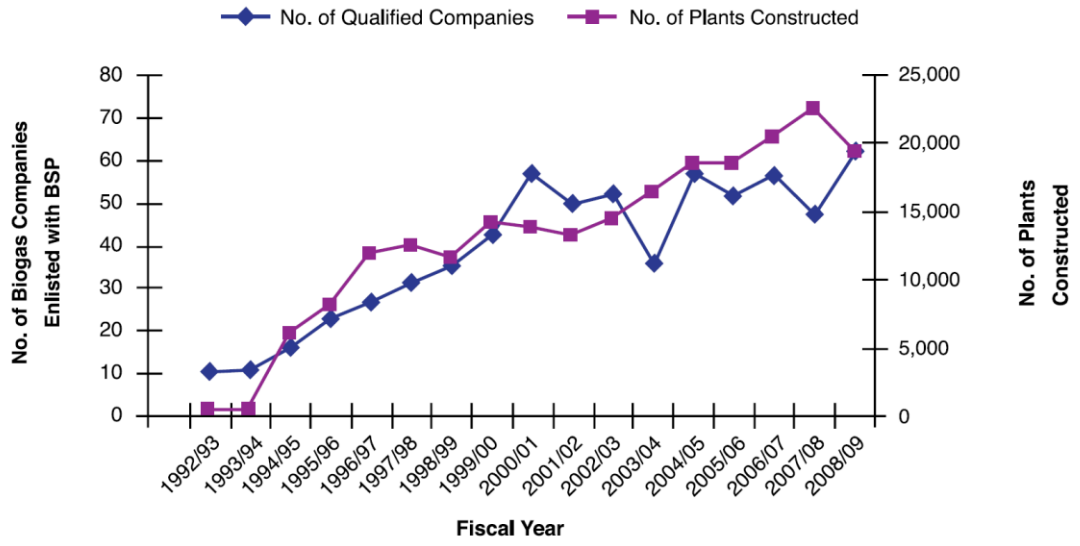
Apart from providing subsidies and loans for taking up biogas plants, BSP engages in other activities like plant promotion, marketing, quality control and technical training of MFIs and plant suppliers.

The program applies a market-based approach by encouraging the private sector's participation as product suppliers. The program has instituted several innovative financial measures, involving banks and microfinance institutions, to make the technology affordable for the poor.

Over the past 17 years, BSP has evolved through four phases – with the involvement of different donors, agencies and institutions – where each new phase solved some of the problems from previous years, in constant improvement as the program consolidated.

As of December 2010, more than 225,000 biogas plants had been constructed in 2,769 villages and municipalities (of a total of 3,919) in Nepal and there was an installation rate of nearly 20,000 new biogas plants per year. BSP had reached all 75 districts, directly benefiting around 1.3 million people.

Figure 1
Biogas Companies (Accumulated) and New Plants (per Year)



Source: United Nations Development Programme (UNDP), *Making Energy Markets Work for the Poor: Large-Scale Dissemination of Biogas Plants in Nepal*, January 2012, page 10.

4. Key Factors in the BSP Strategy

There are several important reasons why the BSP succeeded in accelerating the adoption of biogas in Nepal.

4.1. Product Specifications

Identifying a product design and business model that fit with the needs of the local population was an important factor for the success of BSP.

- Product specifications

  The biogas plants promoted by BSP fit well into the Nepalese integrated farming system. Most rural households rear some cattle and have dung that can be collected to feed into biogas digesters, ranging in size from 4 m^3 to 8 m^3. Under the program, a 6 m^3 biogas plant costs about US$600 and includes a one-year guarantee for appliances, a three-year construction warranty, and two after-sales service visits. Regular maintenance costs after the third year of construction are around US$13 per year. More extensive maintenance, consisting in emptying the plant and checking for gas leaks, is needed roughly once every 12 years.

- Quality control

  An important factor in the successful promotion of biogas technology in Nepal has been strict enforcement of quality and design standards, determined in the agreements signed between the BSP and the participating companies. Quality standards are enforced by imposing penalties for noncompliance detected during inspections. The strict enforcement of the quality standards allowed to achieve a 97% rate of successfully operating biogas systems.

4.2. Financial Mechanisms

A combination of subsidies, loans and other solutions was crucial to improving the affordability of biogas plants:

- 30% (roughly) of the plant cost is covered by the regular subsidy;
- 20% of the cost can be contributed by the user in kind (e.g., unskilled labor or locally available construction materials);
- 50% of the cost must be paid by the user in cash – for this purpose, farmers can take on a loan provided through a Biogas Credit Fund;
- additional subsidies are available for poor or disadvantaged communities.

4.2.1. Loans

Despite the subsidy, most rural households still cannot afford to pay the upfront cost of the biogas plant. To address this challenge, BSP has been working with banks and other MFIs in extending loans for the purchase of biogas plants. To this extent, the creation of the Alternative Energy Promotion Center (AEPC) the government body in charge of operating the Biogas Credit Fund has played a key role. The Biogas Credit Fund is a revolving fund of US$3.5 million – used to provide wholesale loans to MFIs at a 4% annual interest rate which the MFIs then on-lend to farmers at a maximum interest rate of 14%.

With the loan, most of the farmers are able to purchase a biogas system for the equivalent cost of 1 liter of milk per day. In fact, to purchase a 6 m^3 biogas plant a farmer needs a start-up loan of about NPR 16,000. The repayment of a two-year loan at 13% interest rate requires the household to pay a monthly installment of NPR 761. This is equivalent to the cost of 30 liters of milk (or 1 daily liter) or 12.7 liters of kerosene (or 0.42 daily liters) (see Exhibit 1).

4.3. Government Commitment and National Ownership

In 1992, when the BSP was launched, the biogas sector in Nepal was hampered by the absence of a government body that would take the lead. However, the Nepalese government was open to new initiatives led by donors. To support the program designed by SNV, the government incorporated development objectives into the National Development Plans (NDPs), which facilitated implementation of the BSP and empowered the Netherlands Development Organization (SNV). Later, the creation of the Alternative Energy Promotion Center (AEPC), which is now the top government body for promoting renewable solutions in Nepal, played a key role. In 2003, when SNV decided to hand program management over to a national body, the AEPC became the executing agency for the BSP, and Biogas Sector Partnership Nepal (BSP-Nepal) was created to implement the BSP under the AEPC. This changeover was instrumental in institutionalizing the national ownership of the BSP.

4.4. Coordination of Different Stakeholders

The success of the BSP in Nepal is due, in part, to the coordinated roles of six key partners:

- Donor agencies and NGOs: Several sources provide funding to the BSP, including:
  - SNV and the Directorate General for International Cooperation (Ministry of Foreign Affairs, the Netherlands) (DGIS). An important factor in the success of the BSP has been the dedicated and long-term vision of SNV, the principal donor.
  - Kreditanstalt fur Wiederaufbau (German government-owned development bank) (KfW).
  - District Development Committees (DDCs) allocate funds for biogas promotion at the local level, particularly for toilet attachments in biogas plants.
  - Several NGOs are also involved in the program and are responsible for promoting biogas plants, identifying potential beneficiaries and providing links between biogas companies and rural households.
- Governmental institutions: the AEPC, the executive agency of the program, administers subsidies and the Biogas Credit Fund. It also provides supervision and regulatory oversight through the Biogas Coordination Committee (BCC).
- Implementing agency: BSP-Nepal is a national nongovernmental organization responsible for implementing the program in cooperation with Nepal Biogas Promotion Association (NBPA), an association of approximately 85 biogas companies and 17 workshops that manufacture plant appliances and accessories. NBPA is also responsible for providing skill-enhancement programs for constructors and for promoting biogas plants.
- Finance institutions: Agriculture Development Bank (ADB), other participating banks and microfinance institutions (MFI) are responsible for providing loans for the purchase of biogas plants.
- Private-sector companies: responsible for plant construction, after-sales technical support and manufacture of biogas appliances (stoves, lamps, valves, etc.).
- End users: necessarily involved in the phases of contracting, financing, construction, operation and maintenance of the biogas systems. They also provide valuable feedback about the usability of the plants, which allowed improvement of the systems over the years.

4.5. Promotion and Marketing Strategies

The promotion and marketing strategies depend on the level of development of the market:

- In areas with a developed market with a strong demand for biogas plants, biogas companies and MFIs take charge of the promotion and marketing through brochures, posters, radio and television promotion, and demonstrations.
- In areas with undeveloped markets BSP-Nepal works in collaboration with local governments, NGOs, and community-based organizations to raise awareness and create demand through demonstrations and piloting. At this stage, biogas companies are provided with additional support to partially cover their risks and losses as first movers. At a later stage, the biogas companies move in to assume promotion and marketing functions.

5. Challenges

Over the years, the BSP has had to overcome barriers of various kinds to reach its current status.

5.1. Expanding the Market for Biogas

The first ten years of the program saw a steady increase in the construction of biogas plants. After 2000-2001, market growth slowed down. The main reasons for this shortfall included political conflict, rises in raw-material costs, decreased subsidy levels and market saturation. Since 2003, however, the BSP market has consolidated. Contributory factors include:

- an increased regular subsidy adjusted upwards for inflation;
- introduction of new modalities to improve private enterprise performance (including enforcement of Codes of Conduct);
- increased availability of MFI credit.

5.2. Reaching the Poorest Households

Despite the availability of subsidies and loans, in Phases I, II and III of the BSP had failed to reach the poorest households. BSP clients were typically not the poorest in rural communities. A 2008 study revealed that 70% of the biogas plants were owned by Brahmins and Chetris, well-off caste groups representing just over 30% of the population. At the other end of the spectrum, Janajatis and Dalits comprised 50% of the national population, but only 32% of these groups owned biogas plants. Other disadvantaged groups, constituting about 19% of the population, owned just 2% of the biogas plants.

In light of these facts, a primary objective in Phase IV has been to make the BSP more inclusive. Towards this end, new initiatives have included:

- introduction of an additional subsidy for the poorest sections of the population;
- additional subsidies for some disadvantaged categories (Daltis, Janajatis and conflict victims)
- increased availability of microcredit;
- introduction of a smaller biogas plant, with a capacity of 2 m^3, that can be run with dung from just one cow.

The BSP also conducted research activities targeting the following groups:

- people living above 3,000 meters, since technological innovation now enables the BSP to reach remote communities living at these altitudes;
- poor people living in clusters that can benefit from a community biogas plant;
- people who raise only pigs and have no cattle.

5.3. Financial Sustainability

Over the past decades, the BSP has had the support of the government and donors (principally SNV and KfW) for operational costs and consumer subsidies. However, the SNV support was set to end in 2012 and the GoN was expected to continue its support, together with the CDM funds, going forward. Thus, the BSP faced the challenge of continuing its successful growth without its traditional sources of support, depending on its ability to operate on a commercial basis. This presented both challenges and opportunities.

One of these was the opportunity presented by the CDM of the United Nations Framework Convention on Climate Change (UNFCCC) Kyoto Protocol to convert the avoided GHG emissions that result from biogas systems into saleable Carbon Emission Reduction (CERs) credits. The BSP registered two projects under the CDM with an annual carbon revenue of about US$360,000. With the registration of new projects, the annual CDM revenues were expected to rise to as much as US$3.5 million by 2014, meeting about 30%-50% of the annual BSP budget.

5.4. Using Human Waste for Increasing Biogas Production

Besides the growth of installed biogas systems, the BSP has promoted the use of human waste for increasing biogas production for households. This was a challenging objective. As the majority of Nepalese people perceive the kitchen to be a sanctified place where meals for religious deities are also prepared, it is considered sacrilegious to cook using fuels derived from human waste.

The program overcame these taboos by designing a system that eliminated any handling or contact with human waste and by working on consumers' information about the cleanliness of the resulting biogas. As a result, there has been a significant rise in the number of requests to connect the toilet to the biogas systems.

6. Lessons Learned

- Working in a positive political framework… even if the government is not leading the project

  Although the government of Nepal did not contribute to the implementation of the program in the early years, the mere fact that the Nepalese government was open to new initiatives from donors, and that positive development objectives were incorporated into the National Development Plans (NDPs), was an important facilitating circumstance.

- Understanding the end-user 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 conditions of the end-user and to determine the suitability of the available biogas technologies to fit them. Based on this information, the SNV/BSP decided to adopt the fixed-dome biogas technology and embarked on a process to adapt this technology to the needs of Nepalese users. The design phase was carried out with a high participation rate of farmers (the end-users), construction staff and manufacturers to ensure a consumer-friendly and reliable product. At an earlier stage, the development of a single design proved essential to ensure uniform quality and performance. However, in the

following stages the design has been adapted to meet the needs of new markets, like in the case of villages at high altitudes.

- Harnessing the local resources… and creating new ones

  The special position held by cattle, unique to this part of the world, has been an important element in the successful adoption of biogas systems as it helped ensure a steady supply of cattle dung for the biogas system. However, as there was just one state-owned company producing biogas systems back in the 1990s, it has been necessary to create the incentives to involve the private sector.

- Identifying the key institutional partners and assisting in strengthening the capacity of these players to carry out their respective roles effectively

  A key success factor for the BSP has been its ability to identify and work closely with key institutional partners, the government, the banking sector, the private sector and NGOs.

- Providing a flexible and effective financial solution

  Another essential factor has been working in close association with financial institutions to develop loan criteria and portfolio risk mitigation schemes and to secure low-interest credit lines for their biogas portfolio. Flexibility of financial solutions has been equally important. For example, as the initial subsidy package was providing higher subsidies for large digesters, reducing the capital investments of the first users, farmers reacted by selecting oversized digesters. Adjusting the subsidy scheme in Phase lll improved access to lower income farmers while simultaneously providing more appropriately sized systems.

- Giving the right incentives to private companies

  Linking the disbursement of subsidies to the certification of performance of the biogas systems has ensured quality control of all aspects of the production and delivery cycle.

- Education and visibility of results

  Attitudes can be changed if people perceive benefits. Despite the cultural and religious taboos relating to human waste from toilets, more than 70% of households now connect toilets to the biogas system. Educating the farmers on the direct (no smoke, less time spent on firewood procurement) and indirect benefits (better health, education) of biogas systems has been crucial in motivating them to adopt biogas systems. The visible positive impacts on the health and livelihood of rural families utilizing biogas have led their neighbors to adopt biogas systems as well.

7. Program Impact

A number of key indicators demonstrate the success of the BSP in terms of impact on the population's income and livelihood, education, health and gender equality and in terms of impact on the environment. Here we highlight the main aspects:

- Reduced expenditure on fuel. The use of biogas plants can entail direct monetary savings – estimated at US$218 per year per household – in areas where fuel wood or kerosene are purchased for cooking.

- Less drudgery, more time and income generation. Reduced firewood collection means reduced time spent on procurement and fewer loads carried by women and children. The time saved and the light generated by biogas lamps can be used for income generation activities, as 28.6% of biogas users have done.
- Productivity gains via the use of biogas slurry as fertilizer. Instead of burning cattle dung for fuel, using it to produce biogas produces a high-quality fertilizer (slurry) that helps increase agricultural productivity. Eighty-nine percent of farmers used the slurry.
- Improved employment and business opportunities. Over 90 biogas companies are working under the program.
- Reduced indoor pollution. The most visible benefit of adopting biogas is reduced indoor air pollution, observed by about 98% of users of biogas plants. Reduced indoor pollution contributes to reduced child mortality rates.
- Increase in study time. Biogas lamps provide brighter light than kerosene lamps, which helps children study during night hours.
- Improved sanitation. The introduction of toilet-linked biogas plants is often a starting point for communities to start using toilets, which reduces water contamination and related diseases, like cholera and eye and respiratory illnesses. The introduction of toilet-linked biogas plants increased the percentage of households using toilets from 49% to about 76%.
- Reduced greenhouse gas (GHG) emissions. On average, a biogas plant can replace 2.5 to 3 tons of firewood and 6.5 liters of kerosene per year, equivalent to a reduction of around 3 tons of CO_2 of GHG emissions.
- Reduced deforestation and forest degradation, through reduced use of firewood.
- Increased use of organic fertilizers. The use of slurry helps to increase crop yields.

Exhibit
Economics of a Farmer-Owned Biogas Plant

An owner of a 6 m^3 biogas plant needs a start-up loan of about NPR 16,000 (USD 201).[19] The repayment of a two-year loan at a 13 percent interest rate requires the household to pay a monthly instalment of NPR 761 (USD 9.6). This is equivalent to the cost of 30 litres of milk or 9.5 litres of kerosene. If the loan is for five years, the monthly repayments are equivalent to 15 litres of milk per day or six litres of kerosene. These figures are often used by BSP staff in their biogas plant promotions.

Plant Size (m^3)	Total Cost (NPR)	Subsidy	User's In Kind Contribution (NPR)	User's Cash Contribution (NPR)	Estimated Loan Required(NPR)	Payback Period (Years)	Interest Rate (%)	Equal Monthly Instalment(NPR)	Daily Litres of Milk @NPR 26/Litre	Monthly Litres of Kerosene @NPR 60/Litre
2	27,275 - 33,631	9,700 - 18,700	4,451 - 5,771	9,160 - 13,124	8,000	2	10	369	0.47	6.15
							13	380	0.49	6.34
							16	392	0.50	6.53
						5	10	170	0.22	2.83
							13	182	0.23	3.03
							16	195	0.25	3.24
4	32,825 - 40,223	9,700 - 18,700	6,113 - 7,103	14,160 - 17,112	12,000	2	10	554	0.71	9.23
							13	571	0.73	9.51
							16	588	0.75	9.79
						5	10	255	0.33	4.25
							13	273	0.35	4.55
							16	292	0.37	4.86
6	38,423 - 46,894	9,700 - 18,700	7,578 - 9,818	18,376 - 21,240	16,000	2	10	738	1.03	12.31
							13	761	1.06	12.68
							16	783	1.09	13.06
						5	10	340	0.47	5.67
							13	364	0.51	6.07
							16	389	0.54	6.48
8	44,765 - 55,194	9,000 - 16,000	8,686 - 11,246	25,948 - 28,199	20,000	2	10	923	1.28	15.38
							13	951	1.32	15.85
							16	979	1.36	16.32
						5	10	425	0.59	7.08
							13	455	0.63	7.58
							16	486	0.68	8.11

Source: United Nations Development Programme (UNDP), *Making Energy Markets Work for the Poor: Large-Scale Dissemination of Biogas Plants in Nepal*, January 2012, page 6.