UNDA Project on "Promoting Renewable Energy Investments for Climate Change Mitigation and Sustainable Development"

UNDA Project Closing Workshop:

"Renewable Energy UNDA project conclusions and way forward"

13-14 December 2017, Beirut - Lebanon

Economic And Social Commission For Western Asia / United Nations Economic Commission for Europe

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ESCWA

UNDA Renewable Energy ESCWA Pipeline Projects

Agricultural Technology Transfer Society- Sudan

Production of Biogas from Animal Manure for Rural Areas (1000 digesters)

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40 YEARS

Problem statement

- **Sudan is characterized by high dependence on biomass energy (fire wood, charcoal, and** agricultural residues), that constitutes 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 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.

Fuel wood consumption

- According to World Bank Statistics 2011, the estimated total population of Sudan is 34.3 Million. Sudan is an agricultural country with plenty of livestock and agricultural residues.

- As per the Energy Statistics Database, United Nations Statistics Division, fuel wood consumption in Sudan by household per year is given as:

2009	**8,100 thousand cubic metres**
2008	8,050 thousand cubic metres
2007	7,995 thousand cubic metres
2004	7,700 thousand cubic metres
2000	7,475 thousand cubic metres
1995	6,920 thousand cubic metres
1990	6,255 thousand cubic metres

Biogas production

- **Domestic biogas plants** convert *livestock manure* into biogas and slurry. This technology is feasible for small holders with livestock producing 50 Kg manure per day, The bi-product is sludge which is a good fertilizer.
- **Switching** from traditional biomass resources or fossil fuels to biogas improves security of energy supply. The release of methane is avoided thus contributing to *climate mitigation*. A single, small scale biodigester reduces between **3 and 5 tCO2-eq./year**,

Capital and operational costs

- 1000 biodigestors will be installed for demonstration. The total construction cost for a 6 m^3 (slurry volume) biogas fixed dome digester with all fittings and basic appliances is 1,000 US$. As biogas is a proven technology, the lifespan of a fixed dome biogas plant can be expected to be at **least 20 years**. The cost of each biodigester is $ 400 - 480.
- **The revenue will come from households paying $70/y during the first 7 years for investment repayment plus $25/y for maintenance.**
- **Annual financial** cost for **operating the plant** dung and water collection and mixing - are basically calculated **at zero**.
- The notional revenue for the project is through the **savings** of **fuel wood** which is currently being used for **cooking** purposes. The notional revenue will provide the farmers with the ability to repay the loan. It is expected that each biodigester will save 6.2 tons of fuelwood per household per year. The average cost of the fuelwood in Sudan is 20 USD per ton of fuel wood.

SUMMARY TABLE (ESWA)				
Installed number digesters		1000	**units**	
Annual production		2.689	**MWh/annum**	**(2m3 biogas day)/unit**
	$			**LC**
Project cost	479,000			479,000
Tariff $/unit/year	70.00			70.00
Operation cost/ year	25.00			25.00
Finance		**scenarios**		
	35% equity 65% loan 7y			35% equity 65% loan 15 y
Loan interest	16.00%			2.00%
Loan tenor	7			15
IRR on equity	-5%			9%
Cum disc cash @ year 20 in LC	-398,985			5,942
min DSCR	0.50			1.82

Comments (ECSWA)

- The project is to be financed by equity from the households (30%) and a 7 years loan with interest indicated as 16%.
- Given the low proposed charge of $70/y per household for repayment of the loan, the loan DSCR (revenue – operating expenses/ total loan service) would be only 0.50, so a loan cannot be serviced.
- However, if the loan is with a low interest (2%) for 15 years the servicing becomes possible, but it would require that the households are charged with $70+$25 for 15 years.

Summary Table (modified)		
Installed number digesters	**1,000**	**units**
Annual production	2.689	**MWh/annum (2m3 biogas day)/unit**
	$	**SDG**
Project cost	753,513	18,084,318
Tariff $/unit/year	70	1,680.00
Operation cost/ year	23.89	573
Finance	**scenarios**	
	35% equity 65% loan 7y	35% equity 65% loan 15 y 2%
IRR on equity	3%	15%
Cum disc cash @ year 20 in LC	-2,148,279	52,036
min DSCR	10.89	6.62

Business case

- Maintenance cost has been reduced from 25 to 24$. The deficit ($10,000) will be compensated selling biofertilizer, 40 tons will be obtained from the

- Biodigetors every year, if a 1 kilo is sold at $1, giving $40,000 and hence saving $39,000

Biogas Appliances

Biogas is a lean gas that can, in principle, be used like other fuel gas for household and industrial purposes, especially for

- ✓Gas cookers/stoves
- ✓Biogas lamps
- ✓Radiant heaters
- ✓Incubators
- ✓Refrigerators
- ✓Engines

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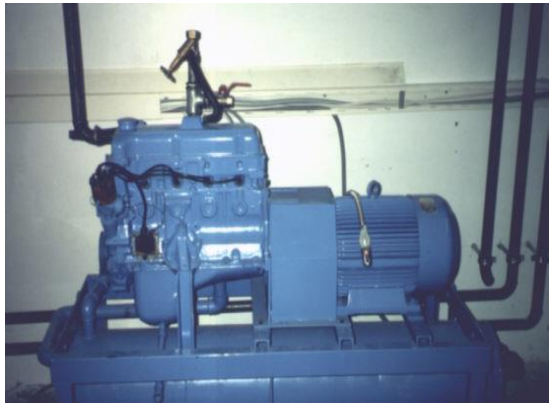

Women garden production after biofertilizer application

Stakeholders

- **Farmers** may want to substitute inputs such as fertilizers, household and engine fuels by biogas slurry and the biogas itself.
- **Industrial estates** can, by processing their waste in a biogas plant, fulfill legal obligations of waste disposal. They can, at the same time, generate energy for production processes, lighting or heating.
- **Municipalities** can use biogas technology to solve problems in public waste disposal and waste water treatment. The energy output of biogas digestion is usually not a priority, but may respond to public energy demands such as street lighting, water pumping and cooking in hospitals or schools.
- **National Governments** have macro-economic interests that may render biogas technology an interesting option in overall development plans.
- **Craftsmen, engineers and maintenance workers** Not only does biogas technology open market niches for masons, plumbers, civil engineers and agronomists, they are often the most effective promoters of biogas technology.

UN Development Account Project

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Creating a favorable climate for biogas dissemination depends almost always on a whole range of decision makers. For example:

- **The Ministry of Finance** will decide on subsidies and tax wavers for biogas users.
- **The Ministry of Energy** can propose laws regarding the feeding of biogas-produced electricity into the grid. It can also propose financial and other assistance.
- **The Ministry of Agriculture and Livestock** can include biogas in the training curriculum of extension officers and agricultural colleges.
- **The Ministry of Education** can include biogas in the curricula of high schools and promote the construction of bio-latrines for schools.
- **The Ministry of Health** can include biogas in the curricula of public health workers and encourage the building of bio-latrines for hospitals.
- **Radio Programs** are an effective means in rural areas to familiarize the population

with basics of biogas technology.

***Link to UN DA project*: https://www.unescwa.org/node/94046**

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40 YEARS