

2.3 Action Plan for Biogas Technology

2.3.1 About the technology

A biogas plant consists of a pit which serves as a digester for organic waste and gas holder. The digester is either built of brick and cement inside the pit or prefabricated and mounted inside the pit. The tank is either made of a metal container floating on the slurry or a fixed dome built on the digester. Different types of organic materials can be fermented to produce the biogas such as animal dung, agricultural waste and industrial waste. The organic material is mixed thoroughly with the same amount of water and fed into the digester to decompose by the act of anaerobic bacteria to produce the biogas. Generally, cow dung is the most suitable; it is homogenous, not fibrous, requires less amount of water to be mixed than other materials and already contains methane producing bacteria. The biogas is a flammable gas that consists mainly of methane (60 per cent), CO₂ (30 per cent) and water vapour (10 per cent). It is odourless, burns without soot and leaves no dirt on utensils.

2.3.2 Target for biogas transfer and diffusion

As a first step, the programs will be directed towards the rural areas in Sudan, mainly Gezira, White Nile and Blue Nile regions. These areas have been selected based on the following characteristics:

- Large numbers of livestock (cattle) potential on semi-sedentary system, about 30 million
- Sedentary population with an average of 10 person/household
- Availability of water as located near the river Nile

In particular, 60 percent of the cattle population is expected to enter such system with dung availability of 70 per cent. As the expected amount of dung is around 1.5 ton (fresh basis) (0.3 dry basis) /head/ year. The dung are expected to produce 350m³ of biogas/ ton dry matter with average heating value of 20 MJ / m³ biogas

The expected impacts are:

- Reduction of GHG emission
- Supply of cooking fuel
- Provision of electricity
- Delivery of lighting service
- Improve public health by collecting dung

2.3.3 Barriers for biogas technology diffusion

Biogas technology for energy purposes has been introduced in the mid-1970s through some projects but there is no systematic use of this technology and most executed projects have failed. Different barriers result from poor adoption of biogas technologies of which the following are identified to be the most significant:

Economic and financial barriers

Biogas technology is a high cost technology that is generally unaffordable for individuals or village communities. In particular these high costs are based around the following aspects:

- Prevalence of small scale units with single purpose mainly cooking fuel neglecting electricity, lighting and fertilizers. Hence the revenue will only be calculated upon the cooking fuel cost which increases the cost/m³ of gas. Ultimately, the payback period is very high
- The available design - building in site Indian design – requires the use of expensive construction material such as cement and iron bars.
- Absence of financial policies for green technologies and biogas, lack of funding opportunities by commercial banks, community development institutions, agricultural funds, or tax and custom authorities
- Absence of commercial technology suppliers like companies and lack of local market incentives. Hence the profit margin is low for any component therefore the purchasing of any commodity or services related to biogas technology will be against higher value.

Non-financial barriers

The non-financial barriers facing the diffusion of biomass include:

- Lack of information at different levels of society including policy makers and planners,
- Lack of awareness about the conditions and benefits of biogas technologies, especially in rural areas. Therefore the livestock owners as general is not aware about why and how biogas technology could be adopted. This situation results in biogas being undiscovered subject hence in absences of demand. This low demand does not encourage the allocation of specific budget for awareness programs as they are generally directed to the more important issues such as new varieties or gender mainstreaming consequently a vicious circle is created.

- Absence of well-defined policies and regulations to mainstream biogas technologies and priorities within the energy, waste and livestock sectors
 - Absence of specific bodies responsible for the patronage of biogas technologies and supporting the dissemination and adaptation efforts and lack of cooperation between governmental bodies and institutions related to biogas.
 - Lack of research on the performance of biogas technologies
 - Limited technical know-how related to biogas technologies as a result of inadequate university curricula and lack of experts exchange programs
- Generally there is lack of information at the different levels of the society including policy maker and planner level. Extra there is complete absence of awareness packages about the conditions and the benefits of such technology whether as direct information mode or through media. This absence extends to rural development programs and agriculture extension services. Therefore the livestock owners as general are not aware about why and how biogas technology could be adopted .This situation results in biogas being undiscovered subject hence in absences of demand. This low demand does not encourage the allocation of specific budget for awareness programs as they are generally directed to the more important issues such as new varieties or gender mainstreaming consequently a vicious circle is created.

There is no well-defined policy and regulations that are issued to mainstream the Biogas technology and priority within the energy, waste and livestock sectors. This could be referred to inadequate awareness among decision makers about green technology importance as biogas benefits.

There is no specific body responsible for patronage the biogas technology and support the dissemination and adoption efforts. Follow-up measures have not been critically considered as this requires dedicated body. This gives rise to unsustainable projects, as a result, negative community perception has been generated. Research and educational institution are relatively active in producing scientific documents including technical packages or execution instructions however the impact of the research outcomes are very limited due to absences of transformation channels. Additionally, there is no smooth systematic cooperation between the main governmental bodies / institutions that are related to biogas e.g. Ministry of Animal Wealth, Ministry of Energy etc. Although there are some biogas professionals, technical know-how is generally very limited at all levels;

planning, scientific research, contractors, builders, operators etc. This could be referred to the fact that the curriculum for many engineering, agriculture, animal production, etc. faculties does not include adequate biogas related topics in their curriculum. There are no expert visit programs through which the experience of the other countries could be exchanged. The relative small job market does not encourage young people to anticipate career in biogas beyond the university level and research centres.

2.3.4 Proposed action plan for the Biogas technology

The following table provides a summary for the actions proposed above to facilitate the diffusion of biogas. The summary includes for each action, types of responsible institute, time frame within which action is implemented and the verifiable indicators for the outcomes of the proposed action.

The biogas technology is not well developed in Sudan and so actions need to concentrate on developing cheap and acceptable designs of biogas plants that fit the socio-economic context of rural Sudan. So actions are based on short- and medium term measures for sustainable implementation of biogas technologies that contribute effectively in GHG reduction.

Different institutions are to be involved in this action to diffuse the biogas technology which includes:

1. The financial institutions:

- Ministry of Finance and National Economy is responsible for the provision of financial resources needed for the implementation of the action for the biogas technology. The estimated budget should be provided by the Ministry of Finance and National Economy.
- Chamber of taxes is responsible for the tax reduction and exemption from income taxes for constructors of the biogas plants.
- Banks are responsible for the provision support to builder of the biogas plants and support to the users in villages.
- Customs authorities are responsible for the exemption from customs and duties for imported building and prefabrication materials used in the building of the biogas plants.

2. The energy institutions:

- Ministry of Water Resources and Electricity is responsible for contribution

of the general energy policies that promote efficient energy technologies.

- Ministry of Oil is responsible for the contribution to general energy policies beside pricing policies for alternative energy sources.
- National Energy Research Centre and universities is responsible for R&D on biogas technologies and assess the availability and accessibility of waste resources (animal dung) in different parts of Sudan which have high potential for biogas applications.
- Forest National Corporation is responsible for the approval of the recommended biogas design, provides training on biogas plant building, operation and maintenance.

3. Public awareness institutions (local media, radio, TVs, newspapers) responsible awareness and promotional campaigns to facilitate the flow of information about the proposed technology.

Table 4: Summary of action plan for biogas technology

The measure	Why is needed	Action needed	Responsible Institution	Time frame (years)	Cost of action	Indicators of success
Establish Financial mechanism and provision of soft loans to investors	To encourage the dissemination of biogas	Support producers village committees	Governmental Banks	20	1000,000	Number of people financed Size of annual finance received percent of loan re-payment of loans
Qualify engineers technicians & skilful labourers	Technology transfer ,operation & maintenance of the biogas	Establish educational programs for university and vocational training centres	Universities/ Research centres/ vocational training centres	5	50,000	Number of curriculums designed and applied Number of Instructors trained Locally/Abroad Number of students graduated
Country wide awareness campaigns	Raise the awareness of the population about the economical & environmental benefits of biogas	Workshops seminars brochures	Energy institutions	10	100,000	Number and types of campaign designed Number of materials prepared Number of campaigns performed Geographical coverage of campaigns
Capacity building and training programs	Training of trainees (engineer technicians)	Training programs	Energy institution/ private training centres/ local media	5	100,000	Number and types of training needs assessment performed Number of training packages prepared Number of training sessions held Number of trained beneficiaries (persons/ institutions)

Develop market chain	Distribution of biogas construction material at reasonable price	Establish link between material suppliers manufacturer The biogas user/users	Private sector	5	500,000	Number of businesses initiated Number of built biogas plants per year Number of prefabricated units sold
Put in place energy and waste policy mechanism & institutional arrangement	Coordination between different stakeholder especially government institutions	Institutional arrangements	Energy Institutions	3	15,000	Institutions establishment Approved biogas standards and specifications Laws and regulations formulated and approved by the government.
Total budget					1,765,000	

Budget:

Total Budget needed for the implementation of the action plan is 1,765,000 USD

To be financed by industry owners, governmental banks and international donors