Biogas as clean energy alternative for communities around the Khartoum green belt

Prepared by

Agricultural Technology Transfer Society (ATTS)

www.sudanatt.com

Introduction (rationale)

Sudan is characterized by high dependence on biomass energy (fire wood, charcoal, and agricultural residues), it constitute 78% of total energy consumption. It is composed of 69% fuel wood (firewood and charcoal) and 9% residues. Households consume about 60% of total energy consumption and 72% of total biomass energy. Sudan is facing real environmental degradation due to combine factors (drought, desertification, over-grazing expansion of agricultural land, firewood/charcoal production, etc) and depletion of forest resources. The green belt that will be established around Khartoum will cover an area of 320 km, this will **create a great opportunity** for reversing the green house gas build up. Carbon sequestration is a recognized method in the removal of CO_2 from the atmosphere under international treaties, such as the Kyoto Protocol. Planting trees and shrubs have proven to be very efficient in reducing wind erosion, stabilizing sand dunes, retention of soil moisture, ensuring restore of soil fertility and biodiversity conservation.

Area of study

The study will target some villages that are located within the green belt which runs from west to east of Khartoum state with a buffer zone of 20 meter and 200 meter width. It passes through localities of Omdurman, Ombaddah, and Karri in the west to Sharg El-Neel (eastern of the Nile) and Bahri (Khartoum-North) in the east. A random of 100 households in the western localities and eastern localities will be selected for biogas project implementation. Before installation of the biogas units, an awareness raising campaign, followed by sensitization and mobilization will be undertaken. Certain criteria will be employed for selection. These include: biomass availability, water availability and households willingness.

Objective

The overall objective is to switch from traditional non renewable biomass resources (i.e., fuel wood) or fossil fuels to renewable biogas from manure management for cooking purposes in the rural households of Sudan. This will

greatly improve availability of decentralized clean energy and improves energy supply security. The usage of manure for biogas generation reduces the emission of GHGs into the atmosphere and their impact on the environment. The decomposed remnants of manure areas an excellent nutrient source for fertilizing the field and improve the productivity of the field through land application.

The program targets deployment of the biogas digesters for the rural households providing improved standard of living to the poor and vulnerable households in the area. The social and economic consequences of the project is to reduce the hours women spend collecting biomass fuel, improving their health, and freeing up their time for more beneficial activities is expected to result in raising the living standards of an entire generation of children and households. Women who can spend less time collecting fuel have more opportunity to undertake income-generating activities and take care of their children.

Technology description

The biogas units will be constructed of bricks, sand, cement, pipes, pipe fittings, metal clips, wire and gas burners. Each bioreactor will have a mesophylic fixed dome. The capacity of the bio-digesters will be either 2 m^3 or 3m^3. Any sort of biomass will be fed to the digester daily. The waste breaks down anaerobically producing biogas which mainly has methane. This biogas builds up above the slurry and remains in the digester until it is released through the gas outlet pipe at the top of the dome. As the slurry increases in the digester, it is pushed into the outlet tank and finally exits through slurry discharge hole. The dried slurry can be used as manure in the farm.

Implementation procedure

ATTS has adopted a bottom-up approach where ATTS will engage distributors from local communities to provide the biogas digester to the households using the support of local masonry/civil engineers. The masonry will be employed from the local communities promoting the employment for local communities. The distributors will provide the required training to the masonry employed for installation of the biogas digester and further oversee the implementation of the biogas digester. Training will be given to technicians on implementation record keeping and maintenance of the biogas

digester through the dedicated channel of technicians. These technicians will also be engaged from local community and will be designated for specific number of biogas digester and will be responsible for data recoding and data storage along with annual operation and maintenance of the biogas digester. The distribution system will follow decentralized model to improve the operational efficiencies and emphasis will be on the quality control so that there is no difference in the quality of the biogas digesters distributed at each stratum. There will be a constant check to improve and adapt to the needs of the distributors, technicians and the makers of the biogas digester. Awareness programs at villages by collaborating with the village tract leaders are being conducted to raise the awareness of the stakeholders on the advantages of biogas digesters and also to focus on the scalability of the program

Women activities development

Biogas byproduct is a good fertilizer that could be used in women garden Backyard home gardening is could be used for women farming activity. Due to the introduction of biogas units, women will have enough time for garden activities. The graden is cultivated with pulses and vegetables crops (Okra, cucurbits, watermelon etc.) for family consumption. The output from this activity becomes in many cases a factor in meeting household food and income shortfalls. Women generate income from the sale of about 50 % of the production of the home garden.

Expected Outcomes:

- Reduced indoor smoke-induced illnesses

- Reduced poor-sanitation induced illnesses

-Reduced drudgery from fuel wood collection

- Reduced pressure for illegal forest encroachment

-Reduced workload for food-preparation

-Reduced soil erosion/degradation

-Improved opportunity for education

Expected Outputs:

- Reduced direct medical costs

-Reduced expenses conventional energy sources

-Reduced chemical fertilizer expenditures

-Increased opportunity for (small-scale) organic agriculture

-Improved agricultural yields

-Increased family income

-Increased employment and generating opportunities

-Opportunity to develop markets for (organic) agricultural produce

-Generating Clean Development Mechanisms revenue

Annual operation, maintenance & cost

As biogas is a proven technology, the lifespan of a fixed dome biogas plant can be expected to be at least 20 years. The total construction cost for a 6 m^3 (slurry volume) biogas fixed dome digester in Sudan with all fittings and basic appliances is 2,000 US$. Besides the biogas plant construction cost as capital investment in the first year, annual cost includes operation, maintenance and repair expenditures. Following experiences in Asian countries, annual repair and maintenance cost is estimated at 1.5% of the total construction cost. Annual financial cost for operating the plant dung and water collection and mixing - are basically calculated at zero.

Technical skills once established in an enterprise will lead to job creation and sustainable development of local economy. In communities where the ATTS will set up clusters for biogas dissemination, hardware stores could benefit from the program by deliverance of construction material and spare parts for biogas equipment. Construction and piping work will be carried out by local enterprises and craftsmen only, thus enhancing not only employment and income, but also long term know how development and local economies. Involving professional media enterprises will create a demand which will be covered by the private sectors' offer. After several years the cost of a biogas plant should cover also promotional costs for maintaining an ongoing publicity campaign.

Expected achievements

Social benefits

- Smoke-free and ash-free kitchen, so women and their children are no longer prone to respiratory infections;
- Women are spared the burden of gathering firewood

Environmental and health benefits

- Keeping manure and waste in a confined area and processing the min the digester reduces the amount of pollutants in the immediate environment and increases sanitation;
- Households no longer need to extract wood for cooking, which can reduce deforestation levels where people heavily rely on woodfuel;
- The sludge remaining after digestion is a good fertilizer, increasing land productivity (and farm incomes).
- The release of methane is avoided thus contributing to climate mitigation. A single, small scale biodigester reduces between 3 and 5 tCO_2-eq./year.

Economic benefits

- Buying (fossil) fuel resources (e.g. kerosene, LPG, charcoal or fuel wood) is no longer needed Switching from traditional biomass resources (e.g., in developing countries) or fossil fuels (e.g. in industrialised countries) to biogas fired generation capacity improves security of energy supply (locally as well as nationally or regionally) as the feedstock can mostly be acquired locally

a) Energy market

The rural household energy market is dominated by fuel wood, charcoal, kerosene and batteries. Solar energy home systems are not yet well accepted due to fairly high prices of the equipment, and LPG distribution encounters still logistic problems. Household biogas has no commercial value, as it could not be sold to the neighborhood. Thus it is to be compared economically with other conventional sources of fuel which are free of charge, like fuel wood and agricultural residues. Traditionally firewood is so to say free of charge, and its supply is only an investment in women's time. Increasing numbers of women however encounter problems in collecting firewood close to their homestead. They have to invest more time now walking kilometers whereas previously only some minutes were needed. Some communes have already introduced tariffs for fuel wood; others have introduced a tax on wood collection. Charcoal availability is reduced and production has been limited by law, as the production of charcoal has lead massive deforestation. Energy for lighting in rural areas is predominantly provided by kerosene lamps or torches. Kerosene for lighting purpose is

subsidized by the government; but still energy resources for lighting are expensive, which fail to provide a comfortable, reliable, healthy light.

b) Fertilizer market

Market for organic fertilizer exists mainly in those places introducing compost pits.

Benefits expected from a biogas plant for potential clients

a) Small farms and rural households

Energy: cooking, lighting, food conservation

- Saving of firewood: environmental protection through reduced deforestation. For women and girls: less time for fuel wood collection, reduced **vulnerability** in terms of health risks, increased time for other activities (e.g. use of health service, income generating activities, literacy programmes etc.).
- Agricultural improvements in plant and animal production yields: improved nutrition and increased household income. Fertilizer production with subsequently protection and/or recovery of soil fertility.
- Sanitation: controlled disposal of animal manure and organic waste; grey water collection and reuse; improved hygiene and sanitary conditions in the household
- Health: reduction of diseases related to waste water and solid waste; reduction of exposure to smoke and flue-gas during to cooking hours
- Modernity: clean and efficient fuel.
- Climate protection.

Technology for sanitation and waste water treatment

Biogas technology could offer a system to make significant improvements in the national sanitation sector, given the following facts: sanitation coverage in Sudan, with wastewater treatment systems present poor performance. Septic tanks with soak away to receive this wastewater are comparatively expensive and require regular sludge maintenance while no safe method of faecal sludge treatment can be provided. Modernization in rural areas, increased formal education, mobile phones, motor bikes and cars, and television promote the awareness on lacking toilet facilities; this leads to discussions in the villages about the most appropriate sanitation system. Latrine coverage in rural areas remains very low, traditional latrines do not meet standards. Facilities that prevent humans, animals and insects from contact with human excreta are classified as improved technologies.

Project Activities:

1-Community Mobilization and Sensitization:

The mobilization will be tackle through:

1.1- **Orientation meeting** with the stack holders and the decision makers in the targeted areas.

So a four orientation meetings will be held in the targeted areas.

1.2- **Awareness Razing Campaigns**:

These campaigns will focus predominantly on the idea of the project. And the team will use a variety of communication means to disseminate the project ideas and the environmental messages. The means include but not limited to:

- Meeting and consultations.

- Open lectures and discussions.

- Local Theatre.

- Formulation of village Development Committee (VDCs).

2- Training:

Five training Courses will be taken to build the capacities of the targeted groups, as are follows:

2.1- Organization & Management of CBOs:

2.2- Based Community Environmental Needs,

This training will design for 25 participants on 6 days.

2.3- Hygiene **and Sanitation:**

2.4- House holds teaching (women farming):

This training will be designed for women only, to teach them how to build community revolving activities.

2.5- Management of Biogas Units:

- To improve the capacities and maintenance requirements of Biogas facilities.

3- Construction of Biogases Units:

The project will establish 200 units in 4 targeted areas (50 in each targeted area) .The proper location will be identified by consultation with the VDCs, and the maintenance of the units will be under the responsibility of each VDC in the targeted area.

4-construction of Women farm:

After the house hold teaching training course, the project will assist the specific women groups to construct A pattern of community women farm, as a revolving activities, which help them in addition income and one of the sustainability of the Biogases Units .Because, they use some of their frame Revenue in the maintenance of the Biogas units

5-Project Management:

5.1- Project coordinator (PC):

She/ he_will be responsible for the overall project implementation in the targeted areas and will be responsible for all mandatory reports.

5.2- Field Assistant Administrator (AA):

The (AA) will assist the (PC) in all the field activities in close liaison and consultation with the VDCs .And sometimes he will stay many days in the targeted areas to facilitate the specific task work.

5.3-**Technical Consultant:**

She/he will be responsible for all technical work (designing, observation, monitoring of construction of Biogases Units in the field; s/he will work under supervision of PC and guided by the specification and regulations that taken in the Biogases Work.

5.4- **Technical Advisory Committee (TAC):**

The TAC will provide technical support to the (PC) and assist in monitoring the project activities in the field.

6- Monitoring and Evaluation:

Weekly reports will be prepared by the VDCs and the Assistant Administrator. The Project Coordinator will compile these reports into a weekly report that will be submitted to the organization. The TAC members will visit the project area at least twice for monitoring purposes.

An external evaluator(s) will be recruited to evaluate the project and submit a comprehensive report.

Project Budget:

No:	Item	Unit	Qty	Rate	Total in SDG	Total in $
A	Programme staff salary					
1-	Project coordinator	Month	12	4000	48.000	4.800
2-	Assistant Administrator	Month	12	2000	24.000	2.400
3-	Biogas consultant	As per contract			20.000	2.000
	Total personnel				102.000	10.200
B	Travel:					
	-car rent(Khartoum to areas)		24	1000	24.000	2.400
	Total car rent				24.000	2.400
	Equipments					
	Data Projector	PSC	1	10000	10.000	1000
	Laptop	PSC	1	8000	8.000	800
	Camera	PSC	1	5000	5.000	500
	Generator	PSC	1	20000	20.000	2000
	Total Equipments				43.000	4.300
C	Project Survey		1	20000	20.000	2.000
	Total Project Survey				20.000	2.000
D	Supplies:					
1-	Construction of Biogas Unit		200	30000	600.000	60.000
2-	Construction of women farm		1	200000	200.000	20.000
	Total Supplies				800.000	80.000
E	Others:					
1-	Technical Committee Meeting	Activity	12	30000	30000	
2-	Project auditing costs	Job	1	10000	10000	
3-	Communication	Month	12	700	8400	
	Total Other				84.400	8.440
	Activities					
	Community Mobilization	Activity	4	30.000	120.000	12.000
	Based Community Environmental Needs	Activity	1	35000	35000	3.500
	Management &Organization of VDGs	Activity	1	30.000	30.000	3.000
	Health training	Activity	1	25.000	25.000	2.500
	House hold teaching	Activity	1	40000	40.000	4.000
	Management and Biogas Unit	Activity	1	40000	40.000	4.000

	Monitoring &Evaluation	Activity	1	30000	30000	3.000
	Total activities				285.000	28.500
F	**Visibility**					
1-	T-shirt		500	60	30.000	3.000
2-	Visibility Board					
	School Unit		2	1000	2000	200
	Total visibility				32.000	3200
	Administration Costs(8% of total)		1		111.232	11.123.3
	Total Grant				1.501.632	150.163.2