

**A paper submitted on “Role of Renewable Energy (Biogas and Improved Cook Stoves) for Creation of Green Jobs in Bangladesh” for presentation in the Workshop on “GREEN JOBS” INIATIVE IN BANGLADESH organized by Ministry of Labour and Employment Bangladesh and International Labour Organization Bangladesh.**

**Prepared by**

**Dr. M. A. Rouf and Md. Naimul Haque of Institute of Fuel Research and Development, BCSIR, Dhaka.**

**Venue: Sonargaon Hotel  
Date: 30<sup>th</sup> July, 2008**

# **Role of Renewable Energy (Biogas and Improved Cook Stoves) for Creation of Green Jobs in Bangladesh**

**Dr. M. A. Rouf and Md. Naimul Haque**

Institute of Fuel Research and Development, BCSIR, Dhaka

## **Abstract**

Bangladesh has a very good potential for creating green jobs through dissemination of renewable energy technology. Institute of Fuel Research and Development (IFRD) of BCSIR has been actively engaged in R & D works on renewable energy and conservation of energy sources. The Institute has successfully developed a fixed dome model biogas plant suitable to Bangladesh and different models of improved cook stoves which have been disseminated throughout the country. Other renewable energy technologies such as solar hot box, solar water heater, solar dryer etc have also been developed by IFRD. The Institute also developed a process for the production of bio fuel (bio diesel) from non-edible oil sources. Feasibility studies on wind energy have also been done by IFRD. Under biogas pilot plant projects (Phase 1 and 2) implemented by IFRD of BCSIR, a total of about 22000 biogas plants were constructed throughout the country and under fuel saving project, more than 300000 improved stoves were set up all over the country. People are using biogas for cooking, lighting and generation of electricity and the residues from biogas plants are being used as organic fertilizer for crop production. The Institute has also trained up 10205 and 1250 nos. of people on improved stoves and biogas technology respectively under these projects.

Grameen shakti, LGED, BRAC, IDCOL, GTz and some other NGOs have also considerable contribution in disseminating biogas plants and cook stoves. Grameen shakti and some other NGOs have also disseminated substantial number of solar home systems in remote areas of Bangladesh. These technologies have created great opportunities for green jobs in Bangladesh. In addition these technologies have been playing important role in reducing greenhouse gas emission and control environmental pollution.

Apart from these, a huge foreign exchange can be earned from carbon credit at the rate of 10-20 dollars per ton of CO<sub>2</sub> emission reduction through these CDM able projects. In this regard government, NGOs, and foreign donor agencies are needed to come forward to implement these projects in order to combat energy crisis as well as create more green jobs in Bangladesh.

## **1.0 Introduction**

### **1.1 Background**

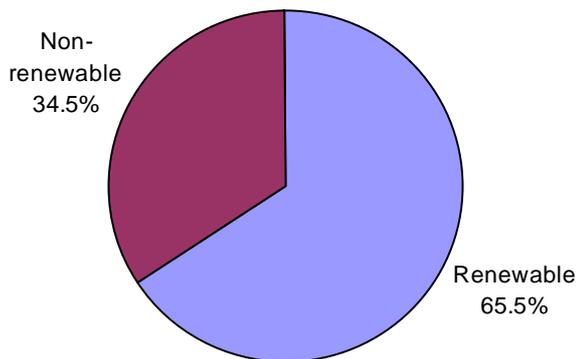
Bangladesh is a densely populated country with a population of about 140 million, about 72% of which live in the rural areas. Bangladesh is endowed with plentiful supply of renewable sources of energy. Out of the various renewable sources, biomass and solar and to a limited extend, wind and hydro-power are effectively used.

The country has a proven natural gas reserve of about 450 billion m<sup>3</sup> and 1.7 billion tons of coal. The overall energy consumption of commercial energy and generation of electricity were 200 kgoe/year and 120 kWh/year respectively. The energy consumption in the rural area is even much lower. The supply of natural gas is limited to urban areas, mostly in the eastern part of the country. Only about 4% of the population has access to

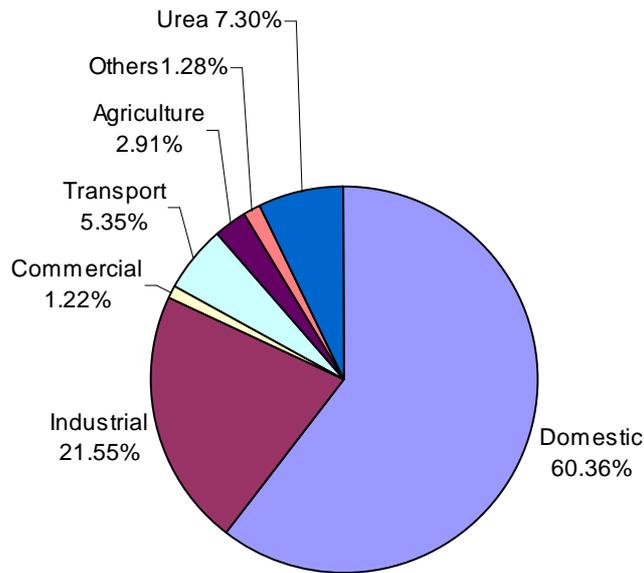
natural gas, and about 30% to grid electricity. About 60% of total energy consumption of the country is being met from biomass. Agricultural residues, animal dung, leaves and twigs, and trees, etc. are the main sources of biomass fuels. There are indications that consumption of biomass energy has already exceeded the regenerative limit and there prevails energy crisis in rural areas in Bangladesh. This is one of the causes of deforestation that is going on in an alarming rate.

It is apprehended that with population growth, the energy crisis, environmental degradation, indoor air pollution related diseases, deforestation, declining of soil fertility, use of chemical fertilizer and declining of agricultural yield will aggravate further if the things move as usual and no alternative measures are undertaken. Renewable energy offers a sustainable solution, at least in part, to all these problems Bangladesh is currently facing. The important points regarding the relative contribution of the non-renewable energy and the renewable energy scene are:

65.5% of the total energy consumption of the country is made by renewable energy and the remaining 34.5 % being made by non-renewable energy. Domestic sectors consume 60.36% of the total energy. Industrial sectors account for 21.57% of the total national energy consumption.



**Fig.1 :Energy Consumption Pattern by Source in 2004 (PJ)**



**Fig.2 :Energy Consumption Pattern By Sector in 2000 (PJ)**

### 1.2 Green Job

Green Job is related to sustainable development and inexhaustible energy sources. Generally Renewable Energy Technology, efficient carbon emission reduction technologies and clean source of energy technologies are related to Green Job. Although people of developed country have idea about Green Job but the concept of Green job is new in Bangladesh. So far, the number of employment found to be green in the country, is a small fraction compared to the total employed workforce. Improved stove can reduce the need for wood for cooking and reduce about 50% of wood requirement for the same purpose and saves firewood and finally biomass can be effective for reducing the use of fossil fuel and reduce green house gas emission. A number of private sectors are already active on Biogas Technology and in the field of solar home system which is cleaner and can reduce environmental pollution and health hazards, organic farming which is avoiding harmful use of chemical fertilizer and pesticides, waste recycling industry such as composting reducing the chemical fertilizer and mitigating green house gas emission; compact fluorescent light (CFL) which is very efficient and reducing almost 80% of electricity requirement. For example, BCSIR, LGED, Waste Concern, Grameen Shakti, Rahimafrooz, Energy Pac, UNDP, GTZ and number of local and international organizations are found to be actively involved in the sectors which is creating potential green job for the poor.

**Table1.** Employment Estimates in the Renewable Energy Sector, Global and Selected Countries, 2006

<b>Renewable Energy Source</b>	<b>World / Selected Countries<sup>1</sup></b>	<b>Employment</b>
Wind	World	300,000
Solar PV	World	115,000
Solar Thermal	China, Europe, USA	624,000 +
Biomass/Biofuels	Brazil, USA, China, Germany	1,174,000
Hydropower	Europe, USA	39,000
Geothermal	USA, Germany	25,000
<b>Renewables Combined</b>		<b>2,277,000</b>

<sup>1</sup> Countries for which information is available

Recently, the number of people in the green job is increasing rapidly due to plantation of palm oil in Indonesia, Malaysia, Brazil and some other places in the world for production of bio fuel.

## **2.0 Improve stove Technology**

The Institute of Fuel Research & Development (IFRD) of Bangladesh Council of Scientific & Industrial Research (BCSIR) has been pursuing R&D activities on “Stove Technology” to suit the need in respect of bio-mass fuel, shape of the cooking pot and cooking habit of the users.

These models may be grouped into 3 categories: (i) improved stoves without chimney, (ii) Improved stoves with chimney, (iii) Improved stoves with waste heat utilization. These improved stoves save 50-65% fuel as compared with the traditional ones and save cooking time.

### **2.1 Dissemination of Improved Stove**

IFRD of BCSIR has successfully completed 2 (two) ADP projects on dissemination of improved cook stoves in the country. Both the projects were implemented jointly by BCSIR with Ansar-VDP and BRDB as shown in Table-2. Some of the main objectives of the projects are given below:

- To save traditional fuels by popularizing the improved stoves and keep pollution free environment in rural areas of Bangladesh.
- To develop skill manpower for dissemination of improved stoves through training courses.
- To create awareness about the effectiveness and usefulness of improved stoves through massive advertisement through various media.

- To reduce deforestation and maintain ecological balance of the country through massive use of improved stoves.
- To involve different Government, Semi-Government and Non-Government Organizations in dissemination program of improved stoves.
- To improve the hygienic condition of the kitchen.

**Table 2.** GOB Project: Dissemination of Improved Cook Stoves

Sl. No.	Name of the projects	Duration	Budget (Tk. In million)	Project Areas (3 Upz. In each Dist.)	No persons trained	No. imp. Stoves installed	No. imp. Stoves installed by 3 orgs.
1.	Dissemination of improved stoves ( 1 <sup>st</sup> phase )	1994-1997	1510	105 Upazillas of 35 Districts	1000	62,848	BCSIR: 12,577 Ansar-VDP: 32,932 BRDB:17000
2.	Dissemination of improved stoves (2 <sup>nd</sup> phase)	1998-2001	42183	92 Upazillas of 29 Districts	1171	1,17,573	BCSIR: 46,597 Ansar-VDP: 31,555 BRDB: 39,421

## 2.2 Training Program of Improved Stove

To popularize the improved stoves IFRD has developed 2 (two) training course manuals on “Improved Stoves” one for one week and the other for four days duration. Scientists of IFRD till now conducted over 215 nos.-training courses on improved stove technology and trained up more than 10205 people men and women from different Government, Semi-Government and Non-Government organizations of the country. Most of the trained personnel are now engaged in dissemination of improved stoves in different parts of the country.

## 3.0 Biogas Technology

Biogas, which is mainly composed of methane (60-70%) and carbon dioxide (30-40%) is a combustible gas produced by anaerobic fermentation of organic materials by the action of methanogenic bacteria. Methane is odorless gas and burns with a clear blue flame without smoke. It produces more heat than kerosene, fuel wood, charcoal and dung-cakes. When biogas is used in suitable designed burners, it gives a clean, smokeless, blue flame, which is ideal for cooking. If biogas is used in specially designed lamp it gives a light similar to the kerosene pressure lamps. Biogas can be used for other purposes such as electricity generation, refrigeration, space heating and running engines but higher amount gas will be required for these purposes. Family size biogas plant is appropriate only for the domestic use such as cooking and lighting.

### 3.1 Biogas Potential in Bangladesh

Bangladesh is in a favorable position in respect of the climatic conditions and availability of the raw materials for biogas production. Biogas is a kind of fuel gas obtained by anaerobic decomposition of organic matter such as cattle dung, poultry droppings, human excreta, agricultural residues, water hyacinth, garbage etc. In Bangladesh from over  $22 \times 10^6$  cattle heads, assuming 80% collection of cow-dung (currently, 34% of raw dung is dried for burning as fuel), the total gas obtainable is  $2,377 \times 10^6 \text{ m}^3$  ( $0.037 \text{ m}^3$  per kg fresh dung) per year. Processing of human excreta will yield biogas to the tune of  $1200 \times 10^6 \text{ m}^3$  per year. 24% of the total population i.e.  $0.24 \times 130 = 31.2$  million people live in the urban areas producing some  $31.2 \times 10^6 \times 0.3 \times 365 = 3.42 \times 10^9$  kgs of household wastes annually. This has a potential of producing  $3.42 \times 10^9 \times 0.046 \text{ m}^3 = 157.3 \times 10^6 \text{ m}^3$  of biogas. Moreover, water hyacinth, which is available in plenty in Bangladesh in her beels, haors, ponds and rivers, is a good source of biogas. It grows very rapidly and is capable of rapid multiplication in any place where water exists. It is a nuisance in agriculture, fisheries and navigation. Yield varies from 10 to 20 tonnes per year per acre. Excluding water hyacinth, total potential of biogas from cow-dung, human excreta and urban wastes stands at  $3675 \times 10^6 \text{ m}^3$  which is equivalent to 1.95 million tonnes of oil ( $1 \text{ m}^3$  biogas =  $22.31 \times 10^6$  Joules).

**Table 3.** Bio-fertilizer and biogas potential in Bangladesh

Raw materials	Organic Fertilizer (million tons)	Yearly gas production (million cubic meter)
1. Cow/Buffalo dung	60.20	2971.10
2. Poultry droppings	2.05	191.60
3. Human excreta	32.85	1226.40
4. Garbage	1.72	115.00
5. Water hyacinth	10.00	740.00
6. Pressed mud	0.07	384.00

### 3.2 Dissemination of Biogas Technology

Dissemination of biogas technology is gaining momentum. A good number of institutions are already involved in planning, research, development and dissemination of this technology. The Institute for Fuel Research and Development (IFRD) of Bangladesh Council of Scientific Industrial Research (BCSIR) has been the main actor for the dissemination of domestic biogas plants in Bangladesh to date. Other organizations involved at different stages have been BRAC, Local Government Engineering Department (LGED), Department of Environment (DOE), Grameen Shakti (GS), Bangladesh Agricultural University (BAU), Bangladesh Small & Cottage Industries Corporation (BSCIC), Danish International Development Agency (DANIDA) and Department of Livestock Service (DLS). In total, close Under biogas pilot plant projects (Phase 1 and 2) implemented by IFRD of BCSIR, a total of about 22000 biogas plants constructed throughout the country, out of 30000 family size biogas plant installed in the country. People are using biogas for cooking, lighting and generation of electricity and the residues from biogas plants are being used as organic fertilizer for crop production.

### 3.3 Training Program of Biogas Technology

The Institute has also trained up 1250 nos. of people on biogas technology under Biogas Pilot Plant Project. A 15 day biogas training program was conducted for people and engineers and 7 day training program were conducted for masons. The biogas engineers who were trained up and involved on biogas pilot plant project are now working in different NGOs, such as Grameen Shakti, GTZ etc.

### 4.0 Wind Energy

Feasibility study on R&D of Renewable Energy Solar, Wind, Micro-Mini Hydro)” has been undertaken by the Institute of Fuel Research Development (IFRD), of Bangladesh Council of Scientific and Industrial Research (BCSIR). Under this program, wind speed data have been collected in the following sites:

- i) Saint Martin (offshore island)
- ii) Teknaf
- iii) Meghnaghat, Dhaka

The maximum velocity obtained at St. Martins Island is 20 m/s and yearly average wind speed in 4.9 m/s. The maximum velocity obtained at Teknaf is 16 m/s and yearly average wind speed is 3.8 m/s.

Available wind speeds in Saint Martin’s Island are presented in the Table 4 below:

**Table 4.** Monthly average wind speeds in the island [IFRD, 2002]

Month	Vav (m/s)	Vmax
January	5.08	23.32
February	4.71	19.78
March	4.29	18.94
April	3.58	20.03
May	5.75	26.30
June	5.96	29.80
July	5.33	24.20
August	5.96	20.40
September	4.79	17.70
October	4.17	15.90
November	3.79	14.50
December	4.08	15.20

### 5.0 Micro/Mini Hydro Prospect in Bangladesh

Bangladesh is an extremely flat delta area built up by the three major rivers, the Ganges, Brahmaputra, and the Meghna. In contrast to this huge delta area the districts of

Chittagong, Cox's Bazar, Bandarban, Rangamati, and Khagrachari, which are hilly. Some hilly areas also lie along the border of the Indian State of Tripura and the districts of Sylhet, Moulavi Bazar and Habiganj. A large portion of the country is less than 33 meter above mean sea level. Flat topography of Bangladesh does not permit building of large scale storage of power generation. However, there are certain locations within the country where small hydropower stations could be set up.

## **6.0 R & D Activities on Solar Energy in IFRD, BCSIR**

IFRD, BCSIR has been engaged in carrying out R & D on Solar thermal and have developed the following solar thermal technologies:

- Reflector type solar cooker
- Absorber type solar cooker
- Cabinet type solar dryer
- Solar water heater

IFRD has been completed a project on the feasibility Study on R & D of Renewable Energy Technology (solar, wind, Micro-minihydro)" project with a total cost of Tk. 17387 million. Under this project solar insulation data at different places such as St. Martins island, Bandarban hilly area, Chittagong, Meghnaghat, Dhaka etc. have been collected and processed in the solar laboratory. Solar PV system have also set up in the above places and studied its performance. It was found that solar insulation is higher in hilly areas than plain lands in Bangladesh

## **7.0 Constraints of Renewable Energy Technologies**

- Lack of awareness
- Lack of sufficient fund for the dissemination of technology
- Initial investment is very high for most of the rural people
- Lack of political commitment
- Technical know how of the technology is not clear to rural people.

## **8.0 Conclusion**

In a world where we feel the need of energy security more acutely with every moment, there is little space for ignoring the essence of development of the renewable energy sector. It is not only the most effective way of quelling the fuel crisis of the country, but it is our best weapon against global warming and the adverse climate changes accompanying it. And as the promotion of renewable energy generation is going to help with poverty alleviation, with improving socioeconomic conditions, we must emphasis on creating green jobs in our venture towards sustainable development. It is palpable that the potential of renewable energy is enormous in Bangladesh, but to harness the benefits

from this potential, stress towards establishing technologies oriented to labour intensive work is imperative as the country is densely populated. This would ensure more jobs in a country plagued with unemployment as well as more cooperation from the ordinary people who is the final goal. There are problems when it comes to disseminating renewable energy technologies. The government and donor agencies are needed to step forward right away to provide necessary supports, initiatives, and to eradicate the shortcomings. In addition these technologies have been playing important role in reducing greenhouse gas emission and control environmental pollution. Further measures to minimize the constraints and promote the facilitators to improved stove use are needed. Given the global burden of disease attributed to indoor smoke, specific policy measures should be developed to reduce indoor air pollution. Based on these findings, strategies could include re-introducing subsidies, introducing micro credit schemes, awareness campaigns and social marketing, although more research is needed to determine the effectiveness of these measures.

Apart from these, a huge foreign exchange can be earned from carbon credit at the rate of 10-20 dollars per ton of CO<sub>2</sub> emission reduction through these CDM able projects. In this regard government, NGOs, and foreign donor agencies are needed to come forward to implement these projects in order to combat energy crisis as well as create more green jobs in Bangladesh.

IFRD, BCSIR has significant contribution on Research and Development on Renewable Energy Technologies. Particularly, Improved cook stove and Biogas Technology dissemination. Grameen Shakti has also unique success in the Solar Home System dissemination. Some other government organization and NGOs have also considerable contribution in dissemination of renewable energy technology. Eventually, the Renewable Energy Technologies have good prospect for creating Green Jobs in Bangladesh.

## **9.0 Recommendation**

- A massive program is a must to disseminate renewable energy technology in Bangladesh.
- A government policy on renewable energy technology is urgently needed.
- Co-operation between govt. NGO and other stakeholder should be strengthened for the dissemination of the technologies.
- Some donor agency should come forward to enhance the renewable energy dissemination program.
- Local and foreign training is necessary on renewable energy technology so that a sustainable green job can be created in the country.

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