Production of biogas from animal manure for rural household

Document Prepared and Submitted by Agriculture Technology Transfer Society (ATTS)

General description of the Project/Program

The program is proposed to be implemented in the households of Sudan. This is a social sector program which aims in distributing biogas digesters for the households in Sudan. Sudan is a Least Developed Country (LDC) located in North Africa.

The majority of surveyed families in Sudan currently use wood as the main fuel source for cooking, primarily using an open fire or "three-stone" method. Though most of the families intend to install biogas digester to replace the use of fuel wood, most of them are skeptical on the affordability and the sustainable access of the digester. Hence the affordability and sustainable access are the primary challenges that the program being promoted by Agriculture Technology Transfer Society (ATTS) intends to address.

Technical Description of the Project

Poverty in the Sudan is deeply entrenched and is largely rural. Poverty particularly affects farmers who practice rainfed agriculture. Although sustained economic growth was behind a decline in extreme poverty from 85 per cent in the 1990s to an estimated 60 per cent at present, important regional disparities still exist. The Sudan remains a low-income, food-deficit country. It ranks 147th on the United Nations Development Programme's Human Development Index (2007/2008), among 177 countries. In the country's poorest areas, the rapidly growing population, including displaced people and returnees, puts significant pressure on already fragile ecosystems. The conspicuous consequence of this widespread poverty is the severe lack of energy resources, often termed as energy poverty, among rural communities of Sudan. Households need fuel for cooking, for lighting, and if possible to power value-adding livelihoods activities. In rural Sudan, cooking fuel mostly is in the form of wood-fuel, the use of which has negative impacts on households and on the environment.

In many rural communities, the traditional method of cooking is with a three-stone cooking fire. It is the simplest and least expensive stove to produce; all that is needed are three suitable stones of roughly the same size, arranged with space for firewood in the middle. The three-stone cooking method has several major drawbacks:

(a) It is very inefficient with fuel. Because so much heat escapes into the

surrounding air and not into the cooking pot, more wood-fuel is required for each meal. (b) There is no exhaust pipe for ventilation, so smoke stays in the room, causing health problems after repeated exposure. The World Health Organisation states that indoor air pollution is responsible for the death of 1.6 million people every year.

The program intends to distribute biogas digesters through market-led approach to the households in Sudan. 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. Cattle Dung and waste water will be fed to the digester daily. Kitchen waste will be added from above through an inlet pipe connecting to the digester chamber. The waste slurry remains in the chamber for approximately 40 days. The waste breaks down anaerobically producing biogas which mainly has methane. This biogas builds up above the slurry and remains in the chamber 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.

Though most of the families intend to install biogas digester to replace the use of fuel wood, most of them are skeptical on the affordability and the sustainable access of the digester. Hence the affordability and sustainable access are the primary challenges that the program being promoted by Agriculture Technology Transfer Society (ATTS) intends to address. In lieu of the same ATTS has adopted a bottom-up approach where the distributors will provide the biogas digester to the households through technician/entrepreneurs working on a contractual basis. The distributors will provide the further training to the technicians 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. These technicians will be designated for certain number of biogas digester and will be responsible for data recoding and data storage along with annual operation and maintenance of the biogas digester. It is envisaged to design social marketing to stimulate the demand and educate the users on 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.

Project/Program Benefits over and above Green House Gas Reduction

As with most countries, in Sudan too the responsibility of cooking lies with women who spend considerable time in collecting the fuel wood and in kitchen preparing meals for the family. Furthermore the impetus of developing the program was the effect of the indoor air pollution, due to the use of fuel wood, on the children who spend substantial time with their mothers in the home. It is reported in the report by World Bank that Women and children in developing countries are exposed each day to pollution from indoor cooking smoke, in the form of small particulates, up to 20 times higher than the maximum recommended levels of the World Health Organization (WHO) and other environmental agencies around the world (WHO 2005). Further, the increase in time and effort for collecting firewood is a damaging factor to the health of women in rural areas. Women become more vulnerable to diseases. **If the mother is often sick or tired, the welfare of the children is similarly affected. The high level of anaemia among pregnant and non-pregnant women, combined with carrying heavy loads is apt to hamper the growth of the foetus and reduce the quantity and quality of maternal milk of the prospective mothers.** Among the surveyed households, time spent for collecting firewood ranged between and 5 hours daily, the distances to walk there ranged between 1 and 10 km. Several households confirmed that they hire donkey charts to bring the deliver the collected wood in order to reduce time for transportation. Prices paid for fuel wood include these transportation fees.

The program targets deployment of the biogas digesters for the rural households providing improved standard of living to the poor and vulnerable households in Sudan. The benefits of program involving deployment of energy efficient Sudan are several, and cut across many development sectors. Prima face, the social and economic consequences of reducing 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.

Project/Program Beneficiaries

The program targets deployment of the biogas digesters for the rural households who are the ultimate beneficiaries of the program. The program will benefit the rural households by providing them with improved standard of living and better conditions to live.

Innovation and Potential for Replication

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ATTS along with their technical partner, CoreCarbonXwill impart the initial training for the local masonry for the construction of biogas digesters. The manufacturing process will also be consistently checked for the quality control. The easy design and the use of indigenous labor for the construction and design of the biogas digesters makes the model replicable at a large scale level as it focuses on empowering individuals rather than focusing on the government subsidies.

Other Partners involved (technology provider, main financier, carbon aggregator, carbon consulting, implementation partners, etc.)

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

Involvement of local communities in the development, implementation and monitoring of progress of the project/program

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Implementation arrangement

Agricultural Technological Transfer Society (ATTS) is the coordinating/managing entity ("CME") for this program and will be implementing the CDM Programme Activities (CPAs) in Sudan. Under the scheme, it will coordinate the set up of biogas in the households, including arranging the finance for the installation, impart training and conduct capacity building programs for the masonry. Thus, ATTS is both the CME and the CPA implementer for the PoA.

CoreCarbonX offer carbon management services to ATTS. These range from the development of the PoA-DD, the CPA-DDs and the Monitoring Reports to the management of the entire CDM cycle up to the issuance of CERs.

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CDM Project Category Type

Type I: Renewable Energy Projects
Category IE: Switch from Non-Renewable Biomass for Thermal Applications by the User
I.E./Version 05.0

CDM Approach proposed (program of activities/ PoA) and justification for the same

The goal of the program is to distribute biogas digesters in the rural households of Sudan. The emission reduction from each biogas digester is low and the emission reductions are physically spread across a large geographical area. Thus a PoA approach was considered for developing the program considering the replicable nature of the program across a large geographical area. Further as the program is linked to higher sustainability benefits, but is too small to pay back the transaction cost involved in the CDM process, a PoA approach is proposed. This category comprises activities to displace the use of non-renewable biomass by introducing renewable energy technologies. Examples of these technologies include but are not limited to biogas stoves, solar cookers, passive solar homes, renewable energy based drinking water treatment technologies.

The program comprises of installation of biogas plants that will replace use of non-renewable biomass. Project participants are able to show that non-renewable biomass has been used since 31 December 1989, using survey methods or referring to published literature, official reports or statistics.
The survey conducted for 403 households indicate that the households have used firewood for cooking purposes since 31st December 1989 and also prices of firewood have shown an increasing trend which shows scarcity of firewood. The survey also indicated that there is an increase in the time spent for the collection of the firewood over the years. Thus the Project Participants are able to demonstrate that non renewable biomass has been used since 31st December 1989 by survey methods.

The mitigation of the status quo bias would include sensitization, education and marketing, and carbon finance allows such essential activities to be funded. Hence it can be concluded that carbon Revenue has been identified as the only realistic and adequate source of finance to overcome the existing barriers and having the scale and consistency over time necessary to

implement and expand the sales of biogas digesters in Sudan, and at the same time maintain quality and customer adherence.

Pricing Approach

The manufacturing costs of each biogas digester considering large scale production is expected to be around 900 USD. The establishment of the supply chain network providing incentives across the value chain, training to the distributors for installing the cook stoves, data recording and data storage along with annual operation and maintenance of the biogas digesters will entail additional expenditure of 100USD per cook stove. Thus the initial cash outflow for the deployment of the cook stove will be 1000USD per biogas digester. Each biogas digester proposed to be distributed by ATTS will be subsidized for distribution to the rural households and will be priced at 300 USD. The differential in the production cost and the selling cost of 700USD levelized over the lifetime of the biogas digester, considered as 20 years, is used to determine the carbon price. Further, the operation and management cost for maintaining the quality of the biogas digester is considered as 10 USD which is anticipated to be funded by the carbon revenue. Thus the carbon price range is determined as 2.8USD to 3.0 USD

Flow of Carbon Revenues

The carbon revenues will help in providing the biogas digesters at subsidized rates reducing the cost to the rural households. The operation and maintenance costs for maintaining the quality will also be funded by the carbon revenue. ATTS will retain the carbon revenue to deploy the biogas digesters at subsidized rates and to provide the operation and maintenance for the efficient operation of the biogas digesters along with the responsibility of ensuring the quality assurance for the data recording and data storage.