SNV
Connecting People's Capacities

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Biogas Support Programme fuels rural household energy supply in Nepal

An estimated 2.5 billion people in developing countries rely on biomass, such as fuel wood, charcoal, agricultural waste and animal dung, to meet their energy needs for cooking. In Sub-Saharan Africa and in Asia, excluding China and India, 93% of the rural population depends on such resources as their primary cooking fuel; in Latin America, excluding Brazil, this figure amounts to 62% (IEA, 2006). It is expected that one-third of the world's population still relies on these fuels until 2030.

Use of biomass is not in itself a cause for concern. However, when resources are harvested unsustainably and energy conversion technologies are inefficient, there are serious adverse consequences for people's health, the environment and economic development. About 1.3 million people – mostly women and children – die prematurely every year because of exposure to indoor air pollution from biomass burning. Valuable time and effort are devoted to fuel collection instead of education, income generation or just leisure. Environmental damage can also result, for example, in deforestation. SNV Netherlands Development Organisation acknowledges the urgent need for alternative, sustainable energy sources and improved sanitation. By converting animal manure and human excreta into cooking energy, biogas could fill the void.

SNV and renewable energy

SNV, an international development organisation of Dutch origin, is dedicated to a society in which all people enjoy the freedom to pursue their own sustainable development. SNV contributes to this by strengthening the capacity of local existing organisations. National and local actors within government, civil society and the private sector are supported by SNV to find and implement local solutions to social and economic development challenges. The provision of renewable energy technologies is not always accompanied by capacity development support to local actors, and therefore hampering the sustainability of initiatives. Here lies the main challenge for SNV. Our main focus is on domestic biogas and biofuels, but we also have experience with local use of improved water mills, improved cook stoves and solar lamps.

Country	Programme took off in	2008	2009	Cumulative up to 2009
Asia				
Nepal	1992	14,002	18,902	205,762
Vietnam	2003	17,012	25,764	75,820
Bangladesh	2006	2,648	5,050	10,019
Cambodia	2006	2,340	2,616	6,402
Lao PDR	2006	188	722	1,020
Indonesia	2009	-	50	50
Pakistan	2009	-	100	100
Africa				
Rwanda	2007	120	213	434
Ethiopia	2008	98	30	128
Tanzania	2008	3	103	106
Burkina Faso	2009	-	1	1
Cameroon	2009	-	23	23
Kenya	2009	-	3	3
Uganda	2009	-	40	40
Total number of plants built		*36,411*	*53,617*	*299,908*

SNV started supporting biogas activities in Nepal in 1989 and since 2003, programmes have also been established in other Asian countries resulting in 300,000 constructed domestic biogas plants (see table), improving the quality of life of 1.8 million people. SNV's activities have been expanded to Africa; except for Rwanda and Cameroon, all targeted as part of the 'Africa Biogas Partnership Programme'. The national programmes aim to develop commercially viable biogas sectors in which local companies market and install biogas plants for households who are willing to invest. These programmes show proof that domestic biogas technology can have impact at scale. SNV is committed to a long-term involvement of replicating domestic biogas technology in developing countries by applying its vast biogas knowledge and expertise.

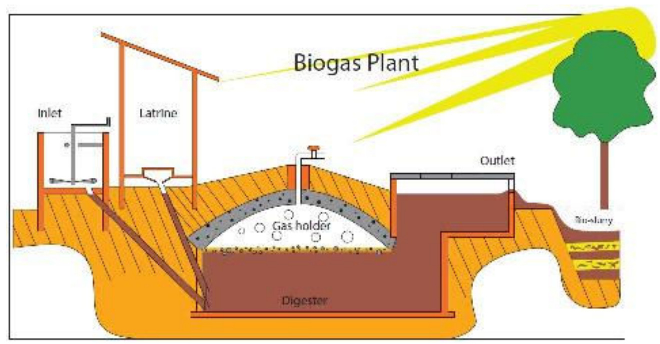
In Nepal, SNV supports the Biogas Support Programme (BSP). The principal objective of the BSP is to promote the wide-scale use of biogas as a substitute for wood, agricultural residues, animal dung and kerosene that are presently used for the cooking and lighting needs of most rural households. The BSP represents a working partnership between the Government of Nepal (GoN), the Directorate General for International Cooperation of the Netherlands (DGIS), the German Financial Cooperation through the German Development Bank (KfW), SNV and a variety of local stakeholders including the private sector and the rural farmers of Nepal.

In most of the rural areas the dependency on fuel wood for cooking is well over 95%. Deforestation around villages is prevailing, effecting the environment negatively. Women and children spend more time collecting fuel wood, while the smoke of burning these traditional fuels poses serious health risks. Many small-scale farmers posses a few cows, and together with other feasibility indicators for Nepal, the country has a enormous potential of nearly 2 million biogas plants to be installed in rural areas to provide households with livestock with a sustainable source of energy.

The following sections elaborate on the barriers that have been identified and are being dealt with by BSP in setting-up a sustainable market-oriented biogas sector. These challenges will be discussed from the perspective of biogas technology itself, the multi-actor sector development approach applied by SNV and the GoN.

Domestic biogas technology features and potential constraints

This section elaborates on domestic biogas technology in Nepal in order to explore the potential of the technology in addressing rural energy problems. The main features and difficulties are introduced from a technical and financial perspective; a side step is made to address trade-related issues.



<u>What is domestic biogas technology?</u>
Domestic biogas plants convert animal manure and human excrement at household level into small, but valuable, amounts of combustible methane gas. This 'biogas' can be effectively used in simple gas stoves for cooking and in lamps for lighting. The residue of the process, bio-slurry, can be easily collected and used as a potent organic fertiliser to enhance agricultural productivity. A minimum of 20 kg of manure is required on a daily basis to feed the plant. All plants are equipped with a provision to attach a toilet. On average, farmers keeping a minimum of two heads of cattle or six adult pigs can generate sufficient gas to meet their daily basic cooking and lighting needs. In Nepal, the 'fixed dome' biogas plant is a well-known type and promoted throughout the country. Investment costs of this type in Nepal vary between EUR 300 and EUR 600, depending on plant size, location of construction and geographical region.

<u>Multiple benefits including gender impact</u>
Biogas plants provide multiple benefits at different levels. These benefits are appreciated differently in different countries, and can be classified according to their impact on gender, health, employment, environment, energy, agriculture and sanitation (see figure).
Women in rural households in Nepal are involved with many daily activities on which biogas use could improve their situation. Spending hours collecting and carrying fuel wood can be minimized; hygiene in the kitchen is tremendously improved as well as cooking and cleaning time. Availability of time means that women potentially can spend this on education, productive or simply leisure activities. Targeting and involvement of women in promoting biogas technology is therefore very important.

Overview of the main benefits of an average biogas plant realised through the BSP in Nepal

Reduction of workload (especially women)	1,100 hours per year (3 hours per day)
Improvement of sanitation and health	- no indoor pollution - attachment of toilets to the biogas plant (for 72% of all plants) - improved dung management
Saving of firewood	2,000 kg per year
Saving of kerosene	32 litres per year
Reduction of greenhouse gas emissions	4,900 kg per year (as per 2005 CDM rules)
Increase of agricultural production	- availability of agricultural residue (1,000 kg per year) and dried manure (500 kg per year) originally used for cooking - saving of chemical fertiliser (39 kg N, 19 kg P and 39 kg K per year)

Biogas plant construction is a labour-intensive process that generates income and business opportunities in rural areas. In the Nepalese biogas sector, at least 9,000 people have obtained employment from different organisations, especially biogas companies and appliance workshops. BSP contributes to opportunities for poor, illiterate rural people to become mason and systematically improve their skills trough training.

Technological constraints

Biogas, mainly composed of methane (60-70%) and carbon dioxide (30-40%), is a combustible gas produced by anaerobic fermentation of organic materials by the action of methanogenic bacteria. The methane is odourless gas and burns with a clear blue flame without smoke. This makes biogas suitable for domestic cooking and lighting use.

One of the important steps in preparing a large-scale biogas programme is exploring the technical feasibility of biogas dissemination besides adopting a type of biogas plant for use in the local context. For example, minimum digester temperatures must be maintained throughout the year; night-stabling is required – preferable even zero-grazing - as well as water availability; and simply space to built one at a farm compound are all examined factors. BSP operates in all geographical regions of Nepal, including the Himalayas. In winter, temperatures drop and affect biogas production. Farmers have reported insufficiency of gas during those colder months. The barrier of cold weather can be overcome to some extent by heap composting on top of the digester; BSP emphasises that biogas farmers are well informed about it.

The technical life time of the Nepalese ‘fixed dome’ model is set at minimum 15 years. Availability of manure and water, mixed together as input for the plant, is needed close by the plant’s inlet. Correct plant operation avoids scum- and sediment formation inside the digester. These manners are addressed through distributing illustrative manuals and user trainings, contributing to the fact that more than 90% of the plants constructed under BSP are in operation.

Financing of biogas plants

Financing domestic biogas plants in Nepal comprises several aspects: investment subsidies, credit facilities and carbon credits (the latter will be discussed in the next sub section).

The GoN, KfW and DGIS through SNV are all contributing to the fund for providing investment subsidies on biogas plants. The current subsidy structure is the same for 2m3, 4m3 and 6m3 sized biogas plants, slightly lower for 8m3 plants and there is no subsidy for 10m3 plants. On average, the subsidy rate (a set amount) is 25%-35% of the total investment costs. To reach a poorer and a larger segment of the rural population, BSP pilots to identify who is poor and have the subsidy scheme adjusted according to that. This approach has not been fully accepted in the districts and even raised discrimination. These initiatives are explored due to a significant increase of construction and labour costs in the past decade.

As many of the potential households may not be able to raise the required investment for the installation of a biogas plant, suitable credit facilities are crucial. About 31% of the total biogas plants installed are credit financed through one of the 200 MFIs or other Nepalese banks (Dhakal, 2008).

Trade-related issues

A less explored subject in the BSP is the effect of biogas plant dissemination on trade activities. There can be identified at least three trade-related BSP supported activities: composting of bio-slurry, import of biogas plants parts and carbon credits.

It is estimated that almost two million tonnes of valuable bio-slurry are produced annually by biogas plants in Nepal. Bio-slurry is a highly potent organic fertilizer which can improve agricultural productivity tremendously when properly applied. Composting of bio-slurry is a well-known practice by biogas farmers. Although there are no specified data on slurry trading at local markets, the potential benefits for non-biogas farmers as well as the environment in general are clear. Therefore, perhaps the main barrier would relate to the question how to scale-up and stimulating bio-slurry use in communities.

From a technological point of view, BSP emphasises the use of appropriate plant parts and appliances (mainly stoves and lamps). To stimulate after-sales services (and local economies), biogas appliances manufacturers in Nepal have been supported and trade networks established. Still, trade with neighbouring China on biogas appliances and accessories contributes to exploring cost price reductions. The main identified barrier that is overcome here, is government tax reduction in order to truly stimulate trade in biogas plant parts.

Domestic biogas installations principally reduce greenhouse gas (GHG) emissions in three ways: by changing the manure management modality; by substituting fossil fuels and non-renewable biomass for cooking with biogas; and by substituting chemical fertiliser with bio-slurry. The actual reduction of GHG emissions by domestic biogas installations depends on the local situation, the size of the installation and the way the installation is operated, whereas the "claimable" GHG emission reduction depends on the applied carbon-accounting methodologies of the compliance (CDM) and voluntary markets. CDM procedures are significantly more complicated, lengthy and expensive than (most of the) voluntary schemes. Under BSP, two small-scale CDM project bundles had been registered, representing nearly 20,000 biogas plants. The carbon revenues amounted to US$30 annually per biogas plant. In 2005 the applied methodologies were withdrawn, so currently new opportunities in the carbon market are investigated (Ter Heegde, 2008).

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 GoN and international donors. The early involvement and active entrepreneurship of the private sector has been crucial to the success. SNV emphasises this is its biogas dissemination approach. The following section elaborates on the features and challenges of this 'multi-stakeholder sector development approach'.

Multi-stakeholder sector development approach

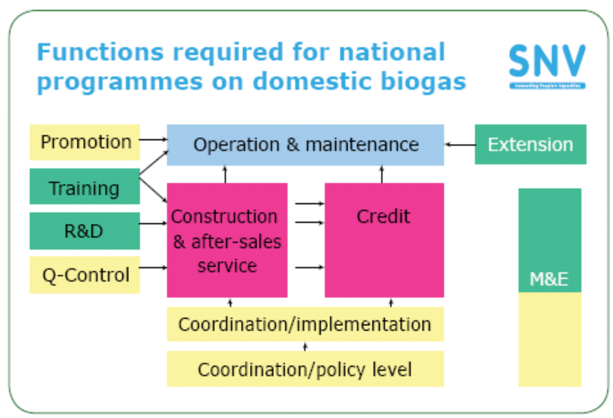
This section details on the main interrelated features of SNV's biogas approach together with their associated challenges. The BSP is a good example of how these programme features are applied in Nepal.

Interlinking impact and capacity development targets

SNV regards impact targets and capacity development as Siamese twins, strongly promoting the link between both. Impact targets, such as the number of households having installed a biogas plant, are directly linked to the development of the capacity of parties on the supply side, such as the number of companies providing quality services on construction and after-sales service. Moreover, the content of capacity building is directly linked with observed gaps in service quality (examples include quality control for biogas technicians, training support for participating vocational training institutes, business training for biogas companies, and ICT and administration training for participating government officials).

Attributing sector functions to multiple stakeholders

In the BSP there is a wide range of functions required and to be executed in a comprehensive and coordinated manner by its partners (see figure). SNV has supported the BSP towards this multi-actor approach successfully since the start in 1992. Whereas the function of operation & maintenance can only be executed by the customers, other functions should be undertaken by multiple rather than single stakeholders as much as possible to avoid monopolies, dependencies, and conflicts of interest. This allows competition on the supply side, from which the users, ultimately, will benefit. Good governance (transparency and accountability) is paramount for all transactions to be concluded in the programme.



Promoting a market-oriented approach

When biogas services fail to live up to the expectations of the owner, it is the user who will suffer. In addition, there will be an immediate negative effect on the progress of the programme, as neighbouring potential users will delay or even cancel their investment decision.

The BSP has helped to open the market for the production of biogas plants in Nepal. Currently, as a direct result of the approach of market development, more than ninety private companies had entered into this business. All participating companies must meet strict production quality and service standards for their biogas plants to be eligible to receive the subsidy that is provided to farmers. As a result of the growing competition, technical design modifications (through R&D efforts) and quality control measures initiated, the overall cost of biogas plants in Nepal has declined by over 50% in real terms since the inception of the BSP (Bajgain & Shakya, 2005).

The following section elaborates on specific aspects of the above discussed programme tasks and actors as barriers identified by the GoN in biogas dissemination and how BSP has succeeded in dealing with some of these challenges.

Government identified barriers for sustainable biogas dissemination

The GoN has played a very supportive role in the success of the BSP, mainly directly through financing part of the subsidy on biogas plants. It supports the development and promotion of successful biogas technologies in the country through the Ministry of Environment (MoE) and Alternative Energy Promotion Centre (AEPC). AEPC's main role is supporting BSP in the formulation and promotion of biogas policies, monitoring the programme and channelling biogas credit for farmers through MFIs. Several other government bodies at national and district level play a key role in the BSP (Bajgain & Shakya, 2005).

In the beginning of this millennium, a study plan has been conducted on the long-term renewable energy perspective for Nepal. This plan, executed on behalf of AEPC, has identified several barriers in promoting and developing biogas, categorised hereunder, of which BSP has been successful to mitigate and dealing with some of these difficulties.

Financial economical barriers

- "*High investment costs* required for plant installation, because it is probably the largest investment made by a farmer. Cost reduction without compromising reliability is an important aspect;
- *Farmer's affordability*: the negative growth in agricultural sector and inflation has adversely affected the farmer's affordability. Lack of adequate income-generating activities and support required for such activity is an important barrier for technology dissemination as biogas;
- *Access to credit*: loans for the construction of a biogas plant is difficult to an ordinary farmer as often mortgage is required to advance the loan. Sufficient properties are often not owned." (AEPC, 2000)

Providing subsidy to farmers who are willing to invest in biogas is a useful policy tool and it can boosts dissemination activities. Increasing subsidy by (I)NGOs and local governments is quite common due to a weak mechanism for enforcing and unifying subsidy on promoting biogas plants. This distorts the market; therefore, BSP aims that all the support coming at district level should be streamlined to healthy maintain a market for biogas promotion.

BSP has been successful in innovating the financial and judicious application of consumer subsidies. A loan and subsidy program was structured that is targeted at supporting the small and medium-scale rural farmers. This programme has been a very critical element in developing the commercial market for biogas plants in Nepal. BSP has also strengthened the institutional support for the development of the market. Specifically, it has helped the GoN to establish the AEPC, which hosts a wholesale lending facility for more than 200 MFIs to enable them in providing loans to farmers for installing biogas plants. A critical note to this facility is the operational lack of enhancing capacities of MFIs involved (Dhakal, 2008).

Technical barriers

- "*Research & Development*: lack of research and development to continuously improve and innovate the technology to improve efficiency and additional end uses for income-generating activities;
- *Orientation of the construction companies*: all the companies engaged in plant construction have a profit motif, there is some negligence about the quality control and after-sale-service." (AEPC, 2000)

As discussed, BSP has helped to open up the market. This was accompanied by strict enforcement of carefully designed quality standards; crucial in the promotion of biogas technology. These standards are not limited to the design, construction materials or method, and after-sales service of biogas plants, but also to the quality of information provided to the potential users prior to their investment decision.

In cooperation with its partners, SNV has developed and tested several systems on quality management and on quality enforcement from the perspective of the customers and for the protection of the investment made by the customers. For example, standards for the construction of biogas plants are put on paper, agreed upon with the companies, and controlled on the basis of samples. Well-performing companies are awarded and provided with a high-quality grade that they can use for the marketing of their product, while non-performing companies are penalised and, if performance doesn't improve, expelled from the programme.

Social barrier

- "*Illiteracy*: Studies show that 75% of the biogas owners are educated. However, it is very difficult to convince uneducated farmers about its importance." (AEPC, 2000)

While it's not directly BSP's role to reduce illiteracy, it is necessary to keep this indicator in mind in promotional and information transfer-related activities. BSP has promoted biogas through radio and TV broadcasting, exhibitions and its user trainings and manual are to a large extent illustrative with little text. Nonetheless, it must be said that BSP is not targeting the very poorest segment of the rural population, as other factors, like the initial investment costs, would leave out the option of biogas use for a large part of rural population. The final section wraps-up the previous sections on identified barriers from the technology, programme approach and GoN perspectives.

Concluding remarks

The previous sections have contributed to the understanding of how to overcome barriers in sustainable biogas dissemination in Nepal from the perspective of the technology itself, the multi-actor programme approach and the GoN. Overall, it is proven that benefits of biogas plants can have a positive impact on basic livelihood indicators as well as rural economic development. The Nepalese biogas sector contributes to the development of other sectors, among others, agriculture (through bio-slurry use), sanitation (through attachment of a latrine to the plant), financing (loan product development for farmers) and construction (increase in skilled labour through training).

BSP has positively affected the lives of the poor and especially women and children in the rural areas. BSP has provided a number of important lessons regarding implementation for other alternative energy initiatives in Nepal and other countries. In addition to the general successes described in this paper, one of the most important achievements of 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.

The success of BSP evolves around three important sustainability aspects: institutional sustainability, technical sustainability and financial sustainability. Optimising institutional arrangements and strengthening the capacities of all actors in the sector is crucial in this approach. By introducing a rigorous, quality management component to the programme, it helps to ensure that supply-side actors remain fully accountable to their customers. The financial sustainability of BSP is more complex to achieve, foremost requiring national governments to contribute to the costs (Bajgain & Shakya, 2005).

Despite all positive developments in the Nepalese biogas sector, BSP has reached 10% of the potential biogas users in the country. In the view of the discussed barriers and challenges, questions arise how to scale-up practices rapidly on the one hand and still maintain a viable market-led biogas sector on the other hand. Taken a step further, successful replicating domestic biogas technology to impact poor rural populations across developing countries is an ongoing challenge for SNV and its partners.

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