

# **Infrastructure Development Company Limited (IDCOL)**



## **REQUEST FOR PROPOSALS (RFP)**

**For**

**Research and Development on Biogas Production Efficiency in  
Domestic Biogas Digesters suitable for Bangladesh**

*Package No.: S-32 under REREDPII*

*Ref No.: IDCOL/REREDPII/S-32/2015/03*

**12 November 2015**

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## Contents

1. INTRODUCTION .....	2
2. OBJECTIVE .....	2
3. SCOPE OF WORK.....	3
4. TIMING AND OUTPUT .....	5
5. BUDGET .....	5
6. OVERSIGHT AND OTHER CONDITIONS.....	5
7. PROJECT TEAM.....	6
8. CONTENTS OF THE PROPOSALS .....	6
9. EVALUATION PROCEDURE AND CRITERIA .....	6
10. EVALUATION COMMITTEE.....	7
11. SUBMISSION OF THE PROPOSALS .....	7
12. SPECIAL NOTES .....	7
ANNEX I: DOMESTIC BIOGAS DIGESTER TECHNOLOGY AND ITS STATUS IN BANGLADESH .....	8
ANNEX II: DETAIL FORMAT OF THE PROPOSAL .....	13
ANNEX III: SAMPLE OF DRAFT AGREEMENT.....	15
REQUEST FOR PROPOSAL (RFP) .....	24



## 1. INTRODUCTION

Infrastructure Development Company Limited (IDCOL) was established on 14 May 1997 by the Government of Bangladesh. The Company was licensed by the Bangladesh Bank as a non-bank financial institution (NBFI) on 5 January 1998. Since its inception, IDCOL is playing a major role in bridging the financing gap for developing infrastructure and renewable energy (RE) projects in Bangladesh. The company now stands as the market leader in private sector infrastructure and renewable energy financing in Bangladesh.

Under renewable energy initiative, IDCOL started its Solar Home Systems Program in January 2003 with a view to providing access to electricity in the off-grid areas of the country. The program now stands as the largest off-grid renewable energy program of the world. IDCOL also has country-wide programs in domestic biogas, solar irrigation, solar mini-grid, biomass and biogas based electricity generation. IDCOL has recently taken initiative to finance energy efficient (EE) technologies under which nationwide Improved Cook Stove (ICS) program has been launched and some energy efficient brick kiln projects have also been financed.

IDCOL offers a comprehensive range of subsidy and concessionary loans to these viable renewable energy or energy efficiency programs/projects. In addition, IDCOL provides support for feasibility analysis, training and capacity building as well as promotion and awareness campaign. Many of the renewable energy technologies are technically viable and proven, but their initial investment costs are very high compared to those of fossil fuel based technologies. As such, renewable energy technologies are still evolving in terms of technological maturity and cost competitiveness.

## 2. OBJECTIVE

Looking at the increasing importance of renewable energy, IDCOL is willing to support research and development (R&D) activities with a view to improving the existing renewable energy technologies as well as exploring other viable renewable energy options in Bangladesh context. 100% grant fund will be provided to the approved R&D proposals. IDCOL recently received USD 1 million fund from the World Bank under Rural Electrification and Renewable Energy Development Project (REREDP) which will be used to support the R&D initiatives. Maximum fund to be allocated for any individual project is approximately BDT 75 lac. However, this may be relaxed to some extent for exceptionally good proposals on the basis of marked obtained in technical evaluation.

IDCOL published Request for Expression of Interests (REoI) in January and July 2015 inviting local entities (universities, research institutes, Firms, NGOs, individuals etc.) to submit EoI for conducting R&D on renewable energy/energy efficiency technologies. IDCOL has already selected a number of proposals for R&D related to various renewable energy technologies.

IDCOL now intends to select proposals for conducting R&D on Biogas Production Efficiency in Domestic Biogas Digesters. While disseminating the domestic biogas in rural area of Bangladesh, IDCOL feels that Comprehensive understanding of biogas production process and its efficiency is essential for optimal utilization of DBDs



(Domestic Biogas Digesters). It appears that substantive studies for such understanding in the local context of Bangladesh (i.e., in respect of feedstock and operating conditions) have not been undertaken so far. Although, it is well-known that complete anaerobic degradation of 1 kg COD may produce about 0.35 m<sup>3</sup> CH<sub>4</sub> at Standard Temperature and Pressure (STP); it is not well documented what is the COD and CN or C: N: P:S (Carbon : Nitrogen : Phosphorus : Sulfur) ratio of dry collected or shed floor flushed dung in Bangladesh or if it varies for different areas and livestock breeding conditions. It is at times stated that 27kg of dung is required to produce one m<sup>3</sup> of gas; but it is not known if this is the maximum or optimal value. Among other things biogas production depends on humidity, bacterial type, stable ambient temperature, pH, volatile fatty acid, trace elements and nutrients (e.g. Fe, Ni, and Co etc). The better knowledge on how these factors impact biogas production are needed for optimize the efficient design and operation of DBD biogas plants. This is all the more important in Bangladesh because of the low availability of animal dung in small households. The possibility of blending dung with easily available organic materials, waste fractions from food and farming may also be a useful thing to investigate as this can augment dung shortage.

The principal objectives of the proposed study are to understand the processes that take place in the Domestic Biogas Digesters (DBDs) as briefly stated below:

- 1) More fully characterize and quantify constituents of the typical feedstock composition used in DBDs;
- 2) Investigate possible augmentation of usual DBD feedstock with typical available household waste and biomass residues;
- 3) Investigate the potential of individual parameters and combinations of these parameters which impact biogas production in DBDs for more efficient conversion of feedstock to biogas; and
- 4) Investigate the relationships between design and operating parameters and the performance of the biological and physical/chemical processes involved.

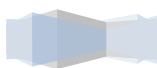
A clear understanding of the above issues is essential for proper design and operation of the DBDs and to identify the specific processes or combinations of processes that will increase the efficiency of the system.

### **3. Scope of Work**

In view of the discussion presented above, a comprehensive study of DBD system including all its components and operational issues are required for optimal use of the DBDs. Some additional information from literature on DBDs are included in *Annex I*. The broad tasks for this TOR to meet the objectives of the study will include, but not necessarily be limited to the following:

#### **a) Task A: Analysis of cow and buffalo dung**

The important parameters for analysis are (per unit of dung): Total Solids (TS), Volatile solids (VS), Volatile Fatty Acids, COD, Total Nitrogen, Phosphorous, Sulfur, pH, Carbon



content, some contaminating or nutrient contributing metals. regional variation may also be looked into if considered necessary.

### **b) Task B: Microbial Community Analysis**

This is necessary to check if the potential linkage between active bacterial presence (i.e., Firmicutes, Bacteroidetes, Proteobacteria, Ruminobacillus etc) and archaeal community (Euryarchaeota (Methanomicrobiales), Euryarchaeota (Methanosarcinales), Euryarchaeota (methanobacteriales), Crenarchaeote, Euryarchaeota etc), its dilution, and bacteria mass retaining capacity will influence the digestion process performance of BDBs.

### **c) Task C: Analysis of Microbial Dynamics during Anaerobic Digestion of Animal Dung**

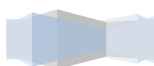
Study of microbial dynamics have shown that in methanogenic population bacterial activity are found to be initially very low and increases gradually towards the end of anaerobic digestion. This dynamics should be looked in the local operating conditions. The effects of inhibitors and synergistic enhancement agents (i.e., trace element and preventive antibiotic feed additives) should also be investigated in the process.

### **d) Task D: pH and temperature dynamics during biogas production**

Alkalinity is an important parameter in anaerobic digestion because it provides enough buffering capacity to neutralize any possible volatile fatty acids accumulation in the reactor and to maintain pH around 6.7 to 7.4 for stable operation. The anaerobic degradation process is highly pH dependent because each of the microbial groups involved in the reactions has a specific pH range for optimal growth. The aspects influenced by pH include utilization of carbon and energy sources, efficiency of substrate dissimilation, synthesis of proteins and various types of storage material and the release of metabolic products from the cell. The anaerobic degradation process is strongly influenced by temperature. As the understanding of pH, temperature dynamics of the anaerobic digestion under local conditions is essential for optimum efficiency of BDBs; these have been studied in reasonable details.

### **e) Task E: Augmentation of cow dung with other organic feedstock**

The possibility of augmentation and process for such augmentation for different organic materials (green material, organic waste material, harvest residues, toilet content if considered acceptable) should be investigated to mitigate the shortage of dung.



## **f) Task F: Operational Improvements**

Investigation of the operation of DBDs in respect of feedstock preparation including dilution, input timing and frequency for feedstock loading, sludge/ manure treatment/disposal and ergonomics of operation. Several types of biogas reactors are currently promoted but the three major groups of biogas reactors commonly in use include batch reactors, a one stage fed and a two stages, or multi-stage daily fed operation. Batch reactors are the simplest, filled with the feedstock and left for a period that can be considered to be the hydraulic retention time, after which they are emptied. The second type of bioreactors is known as 'one-stage continuously fed systems', where all the biochemical reactions take place in one bioreactor. The third type of biogas reactors are 'two-stage' systems', in which various biochemical processes such as hydrolysis & pre-acidification take place separately in the inlet chamber.

## **g) Task G: Data analyses**

- i) Use and integrate the data obtained in tasks 1-6; to characterizing processes in the DBDs for biogas production and identifying the important mechanisms that can lead to optimal efficiency for DBD operation.
- ii) Provide recommendations on improvements of biogas production in DBDs per unit feedstock and their sustainable operation.

## **4. Timing and output**

The work outlined in the TOR will begin on signing of the contract and is to be completed by eighteen months unless extended.

1	Inception Report	End of 1 <sup>st</sup> month
2	Interim quarterly Reports	Five quarterly report after the inception
3	Draft Final Report	End of 16 <sup>th</sup> month
4	Final Report	End of 20 <sup>th</sup> month

## **5. Budget**

To be proposed by the participating institute if necessary with reimbursable expenses.

## **6. Oversight and other conditions**

The study will be overseen by the IDCOL designated person. Comments will also be sought from World Bank Task Team. The vendor may use services of other agencies to perform part of the assignment on sub-contract as all the expertise needed may not be available in one organization. All information and their interpretations will be property of IDCOL but can be used for scientific communications such as journal papers etc. with permission of IDCOL.

## 7. Project Team

A team of professionals and technicians will be involved in the study. A professional with at least 10 years' experience in either Biogas technology or Microbiology should be the team leader. If the team leader is a Biogas technologist, then the deputy leader should be a Microbiologist of similar experience or vice-versa. The details of team should be proposed by the team leader.

## 8. CONTENTS OF THE PROPOSALS

IDCOL invites Proposals from national entities (universities, research institutes, Firms, NGOs, individuals etc.) interested to conduct R&D activities for developing technologies on Biogas Production Efficiency in Domestic Biogas Digesters suitable for Bangladesh. IDCOL is interested to receive proposals with business models.

**The language of the content of the Proposals must be in English.**

The Proposal must contain:

- a) Selection of the Technology: Identification of the technology
- b) Identification of the target group and description of the way to benefit them.
- c) Rationale of the project with expected output;
- d) Preparation of the Detailed Project Report (DPR): The DPR will provide details of the technology, project financials & financing mechanism, implementation schedule, cost-benefit analysis, etc.
- e) Implementation method of the project.

*Note: The detail format is in Annex II.*

## 9. EVALUATION PROCEDURE AND CRITERIA

An Evaluation Committee will evaluate the proposals. Evaluation would be carried out for each application area separately. This will be done in two phases:

1. Initial Screening for Technical Qualification;
2. Evaluation of Technical proposal

The proposal will be evaluated on the basis of the following criteria:

SI No	Criteria	Marks
1	Uniqueness, innovation, impact of application (scalability, business model etc.)	30
2	Qualification and track record of the applicant	20
3	Suitability of the proposed technology for Bangladesh	20
4	Quality of the overall proposal and methodology	20
5	Reasonableness of Project Cost	10
<b>Total</b>		<b>100</b>



## 10. EVALUATION COMMITTEE

The committee comprises of the renowned technical experts, representatives from Technical Universities, Sustainable and Renewable Energy Development Authority (SREDA), Economic Relations Division, Power Cell and IDCOL.

## 11. SUBMISSION OF THE PROPOSALS

The Proposals must be received no later than **09 December 2015 at 06:00 PM (Bangladesh Standard Time)** and be forwarded to the following address in one sealed envelope:

Md. Maidul Islam  
Senior Officer, Procurement  
Infrastructure Development Company Limited  
Level-16, UTC Building, 8 Panthapath, Kawran Bazar, Dhaka-1215  
Email: [maidul@idcol.org](mailto:maidul@idcol.org); [islammaidul@yahoo.com](mailto:islammaidul@yahoo.com)

## 12. SPECIAL NOTES

- IDCOL will consider the selected projects for financing for the demo phase. After positive results from the demo phase, IDCOL will take up the full-fledged subsequent implementation of the projects on regular basis.
- The investigator(s) may register the patent on the project developed/invented under the proposal. However, the researcher will not claim any royalty for dissemination of the technology by IDCOL or any other organization in Bangladesh or by IDCOL outside Bangladesh;
- Authenticity of the concept should be published by the principal investigator of the project with proper documentation.
- Any individual can't play the role of principal investigator in two of the selected projects. He/she may work as co-investigator in maximum of two other selected projects.
- IDCOL will negotiate with the investigator(s) to set the stage payment modality for implementing the selected projects.
- Individuals or Firms will particularly be responsible for copyright of project concept. In case of any issue raised regarding copyright breach, IDCOL shall not bear any responsibility; rather the Consultant will fully be responsible in this regard.





## Annex I: Domestic Biogas Digester Technology and its Status in Bangladesh

1. **Introduction:** Biogas technology implementation was initiated in Bangladesh by BAU (Bangladesh Agriculture University) in 1976; which was subsequently followed by BCSIR, DANIDA, LGED, DLS, Grameen Sakti and IDCOL among others. The total numbers of plants now exceed 40,000. The status of Domestic Biogas Digesters (DBDs) in Bangladesh was recently reviewed in the Bangladesh Biogas Audit (BAB)<sup>1</sup>. So far, only the single-stage digestion system has been used in all the plants in Bangladesh. All of the four biological reactions (i.e., Hydrolysis, Acidogenesis, Acetogenesis and Methanogenesis) in the biogas generation process occur within a single, sealed reactor or holding tank. Using a single stage reduces construction costs, but results in less control of the reactions occurring within the system. Various issues involved in the DBD processes and operations are briefly discussed in the following.

2. **pH Effects:** The digestion process begins with bacterial hydrolysis of the input materials. In this process insoluble organic polymers such as carbohydrates, are broken down to soluble derivatives that become available for other bacteria. Acidogenic bacteria then convert the sugars and amino acids into carbon dioxide, hydrogen, ammonia, and organic acids. Acetogenic bacteria convert these resulting organic acids into acetic acid, along with additional ammonia, hydrogen, and carbon dioxide. Finally, methanogens convert these products to methane and carbon dioxide. Acidogenic bacteria, through the production of acids, reduce the pH of the tank (i.e., pH 5.5 – 6.5). Methanogenic bacteria operate in a strictly defined pH range (i.e., pH 6.5 and pH 8). In a single tank digestion system, the different reaction phases are not isolated. Therefore, the biological reactions of the different species in a single-stage DBD are in direct competition with one another. The best pH range for methanogens is 7.8 – 8.2. The operating pH for combined cultures should be 6.8-7.4 with neutral pH being the optimum. Since methanogenesis is considered as a rate limiting step, it is necessary to maintain the reactor pH close to neutral. Low pH reduces the activity of methanogens causing accumulation of VFA (Volatile Fatty Acids) and H<sub>2</sub>. At higher partial pressure of H<sub>2</sub>, propionic acid degrading bacteria are severely inhibited; thereby causing excessive accumulation of higher molecular weight VFAs such as propionic and butyric acids and the pH drops further. If the situation is left uncorrected, the process may eventually fail. This condition is known as going “SOUR” or “STUCK”. The relative efficiency of methanogen in different pH range is shown in the figure 1. Remediation in such a situation is to supplement chemicals to adjust the pH: alkaline chemicals such as NaHCO<sub>3</sub>, NaOH, Na<sub>2</sub>CO<sub>3</sub>, quick lime (CaO), slaked lime [Ca(OH)<sub>2</sub>], limestone (or softening sludge) CaCO<sub>3</sub>, and NH<sub>3</sub> can be used. The issue of pH and its effects in the plants efficiency in the single tank domestic biogas digesters (DBDs) has not been reported in literature. There may be vertical pH gradient in the in the single tank DBDs and by controlling this gradient, better Methanogenic efficiency may be possible. It has been reported in literature that on average, only about 4% of the influent manure is converted to biogas.

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<sup>1</sup> BANGLADESH BIOGAS AUDIT (2011 – 2013), *NDBMP-IDCOL Dhaka/Bangladesh USTB Beijing/P.R. China (2013)*



Relative activity of methanogens to pH

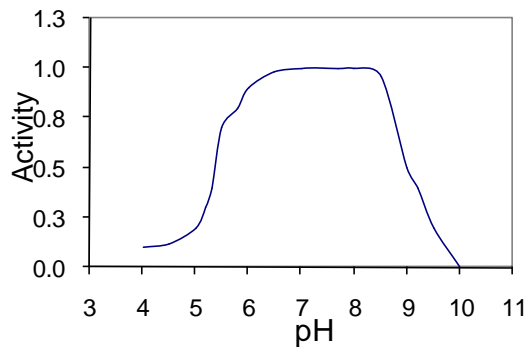


Fig. 1: Relative activity of methanogens to pH levels.

**3. Temperature Effects:** The anaerobic degradation process is strongly influenced by temperature<sup>2</sup>. Anaerobic digestion reactors are normally operated within the mesophilic (20-42°C) and thermophilic ranges (42-75°C) (Figure 2). The hydrolysis and acidogenesis processes are not significantly affected by temperature, but the acetogenesis and methanogenesis stages are carried out by fewer specialized species of microorganisms that are more sensitive to temperature. The temperature in the biogas unit varies with seasons. Because of the low thermal inertia and higher insulating wall of the prefabricated DBDs, the temperature inside this type of plants can be higher than ambient or traditional fixed dome DBDs. The temperature fluctuations in the biogas unit are higher inside the unit than the surrounding atmospheric temperature, because of the exothermic nature of some of the reactions in the DBDs. The temperature inside the digester has a major effect on the biogas production process.

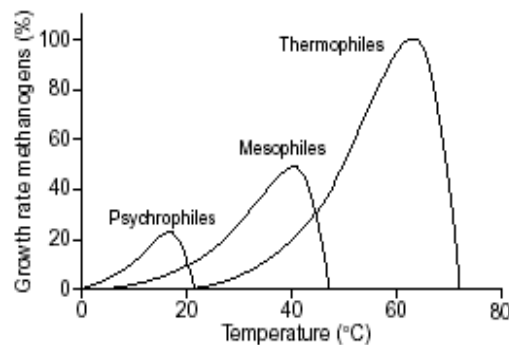


Fig.2: Temperature dependence of methanogens

**4. Inhibitors and Nutrients:** The anaerobic digestion process can be inhibited by several compounds, affecting one or more of the bacterial groups responsible for the different organic matter degradation steps. The degree of the inhibition depends, among other factors, on the concentration of the inhibitor in the digester. Potential inhibitors are ammonia, sulfide, light metal ions (Na, K, Mg, Ca, Al), heavy metals, some organics (chlorophenols, halogenated

<sup>2</sup> P. Merlin Christy\*, L.R. Gopinath and D. Divya, Microbial Dynamics During Anaerobic Digestion Of Cow Dung; Int. J. Plants, Animals And Env. Sciences, 4(2014) 86-94.



aliphatics, N-substituted aromatics, long chain fatty acids), etc. Conversely, nutrients (e.g. Fe, Ni, and Co etc) are known to enhance biogas production.

5. **Feedstock:** The BAB reports that 88% of the DBDs faced shortages of feedstock. Thus feedstock augmentation is a major issue. In addition to dung, feedstock can include biodegradable waste materials, such as waste paper, grass clippings, leftover food, sewage, and animal waste. Woody wastes are the exception, because they are largely unaffected by digestion, as most anaerobes are unable to degrade lignin. Xylophalgeous anaerobes (lignin consumers) or using high temperature pretreatment, such as pyrolysis, lignin can be broken down. After sorting or screening to remove any physical contaminants from the feedstock, the material can be shredded, minced, and mechanically or hydraulically pulped to increase the surface area available to microbes in the digesters and, hence, increase the speed of digestion.

6. **Traditional DBD Designs:** It appears that consumers' willingness to invest in traditional fixed dome brick and mortar biogas plants is facing problem due to various operational difficulties. The issues raised by the IDCOL POs are quite well-known for the traditional fixed dome DBDs. These are failures of the plants due to cracks or land subsidence, natural calamities and non-performance of the plant due to loss of cows by the owner. Nonpayment of loan installments by the consumers are also largely linked with these issues; as without biogas production, the households are not willing to pay. The rising cost of cement, bricks and other raw materials has led to the reduction the margin for the POs which could not be compensated by the increased subsidy from the RERED-II project's biogas component. Additionally, the availability of quality mason for plant construction has emerged as a major issue. Due to pull from the development at urban and industrial centers, it appears that unless competitive compensation can be paid; trained masons can no longer be retained.

7. **DBD Slurry:** Common misconceptions about anaerobic digesters include that anaerobic digestion and the resulting biogas production will reduce the quantity of manure and the amount of nutrients that remain for utilization or disposal. An anaerobic digester 'does not make manure disappear'. Often the volume of material (effluent) handled from a digester increases because of required dilution water for satisfactory pumping or digester operation. On average, only 4% of the influent manure is converted to biogas. Problem with slurry management was also reported in the audit as:

- Safety distances between water sources and slurry pits, or water sources and pit latrines are often not respected thus creating risks of contamination by nitrates, nitrites and pathogens; and
- Slurry pits are generally not sealed resulting in infiltration, runoff, and leaching, or they are permanently overflowing resulting in pollution and soil overloading.

It is good to see that IDCOL has moved to tackle the slurry issue and has declared it as the priority issue for the current year (2015). It is essential that the slurry be disposed in an environmentally safe way or used in a gainful manner.

8. **Prefabricated Biogas Digesters:** The demand for newly introduced PBD (Prefabricated Biogas Digesters) are good and higher gas production efficiency have also been reported for this type of plants. Notable success has been reported in the dissemination of prefabricated plants. However, reportedly some fiber glass imported DBD plants have developed problems which show that the issue of quality assurance in the manufacture is important issue for durability.



Good response from the households is a hopeful sign for the future of these type of plants. The anecdotal reports on higher efficiency of these plants i.e., higher production of biogas for the same dung input call for systematic investigation of the reasons for such effects. PBDs continue to be developed, tested, and extensively applied in developing countries to compensate for the disadvantages of traditional domestic digester models. In view of problems faced with the existing designs, the prospects of prefabricated plants in Bangladesh has also been studied recently<sup>3</sup>. The study looked at the scenarios of Prefabricated Biogas Digesters (PBDs) in developing countries and the report discusses the opportunities and challenges in these scenarios. The PBDs are being increasingly used in the developing countries<sup>4</sup> as many of the disadvantages of traditional fixed dome digester models can be avoided. The main advantages of the PBDs are listed in the report as:

- (i) Construction cycle: Typically 1 to 2 days;
- (ii) Service life: More than 25 years; even longer for underground types;
- (iii) Maintenance: Almost none;
- (iv) Transportation: Between 50 kg and 200 kg; easy to transport (can be dismantled);
- (v) Mechanical property: Good;
- (vi) Insulation: Good with low coefficient of heat conductivity;
- (vii) Tightness: Good; resistant to acid corrosion; and
- (viii) Water absorption rate: Low; suitable for regions with high underground water level.

Because of such reported advantages, IDCOL undertook to pilot about 100 PBDs of both local and imported types. As discussed earlier, this piloting has shown good acceptance from the consumers and many of the advantages reported have been observed in practice. There are some anecdotal reports of increased efficiency of gas production in these plants which has been attributed to better insulation of this type of plants. In view of the success of the PBD piloting and problems with the traditional fixed dome plant, IDCOL wants to start a program for the dissemination of PBDs initially of one size only (i.e., 2.4 m<sup>3</sup>) with Chinese imports. The main barrier in this plan, is the rather high cost of the imported PBDs. One of the reasons for the high cost is the import tariff. The negotiation for tariff reduction may take a long time; *so in the short term answer is probably higher subsidy to bring the price down to consumers' willingness to pay*. It should be possible to fabricate the PBDs locally also, as the industrial capacity for water tank fabrication can be used. So, a two track approach for tariff reduction with simultaneous effort for local fabrication may be undertaken, so that the PBD prices can be brought down probably in 2-3 years.

**8. Efficiency of DBDs:** One area where local work is missing is a comprehensive understanding of biogas production process and its efficiency. Although, it is well-known that complete anaerobic degradation of 1 kg COD produces 0.35 m<sup>3</sup> CH<sub>4</sub> at STP; it is not well documented what is the COD equivalent of dung in Bangladesh or if it varies for different areas. It is at times stated that 27kg of dung is required to produce one m<sup>3</sup> of gas; but it is not known if this is the maximum or

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<sup>3</sup> Xia Zuzhang, Technical Requirements and Quality Assurance for Prefabricated Domestic Biogas Plants of Fiberglass Reinforced Plastics in Bangladesh, Report ADB,RETA-7512 (2012).

<sup>4</sup> Shikun Cheng, Zifu Li , Heinz-Peter Mang, Elisabeth-Maria Huba, Ruiling Gao, Xuemei Wang, Development and application of prefabricated biogas digesters in developing countries, Renewable and Sustainable Energy Reviews 34(2014)387–400.



optimal value. Among other thing biogas production depend on bacterial type, temperature, pH, trace elements and nutrients (e.g. Fe, Ni, and Co etc). The knowledge on how these factors impact biogas production are need for optimum efficiency of biogas plants. This is all the more important in Bangladesh because of low availability of dung in small households. The possibility of blending dung with easily available organic materials, waste fractions from food and farming may also be a useful thing to investigate as this can augment dung shortage. ***Thus, it is imperative that studies discussed above should be undertaken without delay.***



## Annex II: Detail format of the Proposal

1. Title of the Project
2. Principal Investigator

SN	Item	Description (Not in essay form)
1	Background	
2	Educational qualification	
3	General Experience	
4	Experience in similar field	
5	Email	
6	Contact No.	

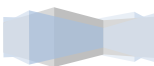
3. Co-Investigator(s) [If any]
  - 3.1. Background and experience of the Co-Investigator including experience in similar field
  - 3.2. Email and Cell Number of Co-Investigator
4. Affiliation with university/organization
5. Contact (if other than the Principal Investigator)
6. Legal Status (Trade licence, Incorporation certificates, TIN certificate, Memorandum of Articles etc. as applicable)
7. Objectives of the project (Not in essay form)
  - a.
  - b.
8. Background and rationale for the proposed technology
9. Present state of the art – Use of the technology in other parts of the world for on commercial or semi-commercial basis (maybe with government subsidy) or on pilot basis
10. Description of the project
11. Selection of the technology
12. Methodology
13. Cost-Benefit Analysis
14. Impact of the project
15. Project Cost (according to the following format):

SN	Items of Expenditure	Unit	Quantity	Estimated Cost	% of Estimated Cost
<b>a) Revenue Expenditure</b>					
1	Allowance of principal investigator				
2	Allowance of co-investigator(s)				
3	Pay of Staff(s)				
4	Supplies and Service				
5	Repair and Maintenance				
<b>Total Revenue Expenditure</b>					

SN	Items of Expenditure	Unit	Quantity	Estimated Cost	% of Estimated Cost
<b>b) Capital Expenditure</b>					
6	Acquisition of Asset 1				
7	Acquisition of Asset 2				
8	Acquisition of Asset 3 and so on.				
<b>Total Capital Expenditure</b>					
Total Cost (a + b)					
<b>c) Contingencies (maximum 2% of the total cost)</b>					
<b>Grand Total (a + b + c)</b>					
					100%

*Note: Overhead cost (such as Travel cost, stationeries, computers, printers, labor fee, Institutional cost etc.) should not be more than 15% of Capital Expenditure*

#### 16. Gantt chart for implementation timeframe



## Annex III: Sample of Draft Agreement

### Financing Agreement

This Financing Agreement has been executed on this ...day of ....., 2015 (hereinafter referred to as the 'Agreement')

BETWEEN

**Infrastructure Development Company Limited (IDCOL)**, a non-bank financial institution, having its registered office at UTC Building (16<sup>th</sup> Floor), 8 Panthapath, Kawran Bazar, Dhaka 1215, Bangladesh, represented by [TBD] (hereinafter referred to as 'IDCOL' which includes his successors and assigns)

AND

**[Name of the Consultant]**, having its address at [TBD], represented by its Principal investigator and [TBD], (hereinafter referred to as '[TBD]', which includes its successors and assigns)

WHEREAS

- A. IDCOL promotes dissemination of renewable energy technologies in Bangladesh and is currently financing different types of renewable energy based program/projects nationwide funded by various development partners;
- B. Pursuant to the Financing Agreement dated 30 June 2014 (Credit no 5514-BD) (Credit no 5158-BD) between the Government of Bangladesh ('GOB') and International Development Association ('IDA') and thereunder a Subsidiary Grant Agreement dated 15 September 2014 between GOB and IDCOL, IDCOL received financing for implementation of its Renewable Energy Programs as well as for supporting research and development (R & D) activities in Bangladesh;
- C. Pursuant to the invitation through Request for Expression of Interest ("EoI") for prospective R &D projects, the Consultant submitted its application for implementing the Project (defined below) and IDCOL has selected it through a competitive process on the basis of the conditions mentioned in the EoI. IDCOL has decided to extend grant support to the Consultant upto 100% of the Project Cost for conduction the research;

NOW therefore, IDCOL and the Consultant hereby have agreed to execute this Agreement on the following terms and conditions:





## **Section 1 : DEFINITIONS AND INTERPRETATIONS**

### **1.1. DEFINITIONS**

The capitalized terms used in Agreement, unless otherwise defined shall have the following meaning:

- a. "Availability period" means, unless otherwise agreed by the parties in writing, the period that shall be available from the date of this Agreement to the date falling [TBD] months thereafter for IDCOL's Grant under Section 3.01;
- b. "Business Day" means days during which Banks are open in Dhaka;
- c. "Disbursement" means the disbursement of Grant under section 5 which is disbursed from time to time by IDOCL to the Consultant under this Agreement;
- d. "Funding Entity" means IDA as mentioned in the preamble of this Agreement;
- e. "GOB" means Government of People's Republic of Bangladesh
- f. "Grant" means the subsidy agreed to be provided by IDCOL to the Consultant for meeting the expenses related to the Project under this Agreement and sourced out of fund of the Funding Entity;
- g. "Disbursement Milestones" means the milestones mutually agreed between the parties as attached in Schedule 5 to this Agreement upon achievement of which disbursements will be made under section 5;
- h. "Project" means the research project as described in details in Schedule I to this Agreement which will be implemented by the Consultant under this Agreement;
- i. "Project Activities" includes procurement, installation, construction, operation and maintenance of the Project and implemented by the Consultant;
- j. "Project Cost" means costs of the Project for procurement of equipment, construction and other related works as described in Schedule II not exceeding [TBD] including all applicable taxes and government dues;
- k. "Termination Notice" means the notice to be given by either party to the other party under section 11

### **1.2. INTERPRETATIONS**

In this Agreement, unless the context otherwise requires -

- (a) headings are for convenience only and do not affect the interpretation of this Agreement;
- (b) words importing the singular include the plural and vice versa;
- (c) a reference to a natural person includes any company, trust, joint venture, association, corporation or other body corporate and any authority;



- (d) a reference to a Section, Article, party or Schedule is a reference to that Section, Article, party or Schedule to this Agreement;
- (e) a reference to a document includes an amendment or supplement to, or replacement or novation of, that document but disregarding any amendment, supplement, replacement or novation made in breach of this Agreement; and
- (f) a reference to a party to a document includes that party's successors and permitted assigns.

## **Section 2 : THE PROJECT**

2.1. The Project under this Financing Agreement is meant to develop a Research and Development facility to: [TBD based on Project nature]

## **Section 3 : IDCOL GRANT**

- (b) IDCOL agrees to provide Grant up to 100% of Project Cost, but not exceeding [TBD] only to the Consultant and the Consultant agrees to receive these Grant in accordance with the terms and conditions of this Agreement.
- (c) IDCOL Grant shall be used exclusively to meet total Project Cost as agreed in Schedule-II.
- (d) Notwithstanding any other provisions in this Agreement, any un-disbursed Grant shall be cancelled and the Consultant shall not be eligible for the unutilized Grant.

## **Section 4 : DISBURSEMENTS**

- (a) The Consultant may request for Disbursement of the Grant under Section 3 by delivering to IDCOL, at least five (5) Business Days prior to the proposed date of Disbursement, through a Disbursement Request in form attached hereto as Schedule III, and a receipt substantially in form attached hereto as Schedule IV.
- (b) Upon submission of the Disbursement Request by The Consultant, IDCOL shall disburse the Grant in favour of The Consultant in its account mentioned in the Disbursement Request upon fulfilment of the Condition Precedents set forth in Section5;
- (c) The number of Disbursements shall not be more than 4 (four) subject to fund requirement and implementation progress of the Project and to be drawn within the Availability Period.
- (d) Notwithstanding anything contained in this Agreement, IDCOL shall disburse Grant only against the costs incurred by The Consultant at actual for the procurement, installation and construction of the Project as per the specification stated in Schedule VII.
- (e) Payment Schedule



- 10% on signing of the contract
- 10% on submission of the inception report plus equipment procurement fund
- 10% on submission of each quarterly report up to 5<sup>th</sup> quarter
- 20% on acceptance of the draft final report
- 10% on acceptance of the final report

## **Section 5 : CONDITIONS PRECEDENT**

### **A. Conditions Precedent for First Disbursement**

In addition to the Conditions Precedent under Section 5 (B), the obligation of IDCOL to make first Disbursement to The Consultant is subject to, the fulfilment of following preconditions unless otherwise waived by IDCOL in writing:

- 1) copies of the following documents have been submitted:
  - (a) Resolution of Board of Trustees enabling The Consultant, if applicable:
    - (i) to carry out the Project Activities;
    - (ii) to enter into this Agreement;
    - (iii) to receive Grant from IDCOL hereunder
    - (iv) to nominate its Authorized Representative under section 14 and
    - (v) to authorise its authorized signatory with his specimen signature attached for execution of this Agreement;

### **B. Conditions Precedent for All Disbursements**

Unless otherwise waived by IDCOL in writing, the obligation of IDCOL to make any Disbursement under this Agreement is subject to the fulfilment of following preconditions, namely that,

- 1) The Availability Period has not expired;
- 2) Numbers of the Disbursement Requests have not exceeded the maximum number of Disbursements as stated under Section 4 (c);
- 3) Disbursement Milestones as per Schedule 5 for respective Disbursement has been achieved;
- 4) supporting documents showing the utilization of the disbursed Grant as and when applicable e.g. money receipt, copy of Letter of Credit if any, distinctive photographs of the equipment procured and installed under the Project Activities have been delivered;
- 5) no Event of Default has occurred, is continuing or likely to occur;
- 6) Representations and Warranties made under section 6 of this Agreement are true on and as of the date of the relevant Disbursement;



- 7) no change in the condition of The Consultant has occurred which is likely to materially or adversely affect the operation of the Sub-project; and
- 8) no litigation or other proceedings has been current, or is likely to be instituted, which if adversely determined would materially affect the operation of the Project;

## **Section 6 : REPRESENTATIONS AND WARRANTIES**

6.1. The Consultant represents and warrants as follows:

- (a) Status. it is a trust created under the Trust Act, 1882 and validly existing under the laws of the People's Republic of Bangladesh. It has license from the University of Grant Commission under the Private Universities Act 2010;
- (b) Power. it has the power to own its assets, carry on its business as it is being conducted and to enter into and perform its obligations under this Agreement;
- (c) Authority. it has the authority to enter into and perform, and has taken all necessary action to authorize the entering into, performance and delivery of, this Agreement, other Transaction Documents;
- (d) Dedicated Staff. it has adequate and trained dedicated staff to operate the Project successfully;
- (e) Validity. this Agreement constitutes, or when executed in accordance with its terms, shall constitute, its legal, valid and binding obligation enforceable against the Consultant in accordance with its terms and, so far, the Consultant is aware, is in full force and effect;
- (f) No Conflict. the execution, delivery and performance by it of this Agreement shall not-
  - (i) violate or conflict with any law, rule or regulation or governmental approval or judicial order to which it is subject in any material respect;
  - (ii) violate or conflict with the constitutional documents of the Consultant;
  - (iii) violate or conflict with any existing contractual undertakings of the Consultant with any third parties including public or private entities;
  - (iv) cause any limitation on it or the powers of members of the board of trustees (whether imposed by any of its constitutional documents or by any law, order, judgement, agreement, instrument or otherwise) to be exceeded; or
  - (v) oblige the Consultant to create or result in the existence of any Encumbrance over any of its assets or result in any breach of any law, order, judgement or agreement.
- (g) Authorizations and Approvals. all material authorizations required in connection with entering into, performance and validity and enforceability of this Agreement have been obtained and are in full force and effect so far as the Consultant is aware and no steps have been taken to revoke or cancel any such authorizations obtained or effected;
- (h) Immunity. the Consultant, its properties and assets do not enjoy any right of

immunity from set-off, suit or execution in respect of its obligations under this Agreement;

(i) Proceedings. No litigation, arbitration or administrative or other proceedings are current, or to its knowledge, pending or threatened which, if adversely determined, would have a material adverse effect on the Project;

(l) Funding by others: it has not received any funding from any other donors or funding agencies to carry out the same Project Activities.

(m) Good title to assets:

(i) the Consultant has good title to all its assets and possession over the assets that will be used for the Project and there is no encumbrance over those assets of the Consultant and the Consultant is not a party to nor is it or any of its assets bound by any order, agreement or instrument under which the Consultant is or in certain events may be required to create, assume or permit to arise any encumbrance.

(ii) the Consultant has all the necessary rights, easements, licenses and interests to enable it to use its assets for the Project;

(n) No misleading information: the Consultant has disclosed fully in writing to IDCOL all facts relating to itself which it knows or should reasonably know and which are material for disclosure to IDCOL in the context of this Agreement.

6.2. The representations and warranties in Section 6.1 shall be deemed to be repeated, updated *mutatis mutandis* at each such date, on the date of each Disbursement Request, on the making of each disbursement and on the first day of each interest period.

## **Section 7 : UNDERTAKINGS OF THE CONSULTANT**

The Consultant undertakes that it:

(a) shall procure that IDCOL be allowed access to inspect by itself, or jointly with GOB and/or Funding Entity, the Laboratory, Project Activities and any relevant records and documents;

(b) shall furnish to IDCOL:

i. the implementation status showing the progress as per the Disbursement Milestones under Schedule V;

ii. such other additional financial or other information as IDCOL or any Funding Entity may from time to time request

(c) shall carry out the Project Activities with due diligence and efficiency and in accordance with sound technical, economical, financial, managerial, environmental and social standards and practices satisfactory to IDCOL and the Funding Entity, including in accordance with the provisions of the Anti-Corruption Guidelines applicable;

- (d) shall enable IDCOL and any Funding Entity to inspect the Sub-project or Sub-project Activities, its operation and relevant records and documents at any time with or without any prior written notice.

## **Section 8 : EVENTS OF DEFAULT**

8.1. It shall be an event of default on the part of the Consultant, if,

- (a) Breach of Representations and Warranties. it commits breach of any Representations and Warranties under Section 6
- (b) that IDCOL determines to have material and adverse effect on the Project;
- (c) Breach of Undertakings. it commits breach of any undertakings under Section 7 that IDCOL determines to have material and adverse effect on the Sub-project;
- (d) Government Action. GOB takes any action to nationalize, expropriate or confiscate the the Consultant and/or its assets;
- (e) Cessation of License: the license of the Consultant obtained from its regulatory authority and/or under any other law has been ceased or not renewed;
- (f) Insolvency proceedings by and/or against the Consultant. any insolvency, bankruptcy or reorganization proceedings is undertaken by the Consultant that has not been discharged within thirty (30) days of its institution;
- (g) Force majeure event. any force majeure events such as fire, riot, strike, earthquake, flood, cyclone and other natural perils occurs rendering the implementation of the Project fully or partially not possible for more than 90 days without restoration or repair.
- (h) Failure and/or Denial to operate. it fails and/or denies to performs its duties and obligations under section 2 and Section 7.

8.2. Upon the occurrence of any Event of Default, IDCOL shall have the right to suspend the undisbursed Grant under section 9 and/or terminate the Agreement under Section 10;

## **Section 9 : SUSPENSION OR CANCELLATION OF GRANT BY IDCOL**

Notwithstanding anything contained in this Agreement, IDCOL may at any time suspend the un-disbursed amounts of all Grant immediately under this Agreement giving a written notice of 15 days to the Consultant, if -

- (a) the Consultant fails to draw the full sanctioned amount of Grant within the Availability Period and/or by maximum number of Disbursement Requests under Section 4 (c);
- (b) disbursements under the any grant agreement among GOB and any Funding Entity and any subsidiary grant agreement between GOB and IDCOL as referred to in the preamble to this Agreement is suspended or terminated for any reasons;
- (c) it becomes unlawful for IDCOL to give effect to any of its obligations under this

Agreement;

- (d) a right of suspension or cancellation arises under Section 8.2
- (e) the GOB or any Funding Entity suspends or terminates the right of IDCOL to use the proceeds of the Grant for the Project;
- (f) the Consultant fails to perform any of its obligations under this Agreement;

#### **Section 10 : TERMINATION OF THE AGREEMENT**

- (a) Any party may terminate this Agreement by giving a 90 (ninety) days' notice in writing to the other party in the event of the failure by the other Party to perform any of its obligations under this Agreement amounts to a fundamental breach of this Agreement and fails to remedy the same within 90 days of receipt of the written notice ('Termination Notice');
- (b) Either Party shall be entitled to terminate the Agreement by giving a written notice if the other Party becomes bankrupt or otherwise insolvent.
- (c) In case of termination of this Agreement by the Consultant on any ground or by IDCOL on the ground any Event of Default and/or failure of the Consultant to remedy the default under this Agreement within the period of Termination Notice, IDCOL will have the right to take back the equipment procured and/or installed under this Agreement, provided that if the Consultant wants to retain the equipment, it will pay to IDCOL the depreciated value of the equipment at the time of termination by either party. The annual depreciation will be at the rate of 20% (twenty percent).

#### **Section 11 : OWNERSHIP OF THE PROJECT AND ITS TECHNOLOGIES**

Any studies, reports or other material, graphic, software, technology or otherwise developed by the Consultant under the Project shall belong and remain the property of the Consultant provided that the Consultant shall not claim any royalty for dissemination of the Project and/or the studies, reports or other material, graphic, software, its technologies or otherwise, technology relating to the Project:

- a. by any person within the territory of Bangladesh;
- b. by IDCOL irrespective of place, time and mode of dissemination

#### **Section 12 : GOVERNING LAW AND JURISDICTION**

This Agreement is governed by and shall be construed with the laws of the People's Republic of Bangladesh ("Governing Law") and the Court of Law of People's Republic of Bangladesh will have the exclusive jurisdiction in case of any dispute arisen between the parties under this Agreement.



**Section 13 : ENTIRE AGREEMENT**

This Agreement and other documents contemplated hereby shall supersede any prior expressions of intent or understandings with respect to the transactions contemplated herein.

**Section 14 : AMENDMENT AND WAIVER**

- (a) Any provision of this Agreement may be amended by mutual agreement of the parties in writing.
- (b) Any waiver of any right under this agreement must be in writing and signed by the parties.

**Section 15 : AUTHORIZED REPRESENTATIVE**

The Consultant may nominate its authorized representative in writing including but not limited to represent the Consultant, perform any undertakings, make communications and be communicated for any correspondence regarding this Agreement (the Authorized Representative) provided that neither the Consultant nor the Authorized Representative shall assign its rights and/or obligation under this Agreement without prior written consent of IDCOL.

**Section 16 : COUNTERPART**

There shall be 2 (two) original copies of this Agreement one of which will be retained by IDCOL and the other one shall be retained by the Consultant.

**IN WITNESS WHEREOF THE PARTIES HAVE EXECUTED THIS MOU THROUGH THEIR AUTHORISED REPRESENTATIVES ON THE DATE AS MENTIONED BEFORE,**

**Witnesses:**

**For INFRASTRUCTURE DEVELOPMENT  
COMPANY LIMITED (IDCOL)**

1.

\_\_\_\_\_

Executive Director and CEO, IDCOL

**For Consultant**

2.

\_\_\_\_\_





**Infrastructure Development Company Limited (IDCOL)**  
Level-16, UTC Building, 8 Panthapath, Kawran Bazaar, Dhaka  
Telephone No.: 9102171-8, Fax No.: +880-2-8116663  
**REQUEST FOR PROPOSAL (RFP)**

**Assignment Title:** *Selection of Individual or Firm for the Research and Development on Biogas Production Efficiency in Domestic Biogas Digesters suitable for Bangladesh*  
**Reference No.** IDCOL/REREDPII/S-32/2015/03, Date: 12/11/2015

Looking at the increasing importance of renewable energy, IDCOL is willing to support research and development (R&D) activities with a view to improving the existing renewable energy technologies as well as exploring other viable renewable energy options in Bangladesh context. 100% grant fund will be provided to the approved R&D proposals. IDCOL recently received USD 1 million fund from the World Bank under Rural Electrification and Renewable Energy Development Project (REREDP)-II which will be used to support the R&D initiatives. IDCOL published a Request for Expression of Interest (REoI) in January and July 2015 inviting local entities (universities, research institutes, Firms, NGOs, individuals etc.) to submit EoI for conducting R&D on renewable energy/energy efficiency technologies. IDCOL has already selected a number of proposals for R&D related to various renewable energy technologies.

IDCOL now intends to select proposals for conducting R&D on Biogas Production Efficiency in Domestic Biogas Digesters suitable for Bangladesh. An Evaluation Committee will evaluate the proposals. Evaluation would be carried out for each application area separately. This will be done in two phases:

1. Initial Screening for Technical Qualification;
2. Evaluation of Technical proposal

The proposal will be evaluated on the basis of the following criteria:

SI No	Criteria	Marks
1	Uniqueness, innovation, impact of application (scalability, business model etc.)	30
2	Qualification and track record of the applicant	20
3	Suitability of the proposed technology for Bangladesh	20
4	Quality of the overall proposal and methodology	20
5	Reasonableness of Project Cost	10
Total		100

The attention of Consultants is drawn to paragraph 1.9 of the World Bank's *Guidelines: Selection and Employment of Consultants* ("Consultant Guidelines"), setting forth the World Bank's policy on conflict of interest. Consultant will be selected in accordance with the Selection based on Consultant's Qualification (CQS) method set out in the Consultant Guidelines and contract will be lump-sum based. Further information can be obtained at the address below during office hours-10:00 AM to 06:00 PM (BST) and the interested firm may visit [www.idcol.org](http://www.idcol.org) for detail RFP of this assignment. Proposals (one hard & one soft) copy must be submitted in a written form to the address below (in person, or by mail, or by e-mail) by **09 December 2015 at 06:00 PM (BST)**.

Md. Maidul Islam  
Senior Officer, Procurement, Infrastructure Development Company Limited  
Level-16, UTC Building, 8 Panthapath, Kawran Bazar, Dhaka-1215  
Email: [maidul@idcol.org](mailto:maidul@idcol.org); [islammaidul@yahoo.com](mailto:islammaidul@yahoo.com)

