Biogas towards Rural Development in Nepal and the role of Technology Users therein

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Introduction to the paper

This paper is written in an attempt to answer the questions below as part of an assignment under the above-cited course and it has two parts. The first part is meant to provide a conceptual framework and basis for the analysis the questions as a problem involving the interaction between technology and society. In the second part of the paper, a specific technology, namely The Case of Biogas Technology in Nepal, will be presented and then analyzed in a way that not only attempts to give possible answers to the questions addressed, but also reflects how the technology-society relationship shows up itself in the development of the biogas technology in a developing country.

Questions Addressed: (As it appeared in the list of topics for assigned works!)

2. What is the role of technology users in developing countries?
    - In relation to technologies' design, production, dissemination, and adoption
    - In relation to society's development and societal debates
    - How are users influenced by the technology? How can they benefit from technology? What could be "appropriate technology"?
    - Role of user knowledge; knowledge network approach
    - Argue from concrete example(s)
    - Choose a specific and pertinent title

Part-I: General approach towards analyzing the questions:

In order to go about and deal with the questions addressed above, it would be here helpful to analyze the question itself and re-address it in manner that clearly shows how it should be approached. To that end, the phrase "Technology Users" can be taken as a reasonably good starting point, in that it comprises of and refers to not only **what** is going to be used, i.e. a given technology, but also **by whom** it is going to be used, i.e. those specific societal groups to whom that technology is meant to serve some end-purpose or fulfill some specific needs arising from such groups. In other words, this phrase refers not only to the existence of the technology in some useable and functionally-ready form, but it does also indicate the presence of the need and purpose from the users side towards which that technology has to end up with. This may mean that the mere physical existence and availability of technology doesn't bring any developmental change by itself – that is to say, should technology lead to the development of a given society, then the use and/or practical application of it towards some intended purpose is a must. Technology has to have a purpose to exist, but this purpose is not 'known' to the technology itself, rather its purpose lies within the social sphere that created it or to whom it is created. Plus, any perceptible value of a given technology can only be realized and sensed during or after its effective use towards the intended purpose, its value will otherwise remain latent. And so, the role and contribution of a certain group of technology users towards **societal development** needs to be seen and measured against the degree of realization of such **values** within a given society.

Although the use of a technology can be an important stage in the process of realizing its societal benefits or effects, it is equally important to identify other set of activities as well as those involved actors that have resulted in its final usable or applicable form. Technology after all doesn't come out of nowhere because the 'user' is there waiting for it – it has to be created, developed, produced and distributed before it finds its way in the hand of its intended user. This means that aside from the user of a given technology, there are other groups of people who not only assume the task of creating or inventing, designing, developing, producing and supplying of the technology in need but might also get involved in matters related to that technology. The role of technology users in the design, production, dissemination and adoption of technologies needs thus to be seen by taking due consideration of the nature and dynamics of their interaction and relationship with other acting social groups. Still other factors like the nature of the very problem that necessitated the need of that technology, the knowledge and skill of the technology users, the number and capability of

technology producers or suppliers, the natural environment, etc. come into play in determining the nature and pattern of the local use of any specific technology and so the role of users in the process.

While what has been stated right above is meant as a general introductory basis to the answers of the addressed questions, answering them on the basis of a specific area of technology, geographical location and those local societies within which users of this technology are found will be a better way of approaching the questions rather than attempting to answer them in a rather generalized way. So, for the purpose of this paper the case of biogas technology in Nepal has been chosen. After giving a brief technical description of this technology, follows the analysis of the technology from the local perspectives and background information as of how this technology became introduced, used and adopted locally. Following the analysis of the benefits and appropriateness of the bio-digester technology to the local conditions as well as the influences it leaves upon its utilization, the role of users of this technology in relation to the design, production, dissemination and adoption of the technology as well as in relation to the development of the local rural society. Moreover, the paper will discuss some problems and issues of societal concern that arose as a result of using this technology as well as the debates that go around them. And finally, some knowledge specific issues like users knowledge pertaining to this technology as well as how knowledge networks may be seen in enhancing further use of this technology towards the development of the local society.

Part-II: Approaching the questions on the Basis of Biogas Technology in Nepal

Background Information

1. The Biogas Technology

Biogas simply refers to the gas that can be produced through anaerobic digestion of organic materials like agricultural byproducts and/or wastes. There are different types of technologies or biodigesters to generate a gas mixture of which methane – combustible gas - is the major constituent. The gas produced can thus be used for cooking and other power demands like lighting. A typical biogas generation system consists of the digester, storage tank with inlet and slurry outlet, gas delivery pipes, stoves and lumps. For good performance of the digester and so the generation of this combustible fuel mix, the operating conditions like temperature and acidity level, under which the bacterial digestion takes place need to be kept within optimum ranges. This technology can particularly be appealing to those rural societies or

families in developing countries where such biomass inputs can be available in relatively good amount and be utilized in meeting their energy demands. Besides the generation of the biogas, the slurry that remains in the digester can also be used as a fertilizer as it is rich in its nitrogen content. The use of this technology can at the same time lead to improved sanitation as the wastes are being used rather than being wasted.

2. The development of Biogas Technology in Nepal

Nepal depends heavily on traditional energy resources and other alternative sources of energy are poorly developed. For instance, of the total energy consumption in Nepal for the year 2003/4 the proportion of biomass was 86%, petroleum 9%, electricity 2% and other renewable sources 1%. (Center for Rural Technology Nepal, 2005, 2). In the same period, biomass could account for 98% of the total energy consumption in rural Nepal. (Ibid) For Nepal, with more than 80% of its population living in rural areas (Ibid) it can apparently be seen that biogas technology can be a good candidate in meeting the rural household energy needs. How does the developmental history of this technology look like?

Biogas was first introduced to Nepal in 1955 (Sundar B. and Indira 2005, 17). But this was just on an experimental basis but the initial experiences obtained from this demonstration could at least show the feasibility of using the technology locally. Then after, different organizations became involved in promoting the technology. In the year 1968 a biogas system was constructed and exhibited by Khadi and Village Industries Commission (KVIC) from India, constructed and exhibited a biogas system (Ibid, Appendix-1). In the year 1974 the government launched the first official biogas program under which shoes potential customers could find loans to construct and develop the technology. Few years later (in 1997), a state owned entity called Gobar Gas Company (GGC) was established with the aim of advancing the development and promoting wide-scale dissemination of the biogas technology in Nepal. With time biogas became to be known as an important source of alternative energy, although the state-owned company GGC was essentially the only one that was producing the biogas systems. By the year 2003, there where 39 companies besides GGC that had already entered in the business of producing biogas plants. As a result of the growing competition among those involved companies, technical design modifications and enforced quality control measures, the biogas systems have gained client satisfaction and become an example of self-promoting technology.

In the course of developmental history of the biogas technology in Nepal, the contribution made under the Biogas Support Program is significant. Among its major activities were: strengthening the capacity of biogas construction companies and collaborating with the private sector, providing subsidies and low-interest financing options so that farmers can afford to buy biogas system, and guarantee of after-sales service to ensure the success of biogas technology in Nepal. Such efforts could lead to the establishment of the Alternative Energy Promotion Center – a center to support biogas and other alternative energy applications in Nepal, the Nepal Biogas Promotion Group (NBPG) – an association of companies that produce biogas systems, and also the formation of a NGO Coalition for Biogas and Alternative Energy Promotion.[1] As of 2005, the total number biogas plants constructed in could reach to 156,575 and in 2003 the number of rural households members that benefited from the deployment of biogas systems under the Nepal Biogas Support Program (BSP) was more than half a million (650,000). (Sundar B. and Indira 2005, 8).

3. Analyzing the case of the Nepalese Biogas Technology for the answers to the questions

The benefits of the biogas technology to those rural households in Nepal can be seen as follows. First and foremost, the biogas produced is used for cooking purposes. Because of its use for cooking, it can help in reducing the use of fuelwood and hence conserve the local forest. The use of biogas can also reduce expenses of those rural families on imported fuel, as it replaces kerosene used for cooking and lighting. The slurry from the digester can be used as an organic fertilizer which in effect not only enhances their agricultural production but also can replace the use of chemical fertilizer.

Still this technology has health benefits from reduced indoor pollutants such as smoke that result from the direct burning of firewood. Indoor air pollution and smoke exposure from the use of fuelwood, dung cakes and agricultural residues for cooking and heating is – in rural Nepal – amongst the worst in the world. It is one of the major causes for acute respiratory infections among women, infants and children (Pandey, 2003). The use of biogas can thus significantly improve the indoor air quality. Moreover, since the combustion of biogas is relatively clean, it reduces eye ailments associated with smoke from ordinary fuelwood stoves. Since women and female children are the ones predominantly involved in cooking,

[1] For detailed information regarding the Nepal BSP can be found in Sundar B. and Indira 2005.

they are the first beneficiaries of the technology. In addition, dung management and sanitary toilets attached to biogas digesters lead to better hygienic conditions. This does help in keeping the areas surrounding households clean and reduces the chances for the spread of infectious diseases.

From environmental point of view, the gas CO2 which can result from the burning of wood as well as the methane (CH4) which is the main constituent of the biogas are both greenhouse gases and their release to the atmosphere should be minimized as much as possible. So, the replacement of firewood by biogas and the use of methane as fuel – which otherwise can also be formed from the natural decomposition of biodegradable materials and escape to the atmosphere – makes the significance of using biogas technology as eco-friendly. Perhaps it might be interesting to mention the possibility of benefiting from biogas utilization as a source national income through carbon trading under the Clean Development Mechanism (CDM). The problem of deforestation can be reduced not only by replacing firewood with biogas, but also by the use of the slurry collected from the digester and returned to the farm land reduces the depletion of soil nutrients. Keeping the soil nutrients means in turn reduces the pressure to expand the area of land cleared for agriculture, the main cause of deforestation in Nepal. (See also: Sundar B. and Indira 2005, P. 49).

Employment creation can also be seen as benefit of the biogas technology in the local development. A number of persons do earn their living from their work in the biogas sector, especially in the installation of biogas systems in the users' locality. For instance, as of year 2003 an estimated number of 11,000 persons were directly involved in the Nepalese biogas sector. Besides this figure, around 400 masons are trained every year as part of the local human capacity development effort in this sector. (Sundar B. and Indira 2005, 29)

What has been stated above regarding the benefits the biogas technology can one way or the other show how this technology can benefit the development of the rural society in general and the betterment of the living condition of those family members that are direct user of the technology in particular. Following will be attempted to see how the technology has influenced the users and how the users come to influence the way the technology should be, especially with respect to **its design**. Besides showing the way this biogas technology and the user society interact with each other, it will be attempted how possibly both can initiate or

necessitate change in the other thereby making it have a society-technology kind of relationship.

Let's start with what one of this technology's users said regarding his choice of the biogas technology:

> *"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." (Source:* Sundar B. and Indira 2005*, P25)*

This user is one who can draw satisfaction out of the technology. This satisfaction in turn is linked to or is a reflection of the utility, comfort, and value received by the end-user. The more utility, comfort and value a given technological product provides, the higher the reported satisfaction of the end-user. This user's satisfaction can also be seen in relation with the design of the technological artifacts making up the biogas system. After all, a given technology can be only as good as how well and rightly designed to fit the purpose it is intended for. It is this purpose that dictates the overall and detailed technical feature of a given technological artifact. This purpose by itself is social by its nature as it owes its very presence or existence to humans – technology is just a human product and, of course, a means as well so as to achieve this so-called purpose. One may say that the conceptual source or origin of a given technological artifact and the purpose towards which it has to end up with are practically the same. Purpose is needed for a given technology to be constructed again it is this purpose towards which the constructed technology ends up.[2]

The following quoted statement may show up another reason for selecting the biogas technology:

> *"We decided to install a biogas system on seeing the comfort enjoyed by our neighbors. 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." (*Sundar B. and Indira 2005, 26)

[2] This just reflects shared or personal view of the writer of this paper.

The expression of this user reflects, like the one before, the satisfaction (s)he could possibly draw out of the utilization of the technology. Here are two important points that are worth to look closer at. The reason for satisfaction with the biogas plant is related to the reduction of some few hours required for collecting fuelwood thereby saving time which can be used for doing other things. In addition, lighting of a biogas stop is simple, fast and convenient which can still be seen as time-saving besides its easier functional usability. This savings of labour time as a result of using biogas systems is the first point. 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 water and fuelwood. The second one is that such a satisfaction of technology users can have a role to play in an increased and widespread use of the technology. As could be seen from both quoted statements, the two peoples' decision to have their own biogas system is provoked by what they observed in other users. This can be seen as one way how technology users may play a role in the **dissemination** of a given technology. Satisfied users can bring yet more users.

A technology that has been accepted and positively exercised by one may face or spark negative reaction from others. The Nepal Biogas Support Program has actively promoted the capture and use of human nightsoil for increasing biogas production for households. This was a particularly challenging objective for BSP as it required overcoming long-standing cultural and social taboos associated with human excreta or nightsoil.

> *"My parents 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." (* Sundar B. and Indira, 2005, p. 27).

How could this be solved? Two important measures have been taken to overcome these taboos. The first was designing an attached toilet system to eliminate any handling or contact with the nightsoil. The second one was an information and outreach program to educate users about the consumers the cleanliness of the resulting biogas. The success of overcoming these taboos is demonstrated by the fact that 72% of the installed biogas systems have attached toilets to capture the human nightsoil. (BSP-N, 2004)

> *"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 villages to accept the system." (Source: Ibid R 28),

The problem or resistance lied in the fact that 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 has biogas derived from nightsoil. However, the 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 the biogas systems. (See also: Sundar B. and Indira 2005, P. 27)

When we see how the above taboo- and/or religion-related resistances to the use of biogas have been solved, technical solutions, i.e. designing the biogas system in a manner that makes it fit to the toilet, alone cannot win the acceptance the biogas technology. Such resistances that stem from the beliefs of people or individuals is hard to change however clever the design of that technology might be. Persuading these people and changing the way they perceive things is rather social by its nature. This is to mean that the individual that is to be persuaded as well as the one that persuades him or her need to understand and communicate based on the common beliefs, culture and value as members of that society to which they belong. In order to persuade or convince an individual, one needs to know him or her well first. The creation of awareness (making people know what they previously don't) as well as changing those already-held beliefs and conceptions requires the contact and/or communication between the two. Should the biogas technology find its way in more rural households, it is important first to convince the rural farmers 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 system. It is thus critical that they are fully informed, trained and supportive of owning, operating and maintaining the biogas plants. To this end, the knowledge network approach may prove worthwhile.

So far knowledge networks are concerned, it would be important to take into consideration the presence of a number of acting social groups that have some interest of their own in the

technology and find themselves get involved in the issues and matters related to it or its users. Knowledge networks could facilitate the exchange of data, information and knowledge between and among the various actors like the government and its different institutions, users, companies producing the biogas, NGOs, donor agencies, banks, and other willing or concerned groups of people. Along with this, the knowledge of the user, in the case here the Nepalese rural families, does matter in determining the nature of interaction and relationship they can have with other acting groups that are involved in the introduction, dissemination and adoption of the technology within and by the rural community. The knowledge and so awareness these users have can determine how far and well they can play their role in relation to the technical features or design of the biogas technology and also the overall effort made towards the dissemination and widespread use of the technology.

The following point illustrates how the design of the biogas system interrelated with the local-specific conditions and the family status. The biogas plants need optimal temperature ranges for the digestion process. This technical requirement of the technology makes the need to take the local conditions like temperature into consideration. For example, a biogas system that is designed and produced for a rural family living in the highlands of Nepal – where it can be lower temperatures than in the lowlands – may not operate properly and fulfill the desired purpose. This is because the bacterial process inside the digester requires a temperature range 10 to 35 degrees for the fermentation and this temperature range has to be maintained should the technology prove functionally feasible. As a result, biogas systems that are installed in highland areas where the temperature falls below 10 degrees must be adjusted with thermal insulation and warm water feeding to maintain the required temperature inside the digester. This means more costs to those rural populations in the high altitudes.

Still another point is how the size of the family affects the design of the biogas systems. Not all rural families are in the same status and level of household incomes and wealth. The size of the biogas plant to be installed for each family can thus vary depending on whether a given family can afford for it or not. Those big families with a large number of cattle can consider having big size biogas plants so far they have the financial capability to afford for it. On the other hand, those farmers with small number of cattle who are intending to use the manure for biogas generation tend to have smaller scale plants which may be more attractive to their situation. The smaller and bigger biogas plants will vary not only in the cost they incur but

also their design. The larger size plants are generally more complex in their design than are the smaller ones.

How **appropriate** has this technology been? The appropriateness of the biogas technology to those families in the rural Nepal can apparently be seen in terms of the benefits it brings to them. The technology has proved itself a success and to that end a number of factors unique to Nepal have contributed. 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 so can have the dung that can be collected to feed the biogas digesters. The handling of cattle dung is not a taboo in the context of the Hindu culture there. The increasing difficulty of obtaining fuelwood in Nepal also provides a strong incentive to look for alternative cooking fuels like biogas.

4. Issues, Challenges and Debates:

The Nepal Biogas Support Program could overcome a number of technical, social, institutional and financial barriers in the course of the local biogas technology development. These barriers are still compounded by the challenging geographical features of the country, the broad range of climatic conditions and the poor economical status of the rural districts. The continuation of this program is also not certain and the subsidy from government side will phase out in 2009. Among the many issues that are of concern today include: the development of affordable biogas system that can be easily transported to very remote and difficult-to-access places as well as for farmers living in high altitude rural Nepal; development of commercial biogas systems for industries and municipalities; develop small biogas systems for common household and kitchen waste for both rural and urban areas, strengthening the private biogas sector and improving the buying capability of rural families.[3]

[3] The detail of those challenges posed to the Nepal biogas sector is to be found in Sundar B. and Indira 2005, Pp. 59-54

References

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