



Impact Evaluation Study
of
System Loss Reduction of
Titas Gas Transmission & Distribution Company Limited
(TGTDCCL)



Carried out by:
Implementation Monitoring and Evaluation Division (IMED)
Ministry of Planning
Government of the People's Republic of Bangladesh

June 2014

**Impact Evaluation Study of System Loss Reduction of Titas
Gas Transmission & Distribution Company Limited (TGTDCL)**

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June 2014

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Acknowledgement

It is indeed a great honor for us that Implementation Monitoring and Evaluation Division has entrusted e.Gen Consultants Ltd. and Creative Consulting Limited (CCL) to carry out the “Impact Evaluation Study of System Loss Reduction of Titas Gas Transmission and Distribution Company Limited (TGTDCCL)”. In the process of working on the methodology and approach, setting indicators and sampling and also for designing the questionnaires for the survey and other instruments, we have enjoyed the support of IMED and TGTDCCL senior officials. We are grateful to all involved in the evaluation work. Our special gratitude is due to Begum Salma Mahmud, Director General, Evaluation Sector, who provided an opportunity to carry out the Evaluation Study. Special thanks are due to Md. Abdul Quiyum, Director, Evaluation Sector, IMED, Begum Kamrun Nessa, Director, Evaluation Sector, IMED, Dr. M Kabir, Member Specialist, Former Professor, Jahangirnagar University, Savar, Engr. Syed Manzur Ilahi, Project Director, TGTDCCL, Dr. Md. Rafiqul Islam, Senior Assistant Chief, Energy Division and Begum Tahmina, Senior Assistant Chief, Planning Ministry for their valuable comments and suggestions on the Draft Inception Report, Questionnaires and Draft Report. We would also like to thank Mr. Md. Shamimul Haque, Deputy Director, Evaluation Sector, IMED for his excellent cooperation. The support of Mr. A.F.M Nurul Islam, Electrical Engineer, System Loss Reduction Project, Md. Rashedul Hasan, Manager and Project Officer, e.Gen Consultants Ltd. is also acknowledged with thanks.

We are also thankful to Mr. Sheikh Md. Abdul Ahad for his detailed evaluation of Draft Final Report presented in the National Level Workshop. We also thank Mr. Wahidunnabi, Director CPTU, Mr. Rezaul Karim, Division Chief, TGTDCCL Representatives and Mr. Shafiuzzaman, DS, Planning Division, Mr. Kazi Jahangir Alam, DG, IMED, Mr. Abu Yusuf Mia, Deputy Chief, Energy and Mineral Resource Division, Mr. Shefaul Alam, DG, IMED and Mr. Manjul Alam, Deputy Chief, Planning Commission, for their valuable comments. Finally, we are grateful to Ms. Suraiya Begum, NDC, Secretary, IMED, Bangladesh Planning Commission for her all out cooperation and support without which this study would not have seen the light of the day.

Foreword

The Titas Gas Transmission and Distribution Company Limited under the Ministry of Power, Energy and Mineral Resources/Energy and Mineral Resources Division implemented the Project titled “System Loss Reduction of Titas Gas Transmission and Distribution Company Limited (TGTDCCL)” from 2006-2010 to 2006-2011 with the financial support of Asian Development Bank (ADB) under the Bangladesh Oil, Gas & Mineral Corporation (Petrobangla), Ministry of Power, Energy and Mineral Resources/ Energy and Mineral Resources Division.

Evaluation Sector of the Implementation Monitoring and Evaluation Division (IMED), the Ministry of Planning contracted out the evaluation of this project to e.Gen Consultants Limited and its associate Creative Consulting Limited (CCL), Bangladesh. The consulting firms was assigned to assess the implementation status of the project, review how far the necessary system loss reduction works are carried out and assess the outcome of the project. The findings of the study indicate that project activities have brought reasonable impacts of system loss of the users of gas.

I, sincerely congratulate e.Gen Consultants team for conducting the evaluation work and making successful completion of the report in time. I also thank to Begum Salma Mahmud, Director General (Evaluation Sector) along with her professional colleagues to provide guidance and supervisory supports to the e.Gen Consultants team members. I would also like to appreciate cooperation of Titas Gas Transmission and Distribution Company Limited, local administration and positive response of project beneficiaries and participation of local influential/civil society members in the National Level Workshop.

I am very hopeful the recommendations of the evaluation study will be much helpful in improving the activities of the project as expected and also be more cost-effective in implementation and maintenance of similar projects in future.

(Suraiya Begum ndc)
Secretary
IMED, MINISTRY OF PLANNING

Preface

This Report has been prepared to meet the requirement of contract signed between Implementation Monitoring and Evaluation Division (IMED) of the Ministry of Planning and e.Gen Consultants Limited and its associate Creative Consulting Limited (CCL), Bangladesh dated on 23rd December, 2013 for conducting an impact evaluation study for System Loss Reduction of Titas Gas Transmission and Distribution Company Limited (TGTDCCL).

Consulting services for the evaluation of the project are being provided by the e.gen Consultants Limited and CCL, which was implemented from 2006-2010 to 2006-2011 with the financial support of Asian Development Bank (ADB) under the Bangladesh Oil, Gas & Mineral Corporation (Petrobangla), Ministry of Power, Energy and Mineral Resources. The major objective of the study is to assess the project implementation status and its impact.

The final report contains information on analysis of primary data and final result. It also contains primary evaluation data set, its charts and analytical framework. The report has been discussed with the Technical Committee and the Steering Committee of the IMED. Based on comments and suggestions of the Technical Committee and Steering Committee meeting the consultant has prepared the draft final Report for the National Level Dissemination Workshop. The final Report is being submitted to the IMED incorporating the comments and suggestions of the stakeholders of the workshop.

I would like to thank the research team for conducting the Impact Evaluation study and also the concerned IMED officials in making the total endeavor a success.

Salma Mahmud
Director General
EVALUATION SECTOR, IMED
Ministry of Planning

Abbreviations

ADB	:	Asian Development Bank
BOGMC	:	Bangladesh Oil, Gas and Mineral Corporation
CCL	:	Creative Consulting Ltd.
EVC	:	Electronic Volume Correctors
FGD	:	Focus Group Discussions
GTDP	:	Gas Transmission and Development Project
IMED	:	Implementation Monitoring and Evaluation Division
KII	:	Key Informant Interviews
PCR	:	Project Completion Report
PP	:	Project Proforma
PRA	:	Participatory Rural Appraisal
RDPP	:	Revised Development Project Proposal
RTAP	:	Revised Time Bound Action Program
RSD	:	Regional Sales Division
SCADA	:	Supervisory Control and Data Acquisition
SLR	:	System Loss Reduction
SLRP	:	System Loss Reduction Plan
SLRP	:	System Loss Reduction Project
STAP	:	Second Time Bound Action Program
SWOT	:	Strength, Weakness, Opportunity and Threats
TGTDCL	:	Titas Gas Transmission and Distribution Company Ltd.
TOR	:	Terms of Reference

Executive Summary

Project Background:

In the event of system loss as percentage of total supply, alarmingly rising to 6-7 percent, TGTDCCL drew up two action programmes: the first one in 1993-94, known as the "Revised Time Bound Action Plan (RTAP), with a view to reducing system loss to 2 percent.

The second one, adopted in 2001, known as the "Second Time Bound Action Plan (STAP), set out a target of reducing system loss to 2.5 percent by 2005.

Both programmes failed and TGTDCCL drew up a new comprehensive plan with advisory service as a component and proposed a new set of measures and steps which were included in the previous programme but not implemented, with a view to bringing down system loss to 2 percent by 2009-10. This plan is known as the System Loss Reduction Plan (SLRP). The project ended in June 2011 with a cost of Tk. 16.67 crores.

Project Objectives:

The main objective of SLRP project was to improve operational and distributional performance of two marketing areas through reduction of system loss gradually to 2 percent level from around 22% in the two Areas: - Area – 1: Narayanganj, Fatullah and Munshiganj and: - Area – 2: Sonargaon. The project included i) installation 604 EVC meters, ii) mobile calibration units, iii) training of 140 staffs and use advisory service.

Objective of the Present Study:

The main objective of this assignment is to assess the installation of metering equipment, procuring mobile calibration units and comprehensive System Loss Reduction Plan (SLRP) in reducing system loss to the desired level.

The specific objectives of the current assignment are to:

- i. assess the actual progress against the target of various components of the project as per revised DPP along with their causes for any gap;
- ii. examine whether the procurement of the packages under the project was done following the PPR 2008/donor's procurement guidelines on the basis of a set of predetermined indicators;
- iii. assess the impact of installation of meters with Electronic Volume Corrector (EVC) meters, and comprehensive System Loss Reduction Plan (SLRP) on instant calibration of industrial meters, as well as reduction in pilferage of gas, and conservation of energy;
- iv. assess the effectiveness of the Revised Time Bound Action Program (RTAP) in analyzing the factors causing system loss and their relative importance and in apportioning the percentages of losses for each factor;
- v. assess impacts of various foundation and specialized training on skill development of the TGTDCCL personnel in conducting gas operation and distribution performance etc.

-
- vi. scrutinize the main recommendations by experts/consultants relating to improvements of system operation and control of operational losses.
 - vii. identify in-built strengths and probable opportunities as well as internal weaknesses and external threats towards improvement of operational and distribution performance through SWOT analysis and
 - viii. provide recommendations to reduce system loss to the desired level and identify the best practices for replication and assess the implementation status in other project areas.

Methodology of the Study:

Both primary and secondary data were collected for the study. Following the TOR, primary data were collected from 418 direct beneficiaries from the four project area from a population of 1056, 70 trainees out of 140, 100 officials of industrial set-ups equally distributed among four areas and 100 households (who are not direct beneficiaries) out of a total of 678. In each case structured questionnaires were used. In addition to this, 8 focus group discussions (FGD), two in each area, were carried out for understanding the impact of the project. Data were analyzed by simple statistical means, e.g., analytical tables, charts, pie-charts and bar-diagrams.

Findings of the Implementation Status of the SLRP Works:

The major findings regarding the implementation status of system loss reduction works under all the selected project area are:

- All system loss reduction works under four selected areas of TGTDCCL had been found similar during physical visit of the project areas as records found in PCR.
- Procurement of EVC meters, mobile calibration equipments under the project was done following the PPR 2008 and donors (ADB) procurement guideline on the basis of a set of pre-determined indicators.
- Specialized training on skill development of the 140 TGTDCCL personnel under the project was a wastage. They were not utilized in the project.
- Metering station is under customer custody for commercial and industrial cases
- Supply gas pressure was found lower than rated pressure in most cases
- Many gas flow meters were found inoperative and stored in department workshop.

Findings of the Survey:

Beneficiary survey revealed the followings:

Utility of using gas line in the project area: All four project area of the TGTDCCL Bangladesh were being used round the year for generator, captive power generation, CNG filling stations, industry and re-rolling mills and mobility of beneficiaries through which most of the project beneficiaries were being benefited.

1. 88.3% of beneficiaries did not have any knowledge about repair and maintenance work. (table 3.11).

-
2. 94.5 percent beneficiaries of Sonargaon have gas supply with pressure all the time while 46.4 percent of beneficiaries in Fatullah did not get gas supply with right pressure all the time.
 3. 68.2 percent of all the respondents said gas supply did not improve after repair and maintenance. It includes all the beneficiaries in Fatullah (100%), 63.0 percent of beneficiaries in Munshiganj and 47.9 percent of beneficiaries in Narayanganj.
 4. Of the total beneficiaries, 63 percent had EVC meters and the rest had manual meters. When meter is out of order, gas bills are prepared on the basis of 3 month load, average bill and on negotiation.
 5. Meter readings are not used for preparation of bills for consumption so there is scope for inaccurate billing.
 6. 63.9 percent of all the beneficiaries reported of that there was no regular repair and maintenance.
 7. 41 beneficiaries reported that there were illegal connections in the area and the rest of beneficiaries did not know about it.

Household survey revealed the following:

1. 92% of households reported that gas supply did not improve after repair and maintenance of gas line.
2. 63% of household complained that gas was not available all the time. This includes 83.3% households in Narayanganj 78.3 percent in Munshiganj and 66.7% in Fatullah.
3. 25% of household reported illegal connections in the area.
4. 83% of all respondents reported that there were leakages in risers and distribution lines.

Findings Regarding System Loss:

Estimated aggregate system loss for the months of January, February and March, 2014 (three months) for area – 1 (Narayanganj, Fatullah and Munshiganj) appears to be 18.360 mmcm (million cubic meter) while the same for area – 2 (Sonargaon) is about 25.149 mmcm. The aggregate for three months for both areas in 43.509 mmcm. The system loss as percentage of the total gas supply in area – 1, area – 2 and for both areas 1 and 2, respectively, are 9.56, 8.27 and 8.77 percent.

Factors causing system loss are inaccurate billing, leakages and illegal connection which account for 1.367, 1.417 and 5.986 percent, respectively, of the total supply. For area 1 and 2 together it amounts to 8.77 percent of the total gas supply. However, these figures may be interpreted as notional, rather than actual as they were estimated from the beneficiary's perception. This means that inaccurate billing, leakages and illegal unmetered connections, respectively, account for 6.782 mmcm, 7.030 mmcm and 29.967 mmcm. If the total system loss of 43.509 mmcm is valued at TK. 6 per cubic meter, it stands at TK. 261.05 million or TK. 26.10 crores in three months (January, February, and March, 2014). If loss figures do not increase, this would mean an amount of TK. 104.44 crores in a year-a huge loss to the national exchequer.

Comparison of two-months aggregate data for Jan-Feb, 2011 with that of 2014 shows that in terms of volume gas, system loss has increased and system loss as percentage of total supply has also increased.

Recommendation:

1. In order to reduce system loss due to leakages, it is recommended that the old distribution net work including customer service line and riser be replaced after making leak test, particularly in Narayanganj, Fatullah and Munshiganj. Also, in the same areas, to ensure regular supply of gas with right pressure, supply capacity be increased by increasing the diameter of service pipe line.
2. In order to reduce inaccuracy of billing and thereby reduce system loss, it is recommended that all the EVC meters installed in the project area be made functional and gas bills be prepared using the meter readings within two months. Repair and maintenance of the installed meters be made regularly and to facilitate this, new contracts, if necessary, be made with the manufacturers with regard to replacement of flawed meters and supply of spare parts. TDTGCL personnel, who were trained as a part of skill development in the project, be brought under the project and used for the purpose of repair and maintenance activities.
3. If the above recommendation (2) cannot be followed, it is recommended that high quality EVC meters be procured and installed for all the large customers and all the manual meters be replaced by new EVC meters. It is also recommended that contractual agreement be made with the manufacturer
 - i) To guarantee quick replacement of flawed meters,
 - ii) To supply spares and consumables, and
 - iii) To provide training to O&M personnel to carry out in-house repair and maintenance.
4. Illegal connection is a serious problem. Illegal intervention by influential people should be stopped and gas connections severed and responsible persons should be taken to task. However, this is easier said than done. Considering the reality (social price of gas much greater than administered price and there exists high excess demand for gas connection for the domestic users), all the illegal gas connections be legalized and owned by the company. In this way, company could get some revenue. For example, if 10,000 domestic connections are legalized, the yearly revenue would be about 5.40 crores (at the rate 450 per month).

Conclusion:

The project appears to have been unsuccessful in bringing down system loss to its desired level, from 22 percent gradually to 2.5 percent. Although it was undertaken in good intention. It appears that procurement and installations of EVC meters to some (not all) customers did not work in reducing system loss.

CHAPTER – 1: BACKGROUND AND UNDERSTANDING OF THE STUDY

1.1 Introduction

Evaluation Study of System Loss Reduction of Titas Gas Transmission and Distribution Company Ltd. is a five (5) months assignment commencing from 23rd December 2013 under the Implementation Monitoring and Evaluation Division (IMED) of the Ministry of Planning of the Government of the People's Republic of Bangladesh.

Consulting service for the impact evaluation study for the System Loss Reduction of Titas Gas Transmission and Distribution Company Ltd, which was implemented from July 01, 2006 to June 30, 2011 with the financial support of ADB and Government of Bangladesh, Ministry of Power, Energy and Mineral Resources/ Energy and Mineral Resources Division are being provided by the e.Gen Consultants Ltd. and Creative Consulting Ltd. (CCL) of Bangladesh. The study team consists of three senior level experts and field and office level support staffs (Details of the team and staffing schedule are provided in **Appendix 2**). The main objective of the project is to improve operational and distribution performance of two marketing areas on the company through reduction of system loss or unaccounted for gas.

1.2 Background of the Project

The operation performance in the gas sector has been affected by high system loss associated with gas transmission and distribution system. TGTDCCL continues to be affected by problem of system loss ever since the mid-80s. As system loss reached a level of 6-7%, the enormity of the problem became clear to everyone. The loss figures were unacceptable by any standards and this raised a lot of concern at the Corporations and Govt. level. The development partners also took serious view of the situation and advised emergent effective measures to control the losses.

As the situation worsened and as ADB decided to make attainment of an acceptable system loss level a condition in this loan agreements, TGTDCCL accordingly drew up two actions programs- one in 1993-94 and another in 2001 for reduction of system loss. The Revised Time Bound Action Program (RTAP) was the first attempt to analyze the factors causing system loss and their relative importance and also apportioned percentages of losses for each factor. The program also set out a target of reducing system loss to a level of 2% within a time frame. However, the program after initial visible success fizzled away and the target was not achieved.

The second Time Bound Action Program (STAP) adopted in 2001 aimed at bringing down the level of system loss to 2.5% by June 2005. However this program also failed to reach its goal. The double failure means that the problem remains unsolved. However, a small achievement was that the overall system loss figures in percentage terms have remained somewhat static. But halting the upward trend or just arresting the system loss level in percentage terms is not a satisfying outcome. As the net throughput goes up, so does the volume of gas lost on this count and the

financial impact on the company becomes more hard hitting. In view of above it was imperative for TGTDCCL to learn from the mistakes or omission from the previous programs and to put together a new “system loss reduction Plan (SLRP)” to achieve the much cherished aim of reduction of system loss level to two (2) percent.

A project titled “Gas Transmission and Development Project” financed by ADB contained component “Institutional Development “under which advisory services were included for launching a comprehensive System Loss Reduction Plan (SLRP). The SLRP proposed a new set of measures as well as steps which were included in the previous programs but remained unimplemented. The goal was for achievement of gross system loss level of 2% by fiscal year 2009-10. An investment requirement schedule for different components was also included for examination.

With two previous failures behind, TGTDCCL intends to be sure that the new plan is effective and implementable from technical, management and legal points of view. A paper was presented before – ADB to consider incorporation of SLRP in GSDP as a separate component at least to grant technical assistance, engage consultants to examine this plan and help draw up a concrete plan for implementation with ADB assistance.

1.2.1 Justification /Adequacy

Procurement of Turbine and Rotary Meter equipped with EVC, on-site Meter Calibration Unit, Installation of Meters, Recruitment of Consultancy Services, and Local Training provided under the project would greatly improve gas operation and distribution performance of two sales areas of the Company through reduction of system loss.

1.2.2 Project Description at a Glance: Table- 1.1

1.	Name of the Project	"System Loss Reduction of Titas Gas Transmission and Distribution Company Limited (TGTDCCL)“
2.	Administrative Ministry/Division	Ministry of Power, Energy and Mineral Resources/ Energy and Mineral Resources Division
3.	i. Executing Agency	a) Bangladesh Oil, Gas & Mineral Corporation (Petrobangla)
	ii. Implementing agency	b) Titas Gas Transmission and Distribution Company Limited (TGTDCCL)“
4.	Location of the Project	Area-1 : Narayanganj, Fatullah, Munshiganj. Area-2 : Sonargaon

Project Estimated Cost of the PCR:

5. Estimated Cost (in Lakh taka):	Original	Latest Revised (3rd Rev)
a) Total	Tk. 2256.75	Tk.1666.25
b) Taka	Tk. 857.75	Tk. 297.85
c) Foreign Currency	-	-
d) Project Aid	Tk.1399.00	Tk. 1368.40
e) RPA	-	-

Project Implementation Period of the PCR:

6. Implementation Period	Date of Commencement	Date of Completion
a) Original	01-July, 2006	30 June 2010
b) Latest Revised	01-July, 2006	30 June 2011
c) Actual	01-July, 2006	30 June 2011

1.3 The Need for Impact Evaluation

Considering the importance of the project the authority decided to carry-out the evaluation study. The main purposes of the evaluation of such type of projects are:

- to review whether the set objectives of the project are achieved or are likely to be achieved.
- to assess whether implementation has been in accordance with the project description.
- to review strengths, weaknesses, opportunities and threats (SWOT) of the project.
- what are the future challenges.

Answers to the above questions are very pertinent to learn lessons. The lessons would help the policy makers to make necessary changes in the similar projects to ensure maximum returns from the project.

1.4 What Is System Loss?

System loss has been defined as the amount of gas that is unaccounted for. That is, it is the difference between total amounts of gas supplied – the total amount of gas accounted for. System loss may be due to several factors. These are-

- i. due to inaccuracy of the metering system and equipment
- ii. due to meter tampering and connection without metering/ illegal Connections
- iii. due to leakages in the pipe line of the distribution system and etc.

1.5 Objectives of the Project

The main objective of the project was to improve operational and distribution performance of two marketing areas of the Company through reduction of System Loss or unaccounted for gas. Main target of this project was to reduce the system loss of two isolated non bulk sales areas (Area-1: Narayanganj, Fatullah, Munshiganj & Area-2: Sonargaon) of the Company's operational system to an acceptable limit of 2%) or less gradually by 2010 from around 22%. This section includes understanding of the objectives of the assignment, approach to the services, methodology and detailed expected outputs.

1.5.1 Understanding of the Objectives of the Study

The main objective of this assignment is to assess the installation of metering equipment, mobile calibration and comprehensive System Loss Reduction Plan (SLRP) in reducing system loss to the desired level and also to assess effectiveness of the Revised Time Bound Action Program (RTAP) in analyzing the factors causing system loss and their relative importance.

The specific objectives of the current assignment are to:

- i. assess the actual progress against the target of various components of the project as per revised DPP along with their causes for any gap;
- ii. examine whether the procurement of the packages under the project was done following the PPR 2008/donor's procurement guidelines on the basis of a set of predetermined indicators;
- iii. assess the impact of installation of meters with Electronic Volume Corrector (EVC) meter, and comprehensive System Loss Reduction Plan (SLRP) on instant calibration of industrial meters, as well as reduction in pilferage of gas, and conservation of energy;
- iv. assess the effectiveness of the Revised Time Bound Action Program (RTAP) in analyzing the factors causing system loss and their relative importance and in apportioning the percentages of losses for each factor;
- v. assess impacts of various foundation and specialized training on skill development of the TGTDCCL personnel in conducting gas operation and distribution performance etc.
- vi. scrutinize the main recommendations by experts/consultants relating to improvements of system operation and control of operational losses.
- vii. identify in-built strengths and probable opportunities as well as internal weaknesses and external threats towards improvement of operational and distribution performance
- viii. provide recommendations to reduce system loss to the desired level and indentify the best practices for replication and assess the implementation status in other project areas.

1.5.2 Project Locations

Project Location by Non Bulk Sales Areas of TGTDCCL: Table-1.2

Area No.	Sales Areas of the Project
Area-1:	Narayanganj
	Fatullah
	Munshiganj
Area-2	Sonargaon

1.6 Scope of Services

The consultant has been prepared the study design and work plan considering the following components of the project. Sampling, however, shall be made on the basis of coverage of work and area coverage mentioned below:

Coverage of work	Area Coverage
I. Implementation status of project in the area (Area-1: Narayanganj, Fatullah, Munshiganj & Area-2: Sonargaon upazila).	• 100% of the project areas (4 upazilas).
II. Interviewing direct beneficiaries, trainees and officials of industrial set ups.	• 20% of direct beneficiaries.
III. Consultative meetings/in-depth interviews with key officials/informants of Ministry, Petrobangla,	• 50% of the trainees.
IV. FGD meetings with local elite, local administration, teachers, religious leaders, women's representatives etc.	• 25% of the industrial set ups.
	• 5-10 FGD meetings

1.7 Understanding of the Project Assignment and Preliminary Field Visit

For the purpose of understanding of the project and the assignment, the evaluation team has reviewed the following documents:

- ❖ Technical Proposal prepared and submitted by e.Gen Consultants Ltd. and Creative Consulting Limited (CCL) for the bidding
- ❖ Terms of Reference provided by IMED
- ❖ RDPP
- ❖ Project Completion Reports by TGTDCCL and PCR by IMED

In addition, on January 09, 2014 the evaluation team led by the Team Leader visited one of the project areas in Sonargaon to see the project activities and had preliminary discussions with some beneficiaries at the project areas.

During the field trip, the team members led by the Team Leader were first meeting with the following senior officials of TGTDCCL at Regional Sales Division (RSD) Sonargaon:

The Senior Officials are-

1. Mr. Khandaker Abdus Sabur, DGM
2. Engr. Md. Shahidul Islam, Manager
3. Mr. Masud Ahmed, Asst. Engineer

The team members discussed about the Gas Transmission and Distribution Company, gas pricing, sales, EVC meter, CNG Stations, Import of Metering System and the condition of the installed EVC equipment, their maintenance and calibration facilities with the senior officials of TGTDCCL at RSD Sonargaon. The team visited the following customers with Mr. Masud Ahmed, Asst. Engineer of RSD Sonargaon. Customer's are-

1. Shuvo C.N.G. Refueling Station Limited.
2. Bikrampur Re-Rolling Mills.
3. Sinha Textile Mills

CHAPTER – 2: METHODOLOGY OF THE STUDY

2.1 Approaches to the Study

The methodology for the present study has been used system-wide approach, which is both detailed and participatory. This approach involves wide-ranging and sequenced discussion with project management persons and beneficiaries, to know their views. The study has involved the use of: (i) formal and informal interviews; (ii) semi-structured interviews by means of focus group discussions (FGDs) and (iii) field survey through structured questionnaire. Collections of primary and secondary information, reviewing the available reports and a series of reconnaissance field visits by a team of consultants have also been carried out to the project areas. The reconnaissance field visits has covered substantial part of the project area. During the field visit the consultants have interact with the project beneficiaries and others concerned personnel of the project.

The reconnaissance field visits including the interaction with the project officials and beneficiaries have subsequently be integrated into the conceptual model towards the formulation of the detailed methodology of the present study. While the conceptual model crystallize different ideas into a simple form for carrying out the study, the detailed methodology provide the modes of implementation including survey design, sampling procedures, preparation of questionnaire, training of enumerators, framing of analytical techniques and the output generation.

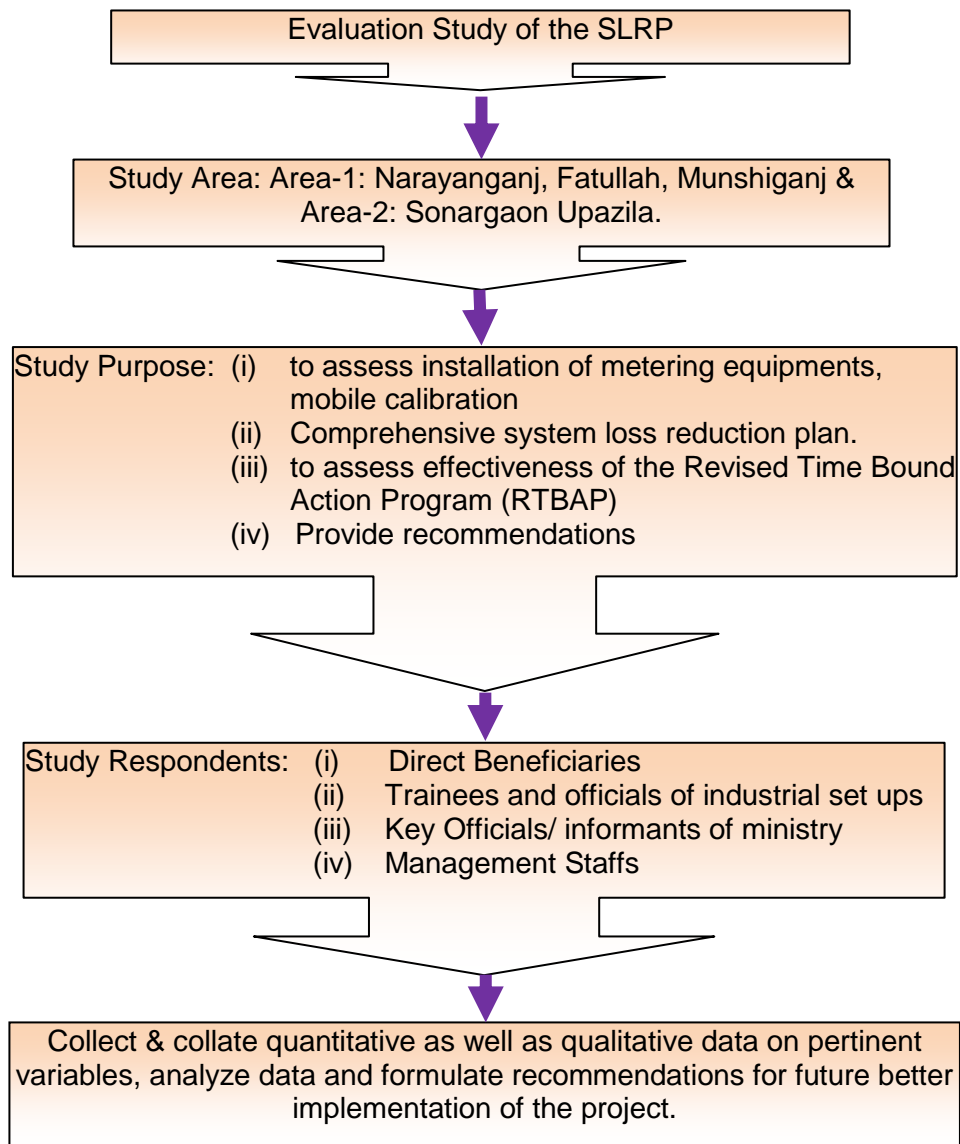
2.2 Sources of Data

Both primary and secondary data were used for this evaluation study. The relevant secondary information on the System Loss Reduction on Titas Gas Transmission and Distribution Company Ltd. of Bangladesh including Revised Development Project Proposal (RDPP) and different reports relevant to the project were obtained from the IMED/ project authority. The secondary data were carefully scanned and were collated with the project situation. For generating the desired primary data, a sample survey was conducted using an appropriate sampling design and a study instrument (questionnaire).

2.3 Study Design

The present study belongs to the category “Before and After method with Data. However, a snap-shot idea of the evaluation study is presented below:

Figure 2.1: Schematic view of the evaluation study



2.3.1 Sample Design

The sample design has been made quantitative analysis technique.

2.3.2 Types of Target Population

The target population to be interviewed under the study has been classified into five categories. They are:

- i. direct beneficiaries
- ii. trainees
- iii. officials of industrial set ups
- iv. key officials/ informants of Ministry and Petrobangla, and
- v. local elite, local administration, teachers, religious leaders, women representatives, etc.

Therefore, sample size needs to be determined for each category of the target population.

2.3.2.1 Quantitative Analysis

For any type of research work representativeness of collected information must have to be ensured so that valid and dependable conclusions can be drawn. The present evaluation study is not an exception. Thus, in order to ensure representativeness of the data and information to be collected, we propose that probabilistic sampling strategy is to be followed. It is delineated below.

The population under the evaluation study universe is constituted to review the project design and management and evaluate the implementation status of major components of the project and identify strengths and weaknesses. The study have also have to assess the impact of the project on direct beneficiaries, trainees and officials of industrial set ups, key officials/ informants of ministry, Petrobangla, Local elite, Local administration, Teachers, Religious leaders, Women's representatives etc. Thus, it is appropriate to determine a representative sample size of direct beneficiary at first. For such purpose we adopt a sound statistical technique.

2.3.3 Determination of Sample Size for Direct Beneficiaries, Domestic Users, Trainees and Officials of Industrial Set Ups

The sample sizes for these three categories of respondents have been determined in such a way that the estimated result of the study does not suffer from small sample bias.

In order to do so, stratified sampling technique has been used. Considering the differential consumption pattern of gas, the direct beneficiaries are divided into following three categories in each of project area:

- i. CNG station Owners/ Operators
- ii. Captive power generation; and
- iii. Industrial users of gas, e.g., re-rolling mills.

In the four project areas, the number of direct beneficiaries in each sub category are not to be the same. As such, in order to avoid small sample bias, a set of 30 samples has been drawn from the smallest sub categories in each project area. Where the size of the population is less than 30 for a sub-category, the entire population of that sub-category has been included to constitute the sample. For other sub categories samples have been drawn proportionately considering the size of the population.

Apart from these direct beneficiaries, there are a large number of domestic users of gas. They obtained authorized gas connections to their households, and pay monthly fixed rents stipulated for one burner or two burner gas cookers. Though these households are not direct beneficiaries of the project, a study of a sample of these domestic users may provide some information regarding system loss e.g. pilferage, unauthorized connections etc. In view of the above, an arbitrary number of 100 households have been selected from the project areas: 70 households from area-1

and 30 from area-2. From Narayanganj, Fatullah, Munshiganj and Sonargaon, respectively, 25, 25, 20 and 30 sample households have been selected.

A statistical formula for the determination of size of the samples in each category was first stated and used but in the steering committee meeting, it was suggested that we drop the formula as the TOR directs what the sample size in each category would be.

An arbitrary number of 100 household would be good enough to provide relevant information. Equal number of trainees and officials of industrial set ups have been selected from each Upazila totally 70 trainees and 100 officials respectively, the same respondents have been randomly selected from each Upazila in order to make the sample representative. Participants of the Focus Group Discussion (FGD) have been selected through purposive sampling technique considering their availability, relevance and awareness of the issues.

2.3.4 Summary of Sample Size for Direct Beneficiaries, Trainees and Officials of Industrial Set Ups: Table-2.1

Project Areas	Project Sales Areas/ Upazilas	Direct Beneficiaries			Trainees	Officials of Industrial Set Ups	Households	
		Category	Actual	Taken			Actual	Taken
Area-1	Narayanganj	CNG	03	03	17	25	240	25
		Captive Power	21	21				
		Industry-RRM	119	65				
		Sub Total	143	89				
	Fatullah	CNG	05	05	17	25	220	25
		Captive Power	78	40				
		Industry-RRM	299	80				
		Sub Total	382	125				
	Munshiganj	CNG	0	0	18	25	72	20
		Captive Power	10	10				
		Industry-RRM	24	24				
		Sub Total	34	34				
Area-2	Sonargaon	CNG	30	30	18	25	146	30
		Captive Power	194	65				
		Industry-RRM	273	75				
		Sub Total	497	170				
Total=			1056	418	70	100	678	100

2.3.5 Summary of Sample Size for Officials/ Informants of Ministry and Petrobangla, and Local Elites, Local Administrations, Teachers, Religious Leaders and Women Representatives: Table-2.2

Project Areas	Project Sales Areas/ Upazilas	KII	FGD
Area-1	Narayanganj	5	10X2=20
	Fatullah	5	10X2=20
	Munshiganj	5	10X2=20
Area-2	Sonargaon	5	10X2=20
Total=		20	8

Quantitative Analysis

Qualitative methods are being increasingly used in social assessments as credible and reliable method of data collection. They provide clear insights in to people’s perceptions and deeper understanding of local contexts, complex coping strategies, major priorities and solutions used by people. Qualitative techniques have been used primarily to collect in depth/ perceptual information on selected indicators related to the study. Of the central methods, the Participatory Rural Appraisal (PRA) would be one of the central methodological approaches for addressing the present assignment.

Thus, we intend to adopt Participatory Assessment for the present study. Among various participatory approaches, the most pertinent one for the present study is “Stakeholders’ Analysis” and Participatory Rural Appraisal (PRA) has been the most appropriate technique.

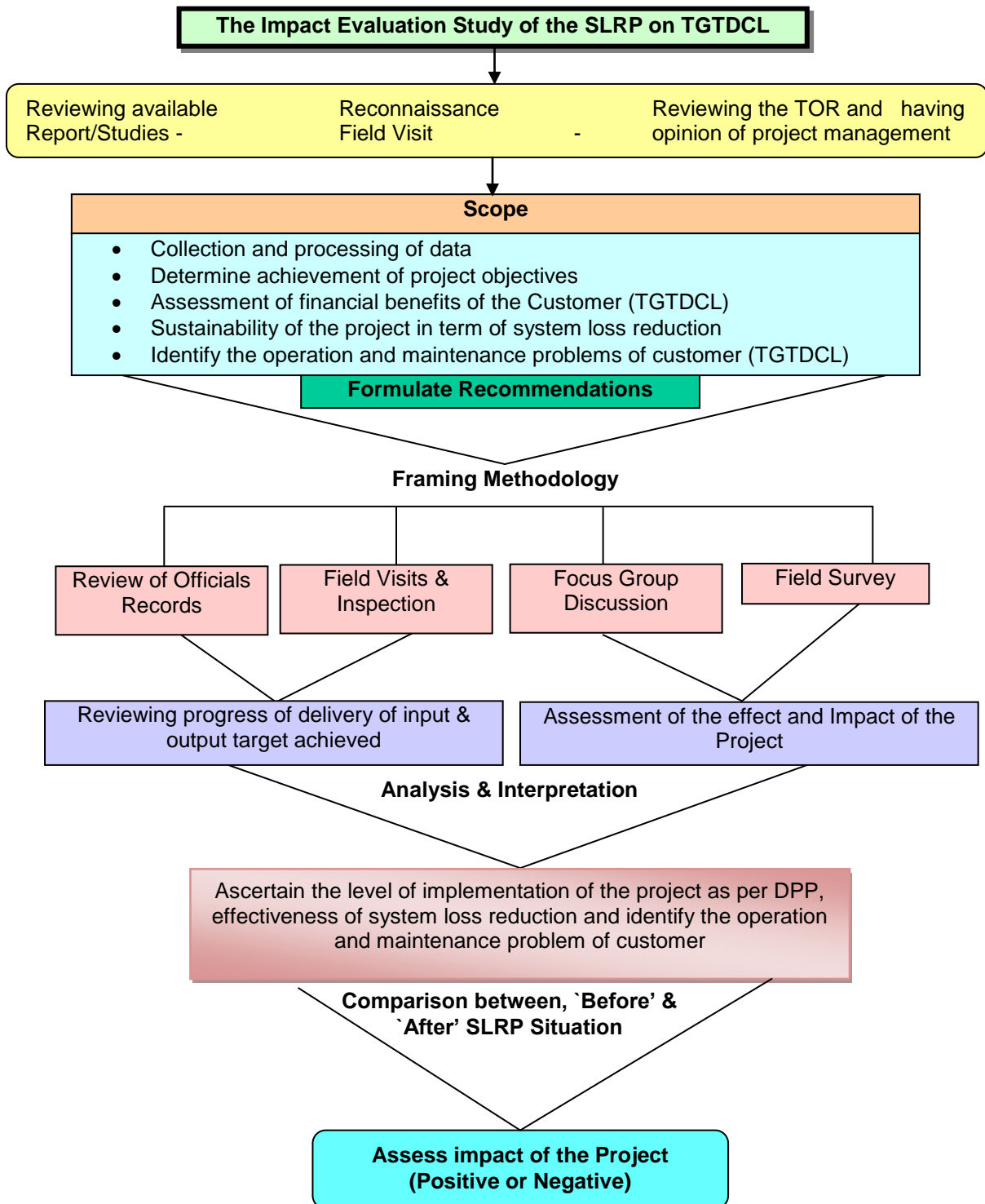
In this analysis the most appropriate tools to be used are suggested as follows:

- a) Focus Group Discussion (FGD)
- b) Key Informant Interviews (KII)
- c) Study of Gas Transmission and Distribution System of the Project Area and Examination of the Metering System and Related Meters.
- d) To examine the procurement process
- e) Impact of the Implemented Projects and the Short Comings.

2.4 The Conceptual Framework

The conceptual framework for the assignment has been developed based on the meticulous reviews of the available literature/documents on the project and based on understanding of the TOR provided by the client. While analyzing the TOR, special thought has put on understanding the objectives, the scope of work, the suggested approach and methodology and the time allocated to undertake the assignment. The conceptual framework thus developed for the assignment is shown in the schematic diagram in **Figure 2.2**, while the salient feature of the methodology followed in implementing the study is presented in the subsequent sections.

Figure 2.2: The Conceptual Model for Impact Evaluation Study for SLRP for TGTDC



2.5 Work Plan

The work plan is primarily aimed at identifying the tasks that has been involved in the proposed evaluation. It is also give an attention to developing a task schedule and an appropriate manning schedule of professional consultants and supporting staff for conducting the impact evaluation.

An understanding of the tasks to be addressed by the evaluation has been facilitated through an analysis of the objectives of the impact evaluation. Such an analysis have lead to an identification of the major areas of activity, which, in turn, has suggest detailed tasks to be undertaken as well as appropriate methodology and measuring instruments.

The firm has tried its best to carry out efficiently the obligations of the services. The entire work has been divided into a number of tasks to be performed by the Study Team. Each task has been broken down to a set of activities. The activities have been arranged in sequential order in a timeframe and have been assigned to the concerned member or group of members of the team. Thus the main activities are arranged in a time bound work plan as shown in **Table 2.3** below and also shown in bar chart format in **Appendix 1**.

Table- 2.3 Detailed Work Plan

Phase	Duration in Days	Major Tasks and Output
Phase A- Inception and Design Phase	0-24 days	<ul style="list-style-type: none"> ➤ Preliminary discussion with IMED/SLR Project Authority and meeting the team member of the study and all sort of correspondence with IMED/ project authority ➤ Mobilization of team with recruitment of required support staff ➤ Establishment of separate cell with all equipments and logistics for this assignment ➤ Organizing meetings of professional personnel with client ➤ Collection of existing available literature and secondary data on e.Gen Consultants Ltd. (including RDPP/PCR/PER and other related papers/reports) ➤ Revision of TOR, data collection instruments (questionnaires), proposed methodology and work program, and discussion with Project Authority ➤ Finalization of methodology and work program in consultation with Project Authority ➤ Training of the field staff on draft study instruments (2 days) ➤ Field testing on study instruments (2 days)

		<ul style="list-style-type: none"> ➤ Finalization of study instruments ➤ In house discussion on inception report and its finalization and Approval from Steering Committee Meeting
Phase B-Field Work/ Data Collection	30- 60 days	<ul style="list-style-type: none"> ➤ Data collection from fields through: administering the instruments (questionnaires, FGD guideline etc. ➤ Field visits by the professional personnel for supervision and monitoring of data collection activities ➤ Checking, editing and entry of the collected data ➤ Conduction the full survey involving pre-test and final survey and analysis of area under review. ➤ To conduct general surveys and updating (marking) of potential study areas in order to obtain up to-date knowledge and understanding of the TGTDC/SLR project concerned ➤ Discussion with IMED for the purpose of study and monitoring of school ➤ Collection of list of respondents of TGTDC/SLR ➤ Collection of data from the respondents
Phase C- Local Level Workshop	45- 60 days	<ul style="list-style-type: none"> ➤ During data collection we have arranged a local level workshop at Narayangonj Club in Narayangonj project area.
Phase D - Data Processing and Analyzing	60-90 days	<ul style="list-style-type: none"> ➤ Design and installation of computer programming and software for data processing ➤ Data Entry and Processing ➤ Analyzing the processed data and evaluation study
Phase E- Reporting	No. of Days	➤ Submission of Inception Report
	24 days	
	105 days	➤ Submission of Draft Report
	120 days	➤ Submission of Draft Final Report
	150 days	➤ Submission of Final Report

2.6 Organization and Staffing Schedule

The outputs of the services under the study have been delivered according to the reporting schedule. The team of experts headed by the Team Leader has performed all the activities in collaboration with each other. The staffing schedule of both professional consultants and support staff have been prepared based on the proposed methodology, work program and the TOR of the study and presented in the **Appendix 2** in this chapter.

Table- 2.4: Specific Responsibilities of the Consultants

No.	Position	Responsibilities by Position
1.	Team Leader - Evaluation Specialist	<ul style="list-style-type: none">• Design the evaluation study and finalize it in consultation with the client❖ Prepare questionnaires, FGD guidelines, observation checklist and project persons questioners etc❖ Finalize study instruments in consultation with the client❖ Train field staffs• Administer and supervise data collection work.❖ Attend Meeting /Discussion at Dhaka & Project Location as per client requirements❖ Prepare dummy table of the reports• Prepare and submit all evaluation reports (Inception, draft, draft final and final reports)• Present evaluation design and reports at different stages of approval.
2.	Electrical Engineer	<ul style="list-style-type: none">• Assist team leader in designing the study and preparing data collection instruments such as Questionnaires, FGD guidelines, observation checklist and project persons questionnaire etc regarding system loss reduction project and other related issues.• Turbine and Rotary Meters Equipment with EVC and electrical related questionnaires.• Visit project locations and collect data according to observation checklist and supervise data collection work of the field staff.• Prepare and submit all evaluation reports (Inception, draft, draft final and final reports)• Assist Team Leader in presenting reports at different stages• Attend Meeting /Discussion at Dhaka & Project Location as per client requirements
3	Statistician	<ul style="list-style-type: none">• Assist the Team Leader to design the study and prepare questionnaire.• Design data analysis plan and develop suitable program for data analysis and analyze all data and prepare tables.• Assist Team Leader in preparing and presenting reports.• Attend Meeting /Discussion at Dhaka & Project Location as per client requirements

2.7 Instruments for Data Collection and Respondents

Direct Beneficiaries: The project facility users and end-users have been asked to fill in a set of pre-designed questionnaire encompassing issues about the system loss reduction, operation, maintenance problems and bottleneck.

2.7.1 Focus Group Discussion (FGD)

Focus Group Discussion is the best participatory way for gathering qualitative data. FGD has been conducted around main study issues. Facilitators have been provided a guide with key issues and indicators to steer the discussion and probe into issues so as to arrive at conclusions. Then, summary statements about the comments have been prepared. The total 8 (eight) FGDs (2 in each project upazila, $4 \times 2 = 8$) shall meet with local elite, administration, teachers, religious leaders, women's representatives etc. The FGD participants have been 10 persons.

2.7.2 Key Informant Interview (KII)

Key Informants Interview: 20 senior level officials of Petrobangla and TGTDCCL have been consulted about the quality, durability of project components and their reliability /performance, project design and cost benefit etc. Management practices and planning of the future project of the system loss reduction of Gas Sector in Bangladesh.

Summary of the data and information collection is presented below:

Table - 2.5: Number and Types of Respondents

Activity	Participants/ Respondents	No of Respondents	Respondents Category
Quantitative Survey			
Direct Interviews with Survey Questionnaire:	Direct Beneficiaries	418	20% of Direct Beneficiaries
	Domestic Users	100	
	Trainees (140X50%)	70	50% of the trainees and
	Officials of Industrial set ups	100	25% of the industrial set ups
FGD	Respondents (2X4)=8X10=80	80	All categories of beneficiaries
KII	Project Management Personnel	20	Senior Officials related to project management and ministry.
Total=		788	

2.8 Variables Covered

The consultant has primarily identified the following variables, which were considered while developing the questionnaire. The variables are as follows:

1. Demographic : Different Class of End-users
2. Social : Industrialist, Business Man, CNG Station owners and Domestic Consumers
3. Project related indicators:

Sl. No.	Objectives	Indicators
1	Assess the actual progress against the target of various components of the project as per revised DPP along with their causes for any gap	<ol style="list-style-type: none"> 1. Number of turbine (3"-12") and rotary (2") meters equipped with EVC procured 2. Number of mobile on-site meter calibration units procured 3. Consultancy services provided in man months 4. Local training imparted in man months 5. Number of meter installed
2	Examine whether the procurement of the packages under the project was done following the PPR 2008/donor's procurement guidelines on the basis of a set of predetermined indicators	<p>Examine whether procurement has followed:</p> <ol style="list-style-type: none"> 1. PPR 2008 guidelines 2. ADB procurement guidelines and 3. Preparation and floating of tender documents 4. Evaluation of tenders: Technical properties and financial proposal 5. Procurement of equipment
3	Assess the impact of installation of meters with EVC, and comprehensive System Loss Reduction Plan (SLRP) on instant calibration of industrial meters, as well as reduction in pilferage of gas, and conservation of energy	<ol style="list-style-type: none"> 1. Degree of accuracy of produced input 2. Percentage of reduction of pilferage of gas 3. Percentage of conservation of energy
4	Assess the effectiveness of the Revised Time Bound Action Program (RTAP) in analyzing the factors causing system loss and their relative importance and in apportioning the percentages of losses for each factor	<ol style="list-style-type: none"> 1. Percentage of system loss in the targeted area
5	Assess impacts of various foundation and specialized training on skill development of the TGTDCCL personnel	<ol style="list-style-type: none"> 1. Number of personnel trained on skill development in conducting gas operation and distribution

Sl. No.	Objectives	Indicators
	in conducting gas operation and distribution performance etc.	2. Percentage of trainees increased skill in conducting gas operation and distribution performance
6	Scrutinized main recommendations by experts/consultants relating to improvements of system operation and control of operational losses	1. Main recommendations scrutinized.
7	Identify in-built strengths and probable opportunities as well as internal weaknesses and external threats towards improvement of operational and distribution performance through SWOT analysis	1. Identified strength, weakness, opportunity and threats to improve operational and distribution performance
8	Provide recommendations to reduce system loss to the desired level and indentify the best practices for replication and assess the implementation status in other project areas	1. Recommendations formulated to reduce system loss 2. Best practices for replication identified 3. Percentage of system loss in other project areas

It is noted that retrospective information on some variables have been collected using the method of 'before' and 'after'.

2.9 Preparation of Study Instruments/Questionnaire

The draft questionnaire has been prepared based on the objectives and scope of work and the needs and indicators for the study as indicated in the TOR, proposed approach and methodologies, and the long experience of the firm in similar assignments. The study questionnaire has been developed to capture necessary indicators specified in the TOR and to fulfill the objectives of the study through further review of the draft questionnaire by the project consultants, discussion with the client, field-testing and moderation etc to cover all the required indicators. The study questionnaire will be pre-tested in the study location and finalized with due care to be able to include appropriate questions for collection of necessary information from different levels and types of respondents to reflect; the indicators relevant to the objectives of the study as well as the consistency with the scope of work.

The pretesting of on questionnaire have been done in order to test of suitability of the study questionnaire and to determine the time and skill needed. Interview for pre-testing the questionnaires have been conducted in several project areas, which meet the set criteria for project target beneficiaries. After analysis of the pre-tested questionnaires, the final questionnaires have been prepared, printed and used for administration of the study.

2.10 Method of Data Collection

Two types of data have been collected from the field:

A. Physical Verification and Inspection:

- Total Number of units in operation condition out of Turbine (3"-12") and Rotary (2") Meters Equipment with EVC (604 Nos),
- The cause of the failure of non-operating meters
- Maintenance facilities and personnel available for repairing and calibrating of the meters.
- Availability of spear parts and supplier support in this regards.
- Examine the condition of Mobile onsite meter calibration units (05 Nos) which are now in operating condition.
- Calibration and accuracy of the mobile onsite meter calibration units.
- Assessment of the additional requirements
- Assessment of additional Meter to be installed for accurate system loss monitoring.
- For installation of group metering/ pre-paid metering for the accurate assessment of the system loss.

B. Interview: Direct personal interview approach has been adopted for collection of primary data. This method is effectively related to the collection of data directly from the beneficiary and end-users. The field enumerators have personally contact the respondents and obtain desired information by explaining the objectives of the study to the respondents. Each enumerators have been provided with an identity card (to hang outside the front pocket of the shirt), a set guideline for code and data collection system and overall administration of the study, a check list to ascertain the target beneficiary and, the designed and pre-tested questionnaire for data collection and administration of the study. The checklist monitors the criteria for selecting the target beneficiary from the sections. The enumerators/investigators reaching the sample sections have move to select the random beneficiary, make self-introduction and describe the purpose of the interview and objectives of the study and benefits of the project and fill up the data sheet and ascertain whether the beneficiary falls under the project target beneficiary. If not, simply by-pass the beneficiary and move to the next beneficiary and so on until he gets a beneficiary that meets the project target beneficiary. When found, he should sit with the beneficiary and start data enumeration as per guideline and the set questionnaire following the techniques, procedures, and instructions of the training and demonstration of the field pre-testing. The enumerators/investigators have record the data only after fully being satisfied that he has been able to make the respondent understand the question, and the respondent is offering any of the probable answers in his own perception. The investigators have made all efforts to have a friendly and open-minded interaction with the respondent instead of asking questions like a school teacher to his students. All questions have to be asked one by one, and data

filled in on the spot and put signature in the space provided and preserve carefully for submission. Questionnaires have always be filled-up in a beneficiary question by question and in no case it should be repeated and be revised at any stage thereafter by anyone. The completed questionnaires have been packed and sealed by upazila and submitted to the supervisors by upazila after completing study of the respective upazila.

2.11 Recruitment, Orientation and Training of Field Staff

2.11.1 Recruitment

e.Gen Consultants Ltd. and it's associate identified 2 field supervisors and the 8 investigators for field data collection. All of the field supervisors and investigators have at least a bachelor's degree or a master's degree in social science or any discipline and have sufficient work experience in field-research and data collection.

The study investigators have been engaged to cover collection of data from the sample beneficiaries and other selected respondents to cover the study works in right locations during the study in the project area. The work of these study investigators have been constantly monitored and supervised by qualified and experienced study supervisors, and also by the specialists of the consultant's team.

2.11.2 Orientation and Training

A 2-day intensive training of the field staff including field demonstration has been organized at the e.Gen office upon approval of study instruments from IMED. The training of the field staff has been designed and imparted so as to make the trainees (field staff) conversant with the procedures of data collection. The training programs have been of two types: (a) basic training and (b) advanced training.

The basic training has included:

- background and objectives of the evaluation study;
- SLRP objectives and components;
- brief on the methodology of the evaluation study;
- drawing of samples;
- establishing rapport with respondents;
- interview techniques;
- clear understanding of the questionnaires;
- group discussion on questionnaires; and
- role play on questionnaires.

The advanced training has been designed for the field supervisors. The training has covered the following areas:

-
- Detailed methodology of the evaluation study;
 - Methodological procedure for conducting focus group discussion;
 - Sampling techniques;
 - Team supervision and management;
 - Role of supervisors;
 - Detailed instructions on the contents of questionnaires;
 - Field editing of interview questionnaires;
 - Record keeping system; and
 - Other related issues.

Emphasis has been given on the field supervisors in order to make them fully able to collect relevant and quantitative data.

The training has included classroom lectures as well as field practice to the trainee participants in actual interview situation. Broadly, the training program has aimed at generating definite skill and enthusiasm among the field staff.

The consultants and other key personnel of e.Gen Consultants Ltd. and its associate has given the training. IMED official has been requested to be present in the training session to provide their necessary guidance.

2.12 Field Operation/Data Collection from the Field

The work of the enumerators have been constantly monitored and supervised by the supervisors. The supervisors have checked all completed questionnaire in the field and re-interviewed some of the respondents to sure about the quality of data collection. It has been done rigorously so as to avoid return visit to any particular site, which has consumed much time. The supervisors have conducted Focus Group Discussions.

The consultants (specialists) including the Team Leader have made random visits to ensure data quality control and also to encourage the beneficiaries` and supervisors. The consultants has also conduct the field visit to discuss with beneficiaries, and project field personnel including other agencies conducted similar works and other GO and Industrial/ Business Organization for co-operation and assistance in the evaluation study.

Each enumerators have collected data from all the selected project areas. The study supervisors have supervised the data collection work in 4 project areas. They have also monitored data checking and field verification of collected data. The filled in questionnaires properly checked and verified by the Field Supervisors.

In addition the collected of beneficiary data, the consultant has also conducted physical verification and technical inspection of the Industry, Re-rolling Mills and CNG Stations improvement works to evaluate the implementation status of major project component and its strengths and weakness.

2.13 Local Level Workshop

Local level workshop was held at the conference hall of Narayanganj Club, Narayanganj, on Thursday, 03rd April 2014. The workshop was presided over by Dr. Khandaker Mustahidur Rahman, the team leader of the project. Mr. Md. Abdul Quyum, Director-1, Evaluation sector IMED was the Chief guest and Mrs. Begum Qamrun Nessa, Director-2, Evaluation sector IMED was the special guest Distinguished members of IMED, Mr. Md. Shamimul Haque, Deputy Director, IMED, Mr. Md. Mahmudul Hasan, Assistant Director, IMED, and Mr. Md. Azgar Ali, Assistant Director, IMED, Ministry of Planning were present. From the team, Mr. A.F.M Nurul Islam, Electrical Engineer of the study, Mr. Md. Rashedul Hasan, and Mr. Fazla Rabbe Bhuiyan, Consultants of the team were also present. The manager and representative of TGTDCCL were present to participate the workshop. The invitees were large gas users, industry owners, local leaders, domestic gas users, captive power generators and CNG owners/operators, but only 40 percent of them turned up in the workshop. At first, it was rather depressing but later as the discussion got lively, it was partially compensated.

The workshop was conducted in two sessions. Inaugural session followed by working session. After the inaugural session the workshop participants were presented with a power point presentation of the project activities, project background, goal of the project, project component, targets and achievements of the project by the Team Leader. He further drew the attention to the Evolution Study Objectives, scope, Technical Approach for Evaluation and present status of field activity. He ended the presentation with explanation of the methodology, study area, study purpose and study respondents. He then invited everyone for an open discussion.

One participant, who is a land-lord in Jollarpar area of Narayanganj, informed that in his house gas was only available between 12.00 and 3 am in the morning. He therefore was compelled to use LP gas and so did his tenants. He complained that he was paying for double burner gas stoves but getting no as at all, Gas was just not available.

One participant stated that in his area Siddirganj, gas was available all the time and at right pressure.

One lady advocate and Notary public residing in Ishdair area was using LP gas despite having gas connection. She complained that 500 new gas connections were being given when there was no gas available in her area. She asked if they were legal. The manager of TGTDCCL answered that he did not know of such connections ! Another participant hastened to say gas connections were given here and there if one paid right kind of money.

Another participant from Baburail area informed the workshop that in his area, gas was only available after dusk with very low pressure. Only water could be boiled for tea but it took a long time. It was not possible to cook rice. He added that risers of 80 houses out of 100 profusely leaked and there were innumerable leakages in the gas distribution line.

Another participant was able to improve gas supply with right pressure after he paid handsomely to the Titas people and gas contractors. He opined that anything was possible if one paid right kind of money.

One other participant, a mill owner, informed that his factory was connected with an EVC meter which went out of order soon after it was installed. Gas consumption bills were prepared on three-month averages and upon negotiation!

The Engineer of TDTDCL admitted that meters would go out of order regularly and even after three days of installation. Consumption bill were prepared on the basis of averages and there was scope for inaccuracy of billing.

In his deliberation as chief guest, Mr. Quiyum observed that the large customers who we were present were not divulging any information! To highlight the need for high morality he gave two examples:

If meter was installed in the customer premises, meter tampering was possible. If on the other hand, meter was installed at Titas premises, one could strike a win-win situation if customers collaborated with Titas people. Meter tampering was possible. If individual possessed high morality with integrity and honesty, something could be done. Decay in moral values was observed everywhere but people could still hope against hope.

The team leader concluded the workshop by thanking all participants for their deliberation and said that whatever information was received would assist in making the report fruitful and informative.

2.14 Quality Control Mechanism

The Team Leader and other team members have been in constant touch with the Field Supervisors and field enumerators. All members of the consultant team have undertaken the monitoring of field study activities at randomly selected places to ensure the quality. The project team members have undertaken field visits in selected areas at randomly to verify and confirmed the study findings with the actual situation. In addition, quality of data collection of the investigators has been monitored over mobile communication to the team as well as the target beneficiaries. To ease the data collection activities, e.Gen Consultants and Creative Consulting Ltd. has arranged necessary letter from e.Gen Consultants Ltd. and TGTDC/SLRP so that the field investigators could easily collect the required information from the field.

2.15 Data Management, Processing and Analysis

Data Management: Data management, processing and analysis include registration of the questionnaires, code construction, coding, data verification and quality control, data punching, data processing and finally the analysis to facilitate the required output generation. As soon as the filled in questionnaires has been received from the field, the questionnaires has been recorded in a registration book which note identification numbers for the stakeholder's status. The registration of questionnaires facilitated storing and handling during the data process stage.

Computer aided data process and analysis technique has been employed for which a systematic approach is needed, where each and every activity has to be properly identified.

Data Origination: The filled-in questionnaires have been considered as the source of raw data and for effective and accurate analysis and quality output generation. The following activities have been undertaken on the collected data.

Editing and Coding of Questionnaires: During data collection from the respondents, some errors may creep in various forms such as inaccuracy, incompleteness, inconsistencies etc. Each questionnaire, has therefore, be edited and coded before entry into the computer. Coding of information will initially be done by coders with guidance of the Experts and then verified by coding verifiers provided by the firm as extra manpower. Editing of the questionnaire have been undertaken in order to ensure that the questionnaires has been accurately and completely out by the enumerators and that were consistent with the responses.

The consultants have mainly relied on manual verification of entered data with the questionnaires. Devising suitable in-built computer programs have further strengthened this.

Data Processing: The data process has involved two important steps. The first step has been categories and the second step to allocated individual answers to them. The set of frames covered all the information has been abstracted from the questionnaires. The purpose of coding has been classified the answers to a question into meaningful categories, so as to bring their essential pattern. Another step of data processing has been data entry/ punch into computer in the software designed for the purpose and obtained output according to the requirement by running the program by the computer programmer to be assigned by the consultant.

Data Input to Computer: Data input to computer has included (a) developing appropriate computer program and (b) data entry operation. Keeping the objectives of the survey in view, the consultants have used the most suitable program (Excel, and FoxPro) as required. The proposed Specialist in Data Processing has finalized a well-organized data entry operation work plan. The entry work has run simultaneously in different computers under the direct supervision of Team Leader.

2.16 Analysis Profile and Preparation of Report

All the necessary analysis have been done using SPSS/PC and FoxPro. In line with the requirements of the TOR, the Team Leader and other consultants of the survey have designed dummy tables, which has been used by the Specialist in Data Analyst for analysis of data.

The main focus of the analysis is system loss reduction related information to assess achievement and challenges. For the analysis of the study, descriptive statistical tools

such as frequency distribution, mean has been used. Method of cross classification, correlation and regression has also been used.

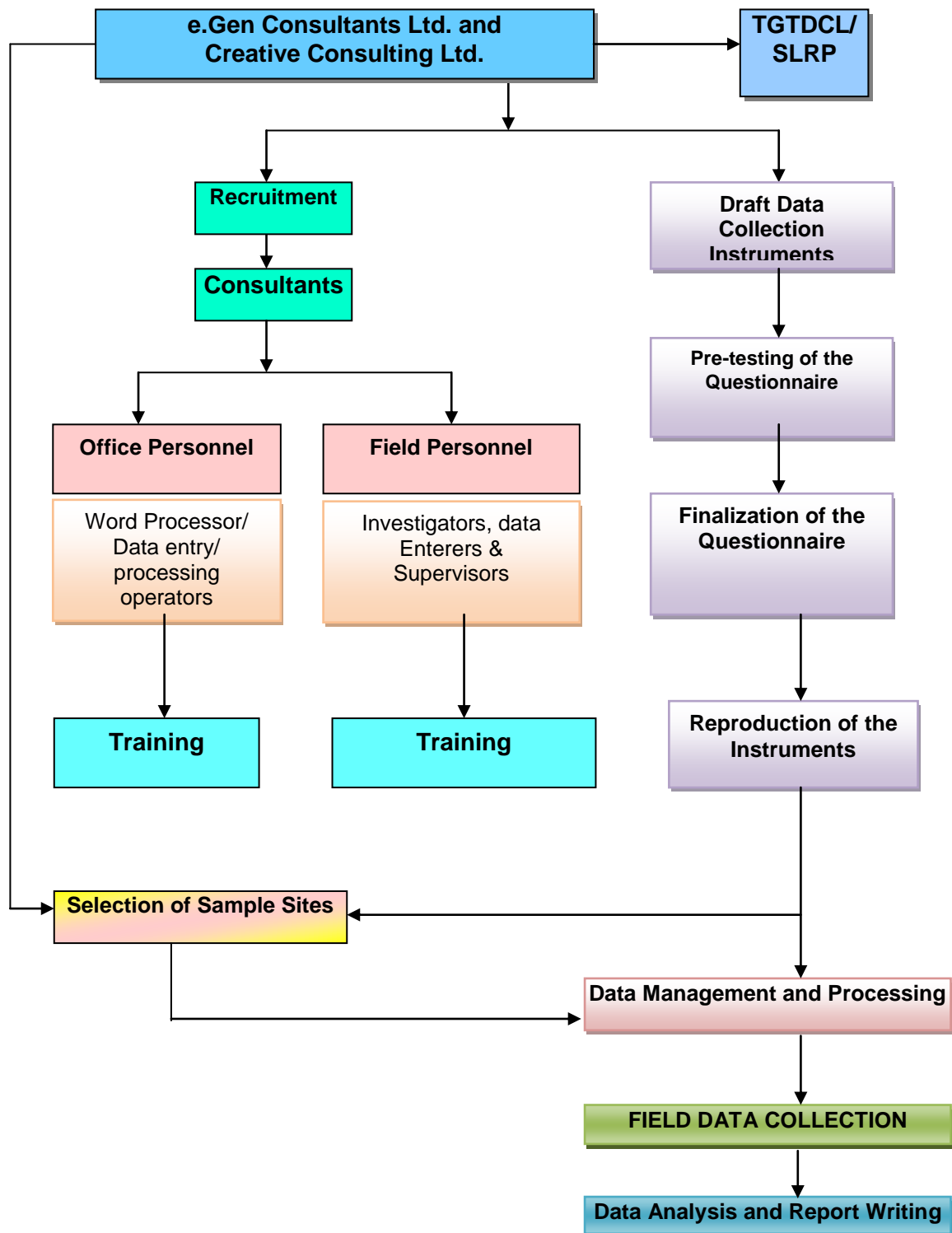
2.17 Analytic Techniques

For a sound and meaningful analysis of collected information several statistical & other tools have been adopted. These are highlighted below:

- a. Descriptive summary statistics**
- b. Graphical representation (few graphs have been given) Inferential analysis**
 - Impact in improving metering system for SLR
 - Impact in installing additional facilities for repairing and calibration of flow meters.
 - Assess status of project implementation
 - Success and bottlenecks of the project implementation.
- c. Economic analysis**
 - Profit due to System Loss Reduction.
 - Increase Customer Satisfaction.

Flow chart for assessment study organization is presented in Figure 2.3

Figure 2-3: Flow Chart for Evaluation Study Management



CHAPTER – 3: FINDINGS OF THE STUDY

3.1 Impact of the System Loss Reduction Works on Major Expected Outputs

The impact of the system loss reduction works on the major expected output—especially with respect to impact in improving metering system for SLR, impact in improving of maintenance, impact in installing additional facilities for repairing and calibration of flow meters, assess status of project implementation, success and bottlenecks of the project implementation, increased profit due to system loss reduction and increased customer satisfaction of users of the gas lines in the project areas were studied and evaluated by the collection of information from the project beneficiaries and from the Focus Group Discussion (FGD) in four project areas. The evaluated findings are reported below:

3.2 Findings of the Survey from Project Beneficiaries

The impact of the system loss reduction works under the four selected areas of TGTDCCL was evaluated by the responses of the project beneficiaries (Direct Beneficiaries, trainees and official of industrial set ups) in the project areas through the pre-tested questionnaire (**Annex-1**). The survey work was conducted in four areas of TGTDCCL. About 567 respondents were interviewed; among which 377 respondents were from direct beneficiaries, 80 respondents were from 8 FGD and 10 were from project management personnel, where project activities had been implemented and 100 respondents were from domestic users, where project activities had not been implemented. By the pre-tested questionnaire interview, the responses were collected about the impact of the system loss reduction works of the project areas of TGTDCCL of Bangladesh and significant responses were found. The responses found from the beneficiaries and households respondents have been interpreted and discussed under the following sub-headings:

3.3 Number of Sample Size by Upazila of the Study

About 377 respondents from the selected project areas expressed their opinion regarding using gas in the project areas of TGTDCCL for their industries. Responses of 100 domestic users of gas were also collected although they were not the direct beneficiaries of the project (Table-3.1).

Table 3.1: Number of sample size by District

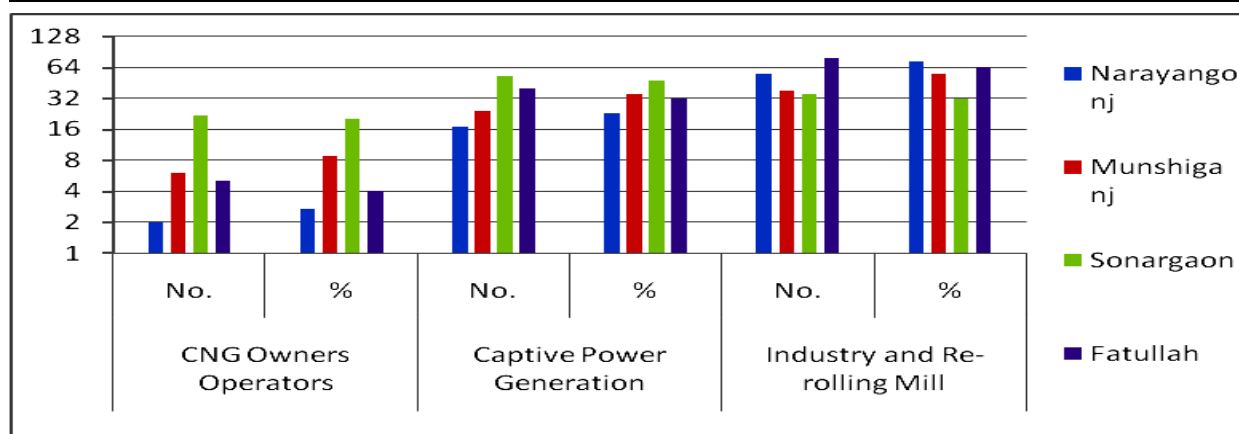
Upazila	Direct Beneficiary		KII		Trainees		Household		FGD	
	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual
Fatullah	125	125	5	2	17	0	25	24	2	2
Sonargaon	170	110	5	3	18	0	30	29	2	2
Narayangonj	89	74	5	3	17	0	25	24	2	2
Munshiganj	34	68	5	2	18	0	20	23	2	2
Total	418	377	20	10	70	0	100	100	8	8

3.4 Category of Beneficiaries by Upazila

Table - 3.2 shows the sample categories of beneficiary by Upazila. From Fatullah 125 sample beneficiaries are drawn, followed by 110 from Sonargaon, 68 from Munshiganj and 74 from Narayanganj. Of the total, 208 are industry and Re-rolling mills, 134 are Captive power generators and 35 are CNG owner operators.

Table 3.2: Category of beneficiaries by Upazila

Upazila	Category						Total No.
	CNG Owners Operators		Captive Power Generation		Industry and Re-rolling Mill		
	No.	%	No.	%	No.	%	
Narayanganj	2	2.7	17	23.0	55	74.3	74
Munshiganj	6	8.8	24	35.3	38	55.9	68
Sonargaon	22	20.0	53	48.2	35	31.8	110
Fatullah	5	4.0	40	32.0	80	64.0	125
Total	35	9.3	134	35.5	208	55.2	377



3.5 Percent Distribution of the Respondent's Designation by Upazila

Table 3.3 shows the distribution of respondent's designation by Upazila. Of 377 beneficiaries, 40.5% are managers, 14.2% are engineers, 11.5% are AGM/DGM and only 8.6% are owners. It appears that the respondents were all highly qualified to attend the industries.

Table 3.3: Percent distribution of the respondent's designation by Upazila

	Designation of respondents								Total
	Engineer	AGM/DGM	Owner	Manager	Admin officer	Accountant	Supervisor	Foreman	
Narayanganj	1.4	15.5	18.3	39.4	4.2	4.2	2.8	14.1	74
Munshiganj	17.9	7.5	9.0	52.2	3.0	3.0	1.5	6.0	68
Sonargaon	22.7	15.5		36.4				25.5	110
Fatullah	12.0	8.0	10.4	38.4	.8	10.4	4.8	15.2	125
Total	14.2	11.5	8.6	40.5	1.6	4.8	2.4	16.3	377

3.6 Percentage Distribution of the Respondent's Education by Upazila

Table 3.4 shows the percentage distribution educational qualification of the respondents by Upazila. One will notice that of the sample respondents, 23.9% own engineering degree, 17.8% are master degree holders and 23.6% are B.A. degree holders. Of the rest 16.4%, 9.0% and 9.3% have qualifications up to H.S.C, S.S.C and below S.S.C, respectively. This shows that about 65.4% are highly educated.

Table 3.4: Percentage distribution of the respondent's education by Upazila

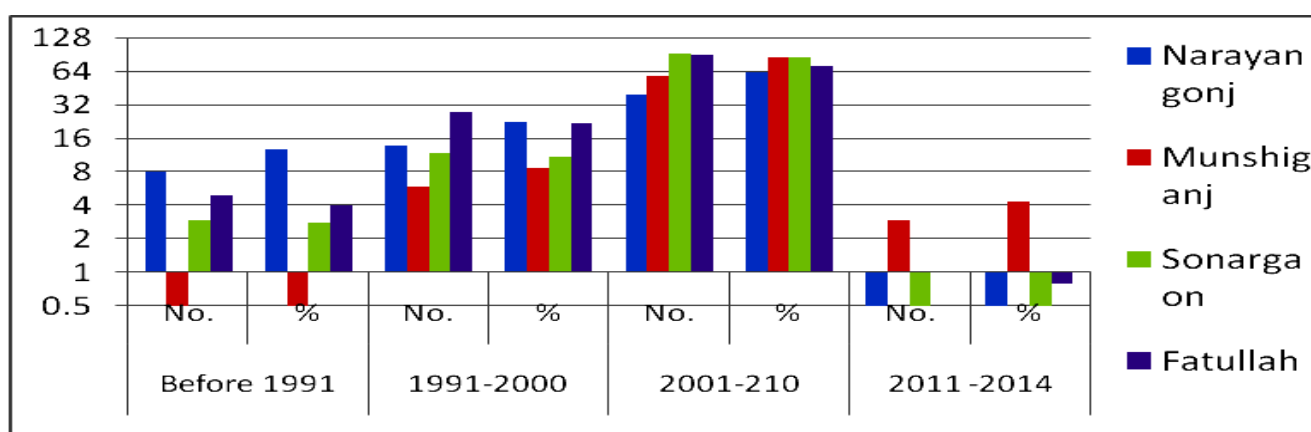
Upazila	Education						Total No.
	Engineering	Masters	BA	HSC	SSC	Secondary	
Narayanganj	10.8	25.7	23.0	17.6	14.9	8.1	74
Munshiganj	32.4	14.7	13.2	17.6	16.2	5.9	68
Sonargaon	41.8	7.3	19.1	17.3	2.7	11.8	110
Fatullah	11.2	24.0	33.6	14.4	7.2	9.6	125
Total	23.9 (90)	17.8 (67)	23.6 (89)	16.4 (62)	9.0 (34)	9.3 (35)	377

3.7 Distribution of the Respondent's Years of Gas Line Connection by Upazila

Table 3.5 shows the distribution of respondent's years of gas connection by Upazila. Table reveals that 284 out of 377 sample beneficiaries took gas connection during 2001-2010 (78%). During 1991-2000, about 60 beneficiaries (16.5%) took gas connection while only 16 beneficiaries (4.7%) took gas connection before 1991.

Table 3.5: Distribution of the respondent's years of GAS line connection by Upazila

Upazila	Year								Total No.
	Before 1991		1991-2000		2001-210		2011 -2014		
	No.	%	No.	%	No.	%	No.	%	
Narayanganj	8	12.9	14	22.6	40	64.5	0	0	62
Munshiganj	0	0.0	6	8.8	59	86.8	3	4.4	68
Sonargaon	3	2.8	12	11.0	94	86.2	0	0.0	109
Fatullah	5	4.0	28	22.4	91	72.8	1	0.8	125
Total	16	4.4	60	16.5	284	78.0	4	1.1	364



3.8 Respondent's Expenditure for Gas Line Connection by Upazila

Table 3.6 shows the distribution of expenditure incurred for taking gas line connection by Upazila. However about 214 out of 377 beneficiaries responded to this question. It will be seen from the table that highest average expenditure is incurred by beneficiaries of Sonargaon Upazila (Tk. 18,14,351) followed by beneficiaries of Narayanganj (Tk. 13,81,149), Munshiganj (Tk. 13,17,097) and Fatullah (Tk. 6,88,063). The overall average was found to be Tk. 10, 55, 323. Of the total of 214 beneficiaries, 59 (27.6%) required expenditure less than Tk. 2,00,000, 67 beneficiaries (31.3%) incurred expenditure between Tk. 2,00,000 and Tk. 4,00,000, 26 beneficiaries required expenditure between Tk. 4,00,000 and Tk. 6,00,000 and 62 beneficiaries (29.9% required expenditure more than Tk. 6,00,000.

Table 3.6: Respondent's expenditure for GAS line connection by Upazila

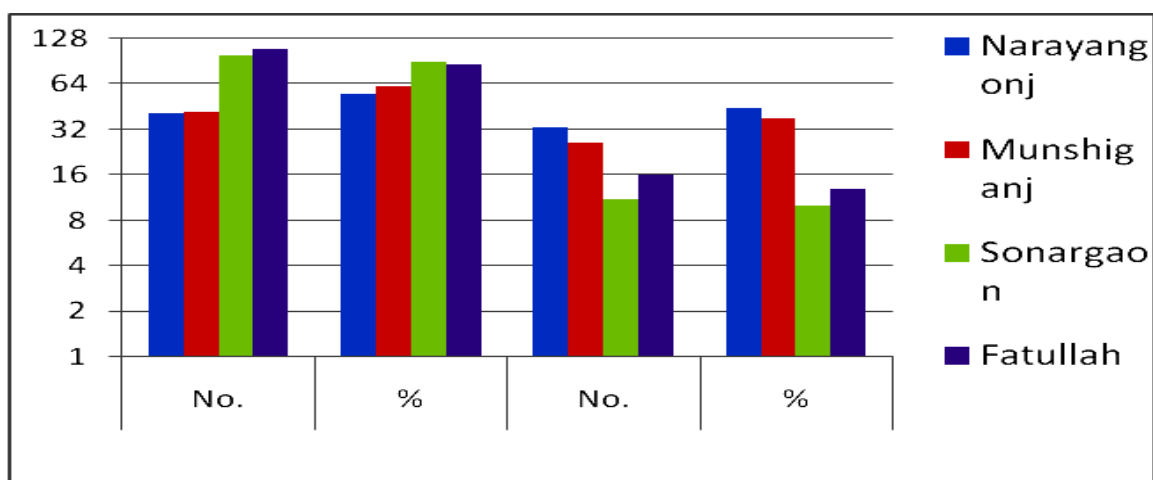
Upazila									Total No.	Average
	<200000		200000-400000		400001-600000		600000>			
	No	%	No	%	No	%	No	%		
Narayanganj	20	51.3	2	5.1	4	10.3	13	33.3	39	13,81,149
Munshiganj	12	30.8	6	15.4	2	5.1	19	48.7	39	13,17,097
Sonargaon	9	37.5	3	12.5	3	12.5	9	37.5	24	18,14,351
Fatullah	18	16.1	56	50.0	17	15.2	21	18.8	112	6,88,083
Total	59	27.6	67	31.3	26	12.1	62	29.0	214	10,55,323

3.9 Respondent's Regular Use of Gas by Upazila

Table 3.7 shows the distribution of regular use by Upazila. This reveals that 291 (77.2%) of beneficiaries use gas regularly and about 86 (22.8%) opined that gas was regularly used by the beneficiaries.

Table 3.7: Respondent's regular use of GAS by Upazila

Upazila	Yes		No		Total
	No.	%	No.	%	N
Narayanganj	41	55.4	33	44.6	74
Munshiganj	42	61.8	26	38.2	68
Sonargaon	99	90	11	10	110
Fatullah	109	87.2	16	12.8	125
Total	291	77.2	86	22.8	377



3.10 Respondent's Use of Gas for Different Types of Works by Upazila

Table 3.8 shows the distribution of sample beneficiary's use of gas for different types of works by Upazila. One will notice from the table that of the 375 respondents, 145 (38.7%) beneficiaries use gas for operating various types of machinery, 115 (30.7%) use gas for production of electricity (captive power generator), 122 (32.5%) beneficiaries use gas for boiler/steel mills, 12 beneficiaries (3.2) use gas for the purpose of producing food/biscuits and the rest 11 beneficiaries (2.93%) use gas for stone mills and lime factory.

Table 3.8: Respondent's use of GAS for different types of works by Upazila

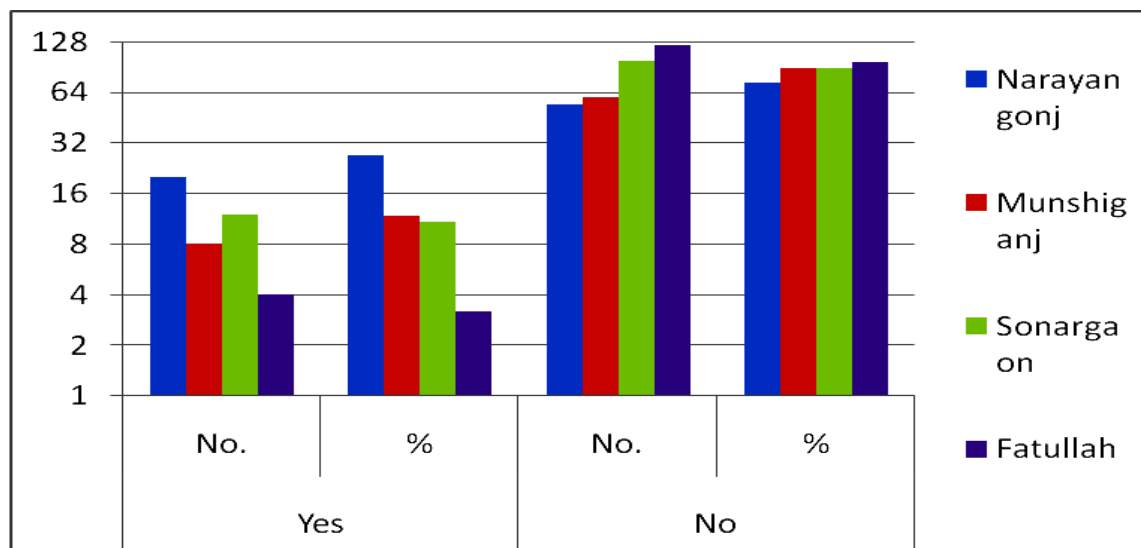
Upazila	Type of work										Total
	Boiler/steel mill		Stone mill/ Lime factory		To make the food/biscuits		Electricity production		Machinery work		
	No.	%	No.	%	No.	%	No.	%	No.	%	
Narayanganj	23	31.5	11	15.06	4	5.5	22	30.1	26	35.6	73
Munshiganj	18	26.5	0	0.0	8	11.8	26	38.2	27	39.7	68
Sonargaon	31	28.4	0	0.0	0	0.0	34	31.2	48	44.0	109
Fatullah	50	40.0	0	0.0	0	0.0	33	26.4	44	35.2	125
Total	122	32.5	11	2.93	12	3.2	115	30.7	145	38.7	375

3.11 Distribution of Respondents Knowledge about Repair and Maintenance of Gas Line in Area by Upazila

Table 3.9 shows the distribution of respondent's knowledge about repair and maintenance of gas transmission line by Upazila. Table reveals that of the 377 respondents, 333 beneficiaries (88.3%) did not have any knowledge about repair and maintenance of gas line. Only 44 beneficiaries responded to this question.

Table 3.9: Distribution of respondents Knowledge about repair and maintenance of GAS line in area by Upazila

Upazila	Yes		No		Total N
	No.	%	No.	%	
Narayangonj	20	27.0	54	73.0	74
Munshiganj	8	11.8	60	88.2	68
Sonargaon	12	10.9	98	89.1	110
Fatullah	4	3.2	121	96.8	125
Total	44	11.7	333	88.3	377



3.12 Respondent's Type of Repair of Gas Line in Area by Upazila

Table 3.10 shows the distribution of 40 out of 44 sample beneficiaries who responded by Upazila. 14 (35.0%) beneficiaries know about new gas line connection, 15 (37.5%) beneficiaries know about monitoring and 10 (25.0%) beneficiaries know about replacing the old by new gas connection.

Table 3.10: Respondent's type of repair of GAS line in area by Upazila

Upazila	Type of repair						Total No.
	Monitoring		Replacing		To give the new connection		
	No.	%	No.	%	No.	%	
Narayanganj	7	36.8	4	21.1	8	42.1	19
Munshiganj	5	83.3	1	16.7	0	0.0	6
Sonargaon	3	27.3	2	18.2	6	54.5	11
Fatullah	0	0.0	3	75.0	1	25.0	4
Total	15	37.5	10	25.0	14	35.0	40

3.13 Respondent's Number of Hour's Use of Gas by Upazila

Table 3.11 shows the distribution of respondent's hours of use of gas by Upazila. Of the total respondents of 358 beneficiaries, 138 (38.5%) beneficiaries use gas for 19-24 hours, 44 (12.3%) beneficiaries use gas for 13-18 hours, 102 (28.5%) beneficiaries use gas for 7-12 hours and 74 (20.7%) respondents use gas for 1-6 hours.

Table 3.11: Respondent's number of hour's use of GAS by Upazila

Upazila	Hour's								Total No.
	1-6 hours		7-12 hours		13-18 hours		19-24 hours		
	No.	%	No.	%	No.	%	No.	%	
Narayangonj	15	20.5	31	42.5	8	11.0	19	26.0	73
Munshiganj	29	82.9	3	8.6	2	5.7	1	2.9	35
Sonargaon	5	3.9	7	5.5	18	14.1	98	76.6	128
Fatullah	34	28.1	53	43.8	19	15.7	15	12.4	121
Total =	83	23.2	94	26.3	47	13.2	133	37.3	357

Table: 3.11 (a), Narayangonj

Categories of Respondents	Hour's								Total No.
	1-6 hours		7-12 hours		13-18 hours		19-24 hours		
	No.	%	No.	%	No.	%	No.	%	
CNG Station							2	100	2
Captive Power Generation	6	35.3	8	47.1			3	17.6	17
Industry	9	16.7	23	42.6	8	14.8	14	25.9	54
Total	15	20.5	31	42.5	8	11.0	19	26.0	73

Table: 3.11 (b), Munshiganj

Categories of Respondents	Hour's								Total No.
	1-6 hours		7-12 hours		13-18 hours		19-24 hours		
	No.	%	No.	%	No.	%	No.	%	
CNG Station									0
Captive Power Generation	8	80.0	2	20.0					10
Industry	21	84.0	1	4.0	2	8.0	1	4.0	25
Total	29	82.9	3	8.6	2	5.7	1	2.9	35

Table: 3.11 (c), Sonargaon

Categories of Respondents	Hour's								Total No.
	1-6 hours		7-12 hours		13-18 hours		19-24 hours		
	No.	%	No.	%	No.	%	No.	%	
CNG Station		0.0		0.0	5	20.0	20	80.0	25
Captive Power Generation	5	8.6	3	5.2	8	13.8	42	72.4	58
Industry	0	0.0	4	8.9	5	11.1	36	80.0	45
Total	5	3.9	7	5.5	18	14.1	98	76.6	128

Table: 3.11 (d), Fatullah

Categories of Respondents	Hour's								Total No.
	1-6 hours		7-12 hours		13-18 hours		19-24 hours		
	No.	%	No.	%	No.	%	No.	%	
CNG Station		0	2	40.0	2	40.0	1	20.0	5
Captive Power Generation	10	26.3	10	26.3	9	23.7	9	23.7	38
Industry	24	30.8	41	52.6	8	10.3	5	6.4	78
Total	34	28.1	53	43.8	19	15.7	15	12.4	121

3.14 Opinion of the Respondent's Quality of Gas Line by Upazila

Table 3.12 provides the distribution of beneficiary's opinions regarding the appropriate quality of gas line connection by Upazila. About 50.1% thinks that the quality of gas line connection is appropriate while 49.9 % beneficiaries opined in the negative. There is almost a 50-50 divide among the beneficiaries. However it appears from the table, about 94.5 present beneficiaries from Sonargaon consider the quality of gas connection appropriate, while about 98.4 present beneficiaries from Fatullah consider the quality of gas connection inappropriate. For Sonargaon, gas connections are from main line which are connected to EPZ and power station and therefore gas pressure is quite high. In Fatullah however, gas pipe lines have leakages and gas pressure is low (less than 0.3 psi).

Table 3.12: Opinion of the respondent's quality of GAS line by Upazila

Upazila	Yes		No		Total
	No.	%	No.	%	N
Narayanganj	48	64.9	26	35.1	74
Munshiganj	35	51.5	33	48.5	68
Sonargaon	104	94.5	6	5.5	110
Fatullah	2	1.6	123	98.4	125
Total	189	50.1	188	49.9	377

3.15 Distribution of Opinions of Respondent's regarding Types of Benefits after Gas Connection

Table 3.13 shows the distribution of opinions of respondents regarding types of benefits after they have received gas connection. Respondents opined this.

Table 3.13. Distribution of opinions of respondent's regarding types of benefits after gas connection

Type	Responses	
	N	Percent
1. Timely production is now possible,	86	22.8
2. Use of iron is possible	10	2.7
3. Business activities increased	4	1.1
4. Employment has increased	49	13.0
5. Cost of production decreased	115	30.5
6. It is now possible to build factories.	173	45.9
Multiple responses	437	116.0

3.16 Distribution of Respondent's Opinions Regarding Types of Difficulties Faced Before Gas Connection

Table 3.14 shows the distribution of respondents opinions regarding types of difficulties faced before gas connection. The table records the following difficulties before the gas connection was made:

Table 3.14. Distribution of respondent's opinions regarding types of difficulties faced before gas connection

Type	Responses	
	N	Percent
1. Production suffered due to lack of fuel	22	5.9
2. Use of boiler was not possible	3	0.8
3. Building of factories was not possible	17	4.5
4. Cost of production per unit was higher	170	45.1
5. Barriers to increase business and	37	9.8
6. Task of employment generation	3	0.8
7. Others	136	36.1
Multiple responses	388	103

3.17 Opinion of the Respondent's Whether Gas Supply Improved After Repair and Maintenance of Gas Line by Upazila

Table 3.15 gives the distribution of the opinions of the respondents whether gas supply is improved after repair and maintenance of gas line by Upazila. The table reveals that about 68.2% of the respondents opined that there was no improvement of gas supply due to repair and maintenance (if any). However, only about 31.8%

respondents opined that because of repair and maintenance of gas line, gas supply improved. It was revealed that Titas Gas carried out repair and maintenance work without making any effort to increase the gas pressure in the area. This happened in Fatullah where repair and maintenance work was carried out without increasing the capacity of gas supply and as a result, gas pressure was getting lower.

Table 3.15: Opinion of the respondent's whether gas supply improved after repair and maintenance of gas line by Upazila

Upazila					Total
	Yes		No		
	No.	%	No.	%	n
Narayangonj	38	52.1	35	47.9	73
Munshiganj	10	37.0	17	63.0	27
Sonargaon	39	73.6	14	26.4	53
Fatullah	0	0.0	121	100.0	121
Total	87	31.8	187	68.2	274

3.18 Availability of Gas All the Time by Upazila

Table 3.16 shows the distribution of opinions of respondents regarding availability of the gas all the time by Upazila. Of the total of 377 beneficiaries, 50.7% opined that gas use available all the time while about 49.3% of the respondent opined that it was not. There is almost a 50-50 divide regarding this question among the sample respondents. However this would be little misleading as one will notice that while beneficiaries in Sonargaon were fortunate to get gas supply all the time, beneficiaries in Fatullah were deprived of gas supply most of the time during the day. In Fatullah, without making any effort to increase the capacity of gas supply, new connection were given and as a result, gas pressure in the pipe line was reduced, Furthermore, no effort was made to mend the leakages in lines.

Table 3.16: Availability of gas all the time by Upazila

Upazila					Total
	Yes		No.		
	No.	%	No.	%	n
Narayangonj	53	71.6	21	28.4	74
Munshiganj	35	51.5	33	48.5	68
Sonargaon	100	90.9	10	9.1	110
Fatullah	3	2.4	122	97.6	125
Total	191	50.7	186	49.3	377

3.19 Respondent's Views Whether Repair and Maintenance Has Increased the Use of Gas Line by Upazila

Table 3.17 shows the distribution of opinions of the respondents whether gas use increased after repair and maintenance of gas line by Upazila. Of the total respondents of 44, 63.6% of the respondents answered in the affirmative while 36.4% of the respondents answered in the negative.

Table 3.17: Respondent's views whether repair and maintenance has increased the use of GAS line by Upazila

Upazila	Yes		No.		Total n
	No.	%	No.	%	
	Narayangonj	12	60.0	8	40.0
Munshiganj	7	87.5	1	12.5	8
Sonargaon	8	66.7	4	33.3	12
Fatullah	1	25.0	3	75.0	4
Total	28	63.6	16	36.4	44

3.20 Whether Gas Line Is Repaired From Time To Time by Upazila

In table 3.18, the distribution of the opinions if gas line is repaired from time to time by Upazila. It is shown that about 23.4% of the total respondents of 377 opined in the affirmative and about 73.7% of the respondents opined in the negative

Table 3.18: whether gas line is repaired from time to time by Upazila

Upazila	Yes		No.		Total n
	No.	%	No.	%	
	Narayangonj	24	32.4	50	67.6
Munshiganj	12	17.6	56	82.4	68
Sonargaon	62	56.4	48	43.6	110
Fatullah	1	0.8	124	99.2	125
Total	99	26.3	278	73.7	377

3.21 Respondent's Views Regarding Problem Faced before the Repair of Gas Line by Upazila

Table 3.19 shows the distribution of respondents opinion regarding problem faced by them before the repair of gas line by Upazila of the total respondents, 63.6% answered that they faced problem while 36.4 of the respondents opined in the negative.

Table 3.19: Opinion of the respondent's regarding problem faced before the repair of gas line by Upazila

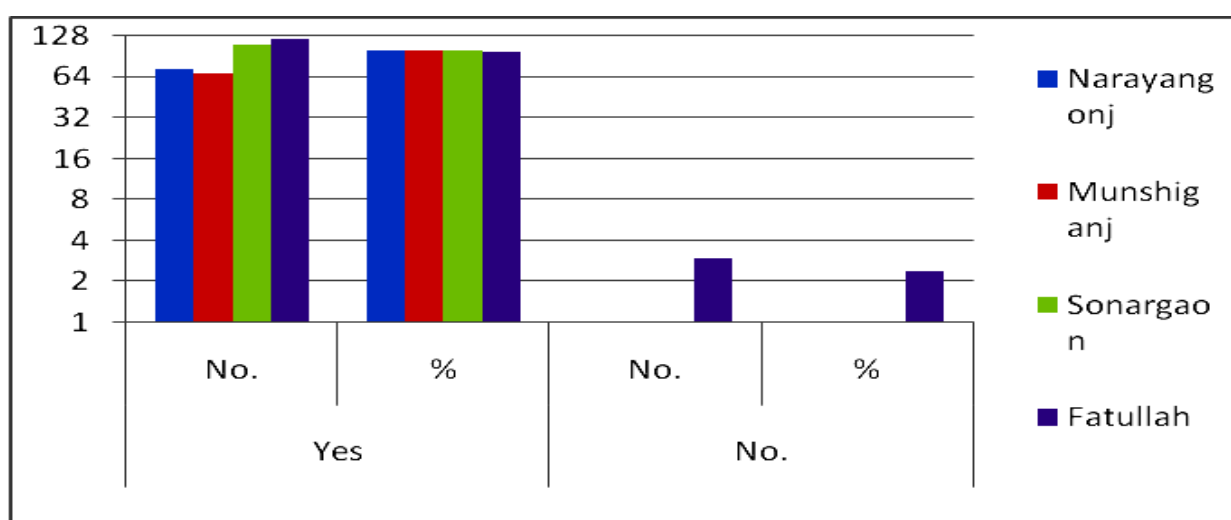
Upazila					Total n
	Yes		No.		
	No.	%	No.	%	
Narayangonj	12	60.0	8	40.0	20
Munshiganj	7	87.5	1	12.5	8
Sonargaon	8	66.7	4	33.3	12
Fatullah	1	25.0	3	75.0	4
Total	28	63.6	16	36.4	44

3.22 Distribution of Gas Line Connection With or Without Meter by Upazila

Table 3.20 shows the distribution of gas line connection with or without meter by Upazila. Of the total respondents of 377, 99.2% affirmed gas connection with meters.

Table 3.20: Whether GAS line connection is with or without meter by Upazila

Upazila					Total n
	Yes		No.		
	No.	%	No.	%	
Narayangonj	74	100.0	0	0.0	74
Munshiganj	68	100.0	0	0.0	68
Sonargaon	110	100.0	0	0.0	110
Fatullah	122	97.6	3	2.4	125
Total	374	99.2	3	0.8	377

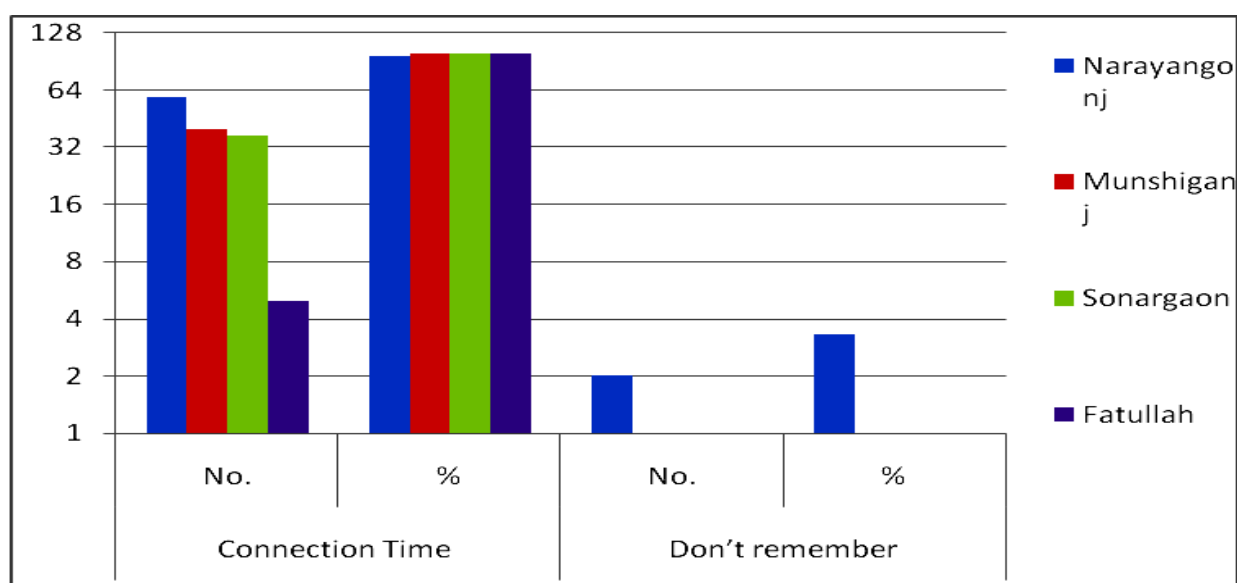


3.23 Simultaneous Meter Connection With Gas Line by Upazila

Table 3.21 shows the distribution of gas line with meter connection by Upazila. Of the total respondents of 143 (98.6%) answered gas connection with meters and only 1.4% answered in the negative.

Table 3.21: Simultaneous Meter connection with gas line by Upazila

Upazila	Connection Time				Total n
	Connection Time		Don't remember		
	No.	%	No.	%	
Narayangonj	59	96.7	2	3.3	61
Munshiganj	40	100.0	0	0.0	40
Sonargaon	37	100.0	0	0.0	37
Fatullah	5	100.0	0	0.0	5
Total	141	98.6	2	1.4	143



3.24 Types of Meters by Upazila

Table 3.22 shows the distribution of type of meters by Upazila. One will notice that of the total 374 respondents, 69.5% have electronic meters while the rest have manual meters. The highest member of manual meters are in Upazila Fatullah (41.8%) follows by Munshiganj (41.2%).

Table 3.22: Types of meters by Upazila

Upazila	EVC meters		Manual meters		Total No.
	No.	%	No.	%	
Narayangonj	67	90.5	7	9.5	74
Munshiganj	40	58.8	28	41.2	68
Sonargaon	82	74.5	28	25.5	110
Fatullah	71	58.2	51	41.8	122
Total	260	69.5	114	30.5	374

3.25 Distribution of Respondents Whether Meter Goes Out of Order by Upazila

Table 3.23 gives the distribution of respondents whether meter goes out of order by Upazila. Table shows about 81.4% of all the respondents answered in the negative, about 70 (18.6%) respondents answered in the affirmative.

Table 3.23: Distribution of respondents whether meter goes out of order by Upazila

Upazila					Total n
	Yes		No		
	No.	%	No.	%	
Narayangonj	30	40.5	44	59.5	74
Munshiganj	11	16.2	57	83.8	68
Sonargaon	23	20.9	87	79.1	110
Fatullah	6	4.8	119	95.2	125
Total	70	18.6	307	81.4	377

3.26 Number of Times Meter is Out of Order by Upazila

Table 3.24 shows the distribution of number of time the meter was out of order by Upazila. It is observed that about 82.9% of all meters was out of order once and 12.2% meter were twice out of order. The average number of times meter is out of order appears to be 1.27.

Table 3.24: Number of times meter out of order by Upazila

Upazila	1 time		2 time		4 time		Total	Average
	No	%	No	%	No	%	n	
Narayangonj	3	75.0	1	25.0	0	0.0	4	1.25
Munshiganj	11	100	0	0	0	0	11	1.00
Sonargaon	17	81.0	4	19.0	0	0.0	21	1.0
Fatullah	3	60.0	0	0.0	2	40.0	5	2.2
Total	34	82.9	5	12.2	2	4.9	41	1.27

3.27 First Time Meter Going Out of Order by Year and Upazila

Table 3.25 shows the distribution of timing of meter going out of order by Upazila. Of the total respondents of 41 (47.6 percent) meters went out of order during 2013-14, 35.7 percent meters during 2011-12 and 16.7% of meters before 2010.

Table 3.25: First time meter going out of order by year and Upazila

Upazila	Before 2010		2011-2012		2013-2014		Total
	No	%	No	%	No	%	No.
Narayangonj	1	25.0	3	75.0	0	0.0	4
Munshiganj	3	27.3	5	45.5	3	27.3	11
Sonargaon	2	13.6	5	22.7	14	63.6	21
Fatullah	0	0.0	2	40.0	3	60.0	5
Total	6	16.7	15	35.7	20	47.6	41

3.28 Determination of Actual Gas Consumption When Meter Is Out Of Order by Upazila

Table 3.26 shows the distribution of determination of actual gas consumption when meter is out of order by Upazila. Table reveals that 65.9% beneficiaries paid bill on three-month average, 22.2% beneficiaries paid average bill and only 9.8% beneficiaries responded that bills were paid depending on load.

Table 3.26: Determination of actual gas consumption when meter is out of order by Upazila

Upazila	Depend on load		Based on 3 month average		average bill		Stop of gas use		Total
	No	%	No	%	No	%	No	%	n
Narayangonj	2	50.0	1	25.0	1	25.0	0	0	4
Munshiganj	1	9.1	5	45.5	4	36.4	1	9.1	11
Sonargaon	1	4.8	19	90.5	1	4.8	0	0.0	21
Fatullah	0	0.0	2	40.0	3	60.0	0	0.0	5
Total	4	9.8	27	65.9	9	22.0	1	2.4	41

3.29 Respondent's Opinions regarding Quality of Gas Supply by Upazila

Table 3.27 shows the distribution of beneficiaries opinions regarding quality of gas supply by Upazila. The table reveals that 190 (50.4%) beneficiaries opined that quality was ensured while 187 (49.6%) beneficiaries opined in the negative. It appears that there is almost a 50-50 divide regarding quality of gas supply. However this conclusion would be misleading unless one looks into the differences that exist between different upozilas. While beneficiaries in Sonargaon (91.8 percent of them) are quite happy about the quality of gas supply which ensures right pressure of gas with 24 hours of supply; the beneficiaries in Fatullah are quite unhappy (100 percent of them) about gas supply quality. They complained about low pressure in the supply line. At times pressure is so low that the beneficiaries do not get gas supply during most of the day.

Table 3.27: Respondent's regarding quality of gas supply by Upazila

Upazila					Total n
	Yes		No		
	No.	%	No.	%	
Narayangonj	50	67.6	24	32.4	74
Munshiganj	39	57.4	29	42.6	68
Sonargaon	101	91.8	9	8.2	110
Fatullah	0	0.0	125	100.0	125
Total	190	50.4	187	49.6	377

3.30 Regular Repair and Maintenance Of Gas Line By Upazila

Table 3.28 shows the distribution of respondent's opinion regarding regular repair and maintenance of gas line by Upazila. Table shows that 63.9% respondents answered in the negative while only about 36.1% respondents answered in the affirmative. However there exists significant differences between Sonargaon and Fatullah. While most of the beneficiaries in Sonargaon (about 73.6 percent) confirmed about regular repair and maintenance of gas line, the beneficiaries in Fatullah (all of them) complained that no regular repair and maintenance works are carried out.

Table 3.28: Opinion of the respondent's regarding regular repair and maintenance of gas line by Upazila

Upazila					Total n
	Yes		No		
	No.	%	No.	%	
Narayangonj	30	40.5	44	59.5	74
Munshiganj	25	36.8	43	63.2	68
Sonargaon	81	73.6	29	26.4	110
Fatullah	0	0.0	125	100.0	125
Total	136	36.1	241	63.9	377

3.31 Opinion of the Respondent's Regarding Frequency of Checking Meters by Upazila

It was revealed that about 99 percent of meters are checked regularly. Table 3.29 shows the frequency of checking meters by Upazila. It is seen from the table, 93.1% respondents opined that meters are checked once-a-month, in 3.7% cases meters are checked every two-month.

Table 3.29: Opinion of the respondent's regarding frequency of checking meters by Upazila

Upazila									Total
	1 month		2 months		3 months		4 months		
	No	%	No	%	No	%	No	%	No.
Narayangonj	51	68.9	12	16.2	6	8.1	5	6.8	74
Munshiganj	67	98.5	0	0.0	1	1.5	0	0.0	68
Sonargaon	110	100.0	0	0.0	0	0.0	0	0.0	110
Fatullah	123	98.4	2	1.6	0	0.0	0	0.0	125
Total	351	93.1	14	3.7	7	1.9	5	1.3	377

3.32 Incidence of Illegal Connection in the Area by Upazila

Table 3.30 shows the distribution of opinions of respondents regarding incidence of illegal gas connection in the area by Upazila. About 88.7% of beneficiaries answered that they did not know while about 11.3% of beneficiaries affirmed incidence of illegal gas connection in the area. It will also be noticed that in munshiganj, about 36.8% beneficiaries affirmed incidence of illegal connection in the area

Table 3.30: Incidence of illegal connection in the area by Upazila

Upazila					Total
	Yes		Don't Know		
	No.	%	No.	%	No.
Narayangonj	8	13.1	53	86.9	61
Munshiganj	25	36.8	43	63.2	68
Sonargaon	6	5.5	104	94.5	110
Fatullah	2	1.6	123	98.4	125
Total	41	11.3	323	88.7	364

3.33 Respondent's Perception Regarding Social Development in the Area

Table 3.31 lists the type of social development that took place after the area was connected by gas line. The following are the developments that the respondents think took place.

Table 3.31: Respondent's perception regarding social development in the area

	Responses	
	N	Percent
1. Development of factories / industries leading to increased employment and businesses,	271	71.9
2. Increase in production	3	0.9
3. Improvement of standard of living	81	21.5
4. Literacy rate increased	104	27.8
5. Increased commutation	95	25.1
Multiple responses	554	147.2

3.34 Respondent's Perception Regarding Economic Development in the Area

Table 3.32 shows the type of economic development that took place after the area was connected by gas line. The following developments that the respondents think took place:

Table 3.32: Respondent's perception regarding economic development in the area

	Responses	
	N	Percent
1. Employment opportunity increased	286	75.9
2. Income of people increased	183	48.5
3. Sale and purchases increased	71	18.8
4. Export increased	18	4.7
Multiple responses	558	147.9

3.35 Opinion of the Respondent's Environmental Development in the Area

Table 3.33 shows the type of environmental development in the area after it was connected by gas line. The respondents think that the following environmental development took place:

Table 3.33: Opinion of the respondent’s environmental development in the area

	Responses	
	N	Percent
1. Felling of trees decreased as demand for fire wood decreased due to availability of gas as fuel	39	10.4
2. Reduction of use of firewood led to decreased in bluish smoke and pollution in decreased	336	89.2
3. Fuel costs substantially dunned for all purposes	86	22.8
4. All these led to improvement in environmental balance	4	1.0
Multiple responses	465	123.4

3.36 Respondent’s Perception of Type of Development Needed For Correct Pressure /Security

Table 3.34 shows the opinions of the respondents regarding the need fuel to maintain correct pressure in the gas line and safe use of gas.

Table 3.34: Respondent’s perception of type of development needed for correct pressure/ security

	Responses	
	N	Percent
1. Regular checking of gas transmission lines	222	28.9%
2. Ensure correct meter reading	50	6.5%
3. Use of improved quality meters	88	11.5%
4. To use pressure regulator in the gas transmission line to ensure pressure of gas for use	408	53.2%
Multiple responses	768	100.0%

CHAPTER – 4: RESPONDENTS OF HOUSEHOLDS

4.1 Distribution of the Respondent's Income by Upazila

At Fatullah of the 24 households, about 37.5% have monthly income above 25,000.00 in Sonargaon, 27.6% have monthly income between 15001 to 2000 in Narayangonj, 29.2% have monthly income between 10001 to 20000 in Munshigonj, 52.2% have monthly income above 25000. Of the total of 100 households, 30% of them have monthly income about 25,000, 11% have income between 20,000 and 25,000, 23% have monthly income between 15,000 and 20,000, 19% have monthly income between 10,000 and 15,000 and the rest have income less 10,000 (table: 4.1).

Table 4.1: Distribution of the respondent's income by Upazila

Upazila	Income range (Tk.)												Total No.	Average
	0-5000		5001-10000		10001-15000		15001-20000		20001-25000		25000 above			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Fatullah	-		1	4.2	5	20.8	5	20.8	4	16.7	9	37.5	24	23,750
Sonargaon	2	6.9	6	20.7	3	10.3	8	27.6	5	17.2	5	17.2	29	16,873
Narayanganj	0	0.0	5	20.8	7	29.2	7	29.2	1	4.2	4	16.7	24	16,275
Munshiganj	1	4.3	2	8.7	4	17.4	3	13.0	1	4.3	12	52.2	23	21,838
Total	3	3.0	14	14.0	19	19.0	23	23.0	11	11.0	30	30.0	100	19,000

4.2 Distribution of the Respondent's Expenditure to Take Gas Line Connection by Upazila

Table 3.45 shows the distribution of expenditure incurred for taking gas line connection by Upazila. However 100 household beneficiaries responded to this question. It will be seen from the table that highest average expenditure was made by households of Fatullah Upazila 33.3% (Tk. 25000 above), Sonargaon Upazila 31.0% (Tk. 15,001-20,000) followed by households of Narayanganj 45.8% (Tk. 10,001-15,000), Munshiganj 47.8% (Tk. 25,000 above) and. The overall highest average was found to be 27.0% and Tk. 10,001-15,000. Of the total of 100 household beneficiaries (Table: 4.2).

Table 4.2: Distribution of the respondent's expenditure to take Gas line connection by Upazila

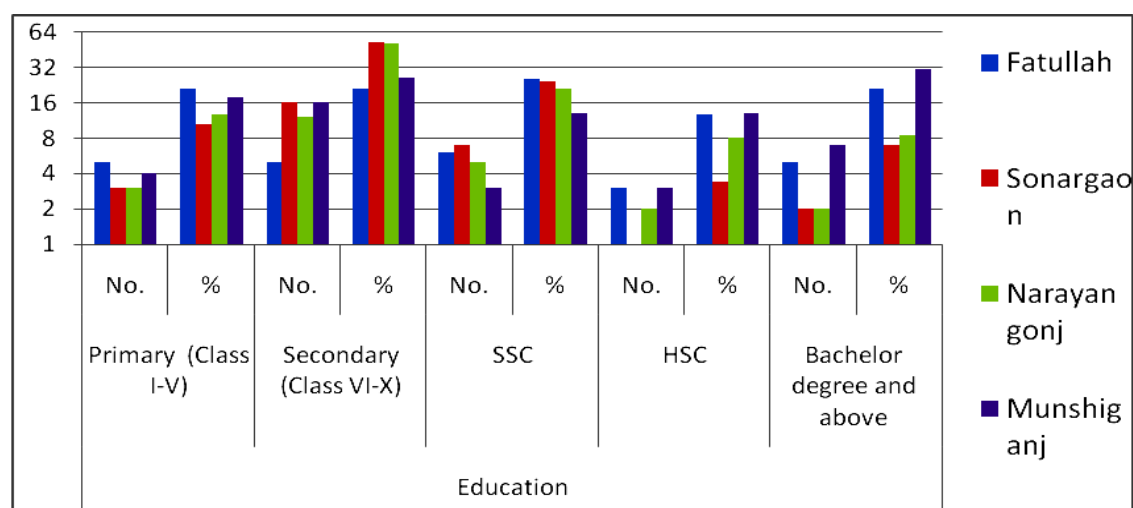
Upazila	Expenditure range (Tk.)												Total No.	Average
	0-5000		5001-10000		10001-15000		15001-20000		20001-25000		25000 above			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Fatullah	1	4.2	1	4.2	7	29.2	4	16.7	3	12.5	8	33.3	24	19,795
Sonargaon	3	10.3	7	24.1	4	13.8	9	31.0	3	10.3	3	10.3	29	14,623
Narayanganj	0	0.0	7	29.2	11	45.8	5	20.8	1	4.2	0	0.0	24	12,500
Munshiganj	3	13.0	1	4.3	5	21.7	2	8.7	1	4.3	11	47.8	23	20,158
Total	7	7.0	16	16.0	27	27.0	20	20.0	8	8.0	22	22.0	100	16,633

4.3 Distribution of the Respondent's Education By Upazila

Education is one of the most important indicators of the project intervention. Among 100 respondents of households, most of them 25.0% respondents have completed SSC level at Fatullah, most of them 52.2% respondents have completed their education in class VI to X at Sonargaon, most of them 50.0% respondents have complete their education in class VI to X at Narayangonj, most of them 30.4% respondents have completed her education in Bachelor degree and above at Munshiganj area in TGTDC. Quality of education in general at all households is low as indicated by the fact that only 39.0 % of eligible population passed class eight to ten (Table: 4.3).

Table 4.3: Distribution of the respondent's education by Upazila

Upazila	Education										Total No.
	Primary (Class I-V)		Secondary (Class VI-X)		SSC		HSC		Bachelor degree and above		
	No.	%	No.	%	No.	%	No.	%	No.	%	
Fatullah	5	20.8	5	20.8	6	25	3	12.5	5	20.8	24
Sonargaon	3	10.3	16	52.2	7	24.1	1	3.4	2	6.9	29
Narayanganj	3	12.5	12	50	5	20.8	2	8	2	8.3	24
Munshiganj	4	17.4	16	26.1	3	13	3	13	7	30.4	23
Total	15	15	39	39	21	21	9	9	16	16	100

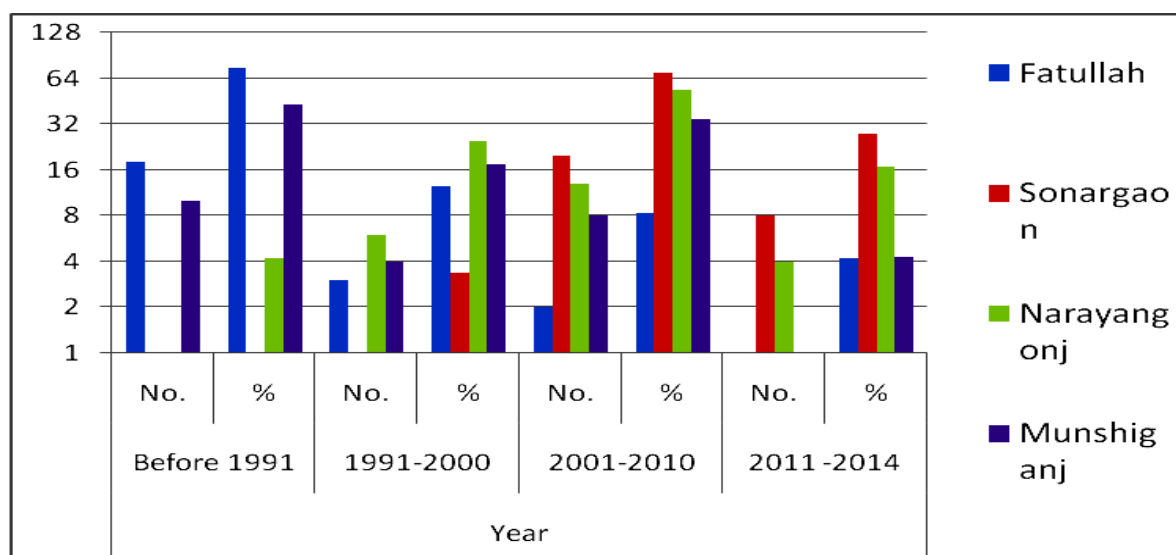


4.4 Distribution of the Respondent's Year of Gas Line Connection by Upazila

Among 100 respondents of households, most of them 75.0% respondents said their gas line connection taken before 1991 in Fatullah TGTDC area, and 69.0% respondents took the gas line connection in 2001 to 2010 at Sonargaon, 54.2% respondents taken gas line in 2001 to 2010 at Narayanganj and 43.5% respondents taken gas line before 1991 in Munshiganj area in TGTDC, whereas the table shown as only 14.0% respondents said the gas connection in 1991 to 2000 and newly 2011 to 2014 in project areas. On the other hand, among 100 respondents of the Households, most of the respondents 43.0% said the maximum gas connection was taken in 2001 to 2010 year (Table: 4.4).

Table 4.4: Distribution of the respondent's year of GAS line connection by Upazila

Upazila	Year								Total No.
	Before 1991		1991-2000		2001-2010		2011 -2014		
	No.	%	No.	%	No.	%	No.	%	
Fatullah	18	75.0	3	12.5	2	8.3	1	4.2	24
Sonargaon	0	0.0	1	3.4	20	69.0	8	27.6	29
Narayangonj	1	4.2	6	25.0	13	54.2	4	16.7	24
Munshiganj	10	43.5	4	17.4	8	34.8	1	4.3	23
Total	29	29.0	14	14.0	43	43.0	14	14.0	100



4.5 Opinion of the Respondent's Use of Gas in Full Time by Upazila

Among 100 respondents of households, most of them 100% respondents said they are using the gas full time at Fatullah, 75.9% respondents said they are using the gas full time at Sonargaon, 66.7% respondents given answer they are using gas full time at Narayangonj and 87.0% respondents are using gas full time at Munshiganj area in TGTDC, whereas the table shown as only 18.0% respondents said they were not using gas full time in project areas. On the other hand, among 100 respondents of the Households 82.0% respondents gave their opinion and said using full time gas in the project areas (Table: 4.5).

Table 4.5: Opinion of the respondent's use of GAS in full time by Upazila

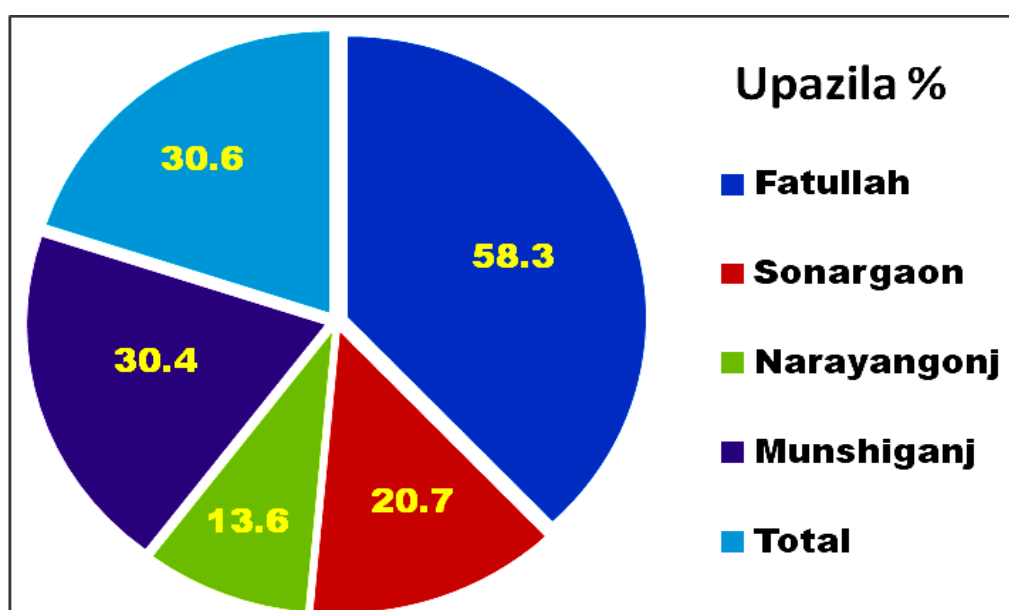
Upazila	Yes		No		Total N
	No.	%	No.	%	
Fatullah	24	100.0	-	-	24
Sonargaon	22	75.9	7	24.1	29
Narayangonj	16	66.7	8	33.3	24
Munshiganj	20	87.0	3	13.0	23
Total	82	82.0	18	18.0	100

4.6 Opinion of the Respondent's What was The Expenditure to Get the Gas Connection by Upazila

Expenditure is one of the most important indicators of the project intervention. Among 98 respondents of households, most of them 30.6% of all respondents spent 10000.00 tk. to take the gas line connection in the project areas. About Fatullah, almost 58.3% of all respondents spent tk. 10000 to take the gas connection. Among 29 respondents at Sonargaon, most of them 44.8% spent more than tk. 30000 to take the gas connection, among 22 at Narayangonj 36.4% spent more than 30000 tk. to take the gas connection and also in Munshiganj almost 34.8% of households spent more than 30000 tk. to take the gas connection in households line (Table: 4.6).

Table 4.6: Opinion of the respondent's what was the expenditure to get the GAS line connection by Upazila

Upazila	Year								Total No.
	10000		10001-20000		20001-30000		More than 30000		
	No.	%	No.	%	No.	%	No.	%	
Fatullah	14	58.3	9	37.5	1	4.2	0	0.0	24
Sonargaon	6	20.7	5	17.2	5	17.2	13	44.8	29
Narayanganj	3	13.6	4	18.2	7	31.8	8	36.4	22
Munshiganj	7	30.4	6	26.1	2	8.7	8	34.8	23
Total	30	30.6	24	24.5	15	15.3	29	29.6	98



4.7 Opinion of the Respondent's Number of Hour's Use of Gas by Upazila

Among 100 respondents of households, most of them 41.7% are using 4 hour's in a day at Fatullah, 34.5% are using at Sonargaon, 37.5% are using 6 hour's gas at Narayanganj, 39.1% are using 3 hour's gas at Munshiganj. On the other hand, among 100 respondents of the Households, most of them 34.0% are using 4 hour's gas in a day and household respondents expressed their opinion about the using of gas on TGTDC, Bangladesh (Table: 4.7).

Table 4.7: Opinion of the respondent's number of hour's use of GAS by Upazila

Upazila	Hour's										Total No.
	3		4		5		6		8		
	No.	%	No.	%	No.	%	No.	%	No.	%	
Fatullah	3	12.0	10	41.7	5	20.8	5	20.8	1	4.2	24
Sonargaon	9	31.0	10	34.5	8	27.6	2	6.9	0	-	29
Narayanganj	6	25.0	7	29.2	0	-	9	37.5	2	8.3	24
Munshiganj	9	39.1	7	30.4	2	8.7	5	21.5	0	-	23
Total	27	27.0	34	34.0	15	15.0	21	21.0	3	3.0	100

4.8 Quality of Gas Line by Upazila

By quality of gas line we wanted to know whether the supply of gas in continuous and with proper pressure. Responses regarding quality of gas line attitude have been highlighted in the Table 4.8. Among 100 household respondents in four project areas most of them 73.0% said the gas line quality was not sufficient. On the other hand only 27.0% respondents expressed satisfaction about the gas connection. The most raftering households are Narayanganj (95.8 percent), Munshiganj (87 percent) and Fatullah (75 percent).

Table 4.8: Quality of GAS line by Upazila

Upazila	Yes		No		Total N
	No.	%	No.	%	
Fatullah	6	25.0	18	75.0	24
Sonargaon	17	58.6	12	41.4	29
Narayanganj	1	4.2	23	95.8	24
Munshiganj	3	13.0	20	87.0	23
Total	27	27.0	73	73.0	100

4.9 Distribution Respondents Regarding Types of Benefits after Gas Connection

Responses regarding types of benefit after gas connection have been highlighted in the Table 4.9. Every one of 100 household got benefits in the form reduction in cooking time as well as cost. About 40 percent expressed that they are free from burning fuel wood.

Table 4.9: Distribution respondents regarding types of benefits after gas connection

Type	Responses	
	N	Percent
6. Reduce cooking time	100	100
7. Reduce financial expense	100	100
8. Free from fuel wood	40	40
Multiple responses	240	240

4.10 Distribution of Types of Difficulties Faced Before Connection

Responses regarding types of difficulties faced before gas connection have been highlighted in the Table 4.10. Among 100 household respondents in four project areas most of them 50.5% said earlier we used fuel wood for cooking but now there were happy with clean energy, 49.5% said no inkling of back side of the pan were faced.

Table 4.10: Distribution of respondents regarding types of difficulties faced before connection

	Responses	
	N	Percent
1. Used fuel wood which is not necessary now	100	100%
2. Suffered from smoke and black dust with stained utensils	98	98%
Multiple responses	198	198%

4.11 Distribution of Respondents Whether Gas Supply Improve After Repair and Maintenance of Gas Line Regarding Types of Difficulties Faced Before Connection

About 92 percent of the household said there were no repair and maintenance work and as such no improvement in supply of gas with right pressure took place (Table: 4.11).

Table 4.11: Distribution of respondents whether gas supply improve after repair and maintenance of gas line regarding types of difficulties faced before connection

Upazila	Yes		No repair		Total
	No.	%	No.	%	No.
Fatullah	2	8.3	22	91.7	24
Sonargaon	4	13.8	25	86.2	29
Narayanganj	2	8.3	22	91.7	24
Munshiganj	0	0.0	23	100.0	23
Total	8	8.0	92	92.0	100

4.12 Distribution of Household by Availability of Gas All the Time by Upazila

Table 4.12 shows the distribution of household regarding availability of gas all the time. Table shows that about 67 percent of households did not get supply of gas all the time, while only 33 percent answered in the affirmative. It also reveals that 83.3 percent 78.3 percent and 66.7 percent of household, respectively from Narayanganj, Munshiganj and Fatullah did not have gas supply all the time.

Table 4.12: Distribution of household's availability gas all the time by Upazila

Upazila	Type of Difficulties				Total n
	Yes		No.		
	No.	%	No.	%	
Fatullah	8	33.3	16	66.7	24
Sonargaon	16	55.2	13	44.8	29
Narayanganj	4	16.7	20	83.3	24
Munshiganj	5	21.7	18	78.3	23
Total	33	33.0	67	67.0	100

4.13 Distribution of Respondents Regarding the Difficulties of New Gas Connection In House by Upazila

Household respondents of regarding the difficulties of new gas connection in house of the project areas have been highlighted in the Table 4.13. Among 87 respondents of households, most of them 69.0% respondents expressed their opinion about do not get the new connection for house, and another 31% respondents answered need to more money for taking new gas connection. In this regard we shown the table is higher percent of do not get the new connection for house.

Table 4.13: Distribution of respondents regarding the difficulties of new gas connection by Upazila

Upazila	Type of Difficulties				Total n
	Do not get the new connection		Need to more Money		
	No.	%	No.	%	
Fatullah	13	65.0	7	35.0	20
Sonargaon	17	73.9	6	26.1	23
Narayanganj	14	60.9	9	39.1	23
Munshiganj	16	76.2	5	23.8	21
Total	60	69.0	27	31.0	87

4.14 Distribution of Respondents Regarding the Illegal Connection In House by Upazila

Household respondents of regarding the illegal connection in house of the project areas have been highlighted in the Table 4.14. Among 100 respondents of households, most of them 75.0% respondents said that they did not know about illegal connection in project areas. On the other hand only 25.0% respondents said reported existence of illegal connection in project areas.

Table 4.14: Distribution of respondents regarding the illegal connection by Upazila

Upazila					Total
	Yes		No.		
	No.	%	No.	%	n
Fatullah	4	16.7	20	83.3	24
Sonargaon	4	13.8	25	86.2	29
Narayangonj	8	33.3	16	66.7	24
Munshiganj	9	39.1	14	60.9	23
Total	25	25.0	75	75.0	100

Local influential leaders and local tents negotiate with gas contractors to provide gas connection to households who need it so desperately in exchange money.

4.15 Distribution of Respondents Regarding Social Development for Gas Connection By Upazila

Household's responses regarding social development for gas connection have been highlighted in the Table 4.15. We have asked their attitude about social development after gas connection in the project areas. Among 100 household respondents in four project areas most of them 45.4% said increase high-rise building and increase industry, and other 9.2% said increase employment in project areas. So we can say after gas connection the project area has been developing day by day.

Table 4.15: Distribution of respondents regarding social development for gas connection by Upazila

Type of benefit	Responses	
	N	Percent
1. Increase high-rise building	99	45.4%
2. Increase industry	99	45.4%
3. Increase employment	20	9.2%
Multiple responses	218	100.0%

4.16 Distribution of Respondents Regarding Economic Development for Gas Connection by Upazila

Household's responses regarding economic development for gas connection have been highlighted in the Table 4.16. We have asked their attitude about economic development after gas connection in the project areas. Among 100 household respondents in four project areas most of them 50.0% said increase business and 50.0% said increase production in project areas. So we can say after gas connection the project area has been developing day by day.

Table 4.16: Distribution of respondents regarding economic development for gas connection by Upazila

Problem	Responses	
	N	Percent
1. Increase business	100	50.0%
2. Increase production	100	50.0%
Multiple responses	200	100.0%

4.17 Distribution of Respondents Regarding Environmental Development for Gas Connection by Upazila

Household's responses regarding environmental development for gas connection have been highlighted in the Table 4.17. We have asked their attitude about environmental development after gas connection in the project areas. Among 100 household respondents in four project areas most of them 48.5% said make environmental balancing, 48.5% said cutting tree has stopped and 3.0% said reduce air pollution in project areas.

Table 4.17: Distribution of respondents regarding environmental development for gas connection by Upazila

	Responses	
	N	Percent
1. Make environmental balance	97	48.5%
2. Cutting tree has stopped	97	48.5%
3. Reduce air pollution	6	3.0%
Multiple responses	200	100.0%

4.18 Distribution of Respondent's Type of Development Need To Be Actual Pressure / Security

Table 4.18 shows the opinions of the respondents regarding the need fuel to maintain correct presence in the gas line and safe use of gas.

Table 4.18: Distribution of respondent's type of development need to be actual pressure / Security

	Responses	
	N	Percent
1. Daily monitoring of the gas connection	66	33.7%
2. To use pressure regulator in the gas transmission line to ensure pressure of gas for use	62	31.6%
3. Regular checking of gas transmission lines	68	34.7%
Multiple responses	196	100.0%

CHAPTER – 5: ANALYSIS OF GAS SUPPLY AND GAS CONSUMPTION DATA FOR SYSTEM LOSS

Estimation of the System Loss in the Project Area

In this chapter, we make an endeavor to estimate system loss of gas distribution in the TGTDCCL marketing area 1 and 2. In section 5.1, billed consumption data as received from TGTDCCL for the months of January, February and March, 2014 are presented. In section 5.2 quantities of gas supplied are matched with billed consumption data for those three months to find the system loss in each month. In section 5.3, we also try to figure out the factors causing system loss. In section 5.4, system loss data for the month of January and February, 2011 are compared with the same for the month of January and February, 2014 to get an idea whether system loss is reduced due to implementation of the project.

5.1 Billed Consumption of Gas for January, February and March, 2014.

Table 5.1.1, 5.1.2 and 5.1.3 respectively, show billed consumption of Captive power, commercial customer, Industrial customer and CNG owners/operators by Upozila for the month of January, February and March, 2014. Table 5.1.4 shows the aggregate billed consumption for three months of different categories of beneficiaries by Upozila. Table 5.11, 5.12 and 5.13 are self-explanatory. Table 5.14 reveals that of the total consumption of 452.685 mmcm (Million cubic meter), beneficiaries of Sonargaon alone account for about 63.63 percent, followed by those from Narayangonj (31.11 percent), Fatullah (3.12 percent) and Munshiganj (2.14 percent). It is also revealed that of the total billed consumption, Industrial customers account for about 51.32 percent, followed by the generators of captive power (45 percent), CNG operators (3.09 percent) and commercial customers (0.59 percent).

Table: 5.1.1 Bill Consumption for the month of January 2014 in Cubic Meter (CM)

Area Description	Bill Consu. for Cap. Power	Bill Consu. for Comm. Customer	Bill Consu. for Industrial Customer	Bill Consu. For CNG Customer	Total
01. Demra	515,494.00	-	1,363,739.67	-	1,879,233.67
05. Jatra Bari	334,147.64	2,241.31	2,304,701.95	-	2,641,090.90
06. Narayangonj	17,834,850.20	649,750.84	29,220,977.21	966,821.07	48,672,399.32
70. Munshigonj	1,800,490.57	40,787.47	1,839,042.24	-	3,680,320.28
37. Sonargaon	46,926,651.46	212,642.16	42,533,751.88	3,328,650.00	93,001,695.50
Total =	67,411,633.87	905,421.78	77,262,212.95	4,295,471.07	149,874,739.67

Table: 5.1.2 Bill Consumption For the month of February 2014 in Cubic Meter (CM)

Area Description	Bill Consu. for Cap. Power	Bill Consu. for Comm. Customer	Bill Consu. for Industrial Customer	Bill Consu. For CNG Customer	Total
01. Demra	496685.47	0.00	1475129.21	0.00	1971814.68
05. Jatra Bari	433733.46	2553.11	2107307.17	0.00	2543593.74
06. Narayangonj	18263610.26	664409.69	29506597.22	1015846.00	49450463.17
70. Munshigonj	1345217.78	33455.03	1520300.63	0.00	2898973.44
37. Sonargaon	45250114.84	188976.20	41447451.83	3752328.00	90638870.87
Total =	65789361.81	889394.03	76056786.06	4768174.00	147503715.90

Table: 5.1.3 Bill Consumption For the month of March 2014 in Cubic Meter (CM)

Area Description	Bill Consu. for Cap. Power	Bill Consu. for Comm. Customer	Bill Consu. for Industrial Customer	Bill Consu. For CNG Customer	Total
01. Demra	554198.94	0.00	1668836.82	0.00	2223035.76
05. Jatra Bari	509797.83	2221.03	2330408.70	0.00	2842427.56
06. Narayangonj	19723447.95	637773.13	30327384.71	1085910.97	51774516.76
70. Munshigonj	1523873.26	36448.48	1568344.36	0.00	3128666.10
37. Sonargaon	48167932.82	196317.46	43100571.96	3873484.00	95338306.24
Total =	70479250.8	872760.10	78995546.55	4959394.97	155306952.42

Table: 5.1.4 Area Wise Total Three Month Consumptions in Cubic Meter (CM)

Area Description	Bill Consu. for Cap. Power	Bill Consu. for Comm. Customer	Bill Consu. for Industrial Customer	Bill Consu. For CNG Customer	Total
01. Demra	1566378.41	0.00	4507705.70	0.00	6074084.11
05. Jatra Bari	1277678.93	7015.45	6742417.82	0.00	8027112.20
06. Narayangonj	55821908.41	1951933.66	89054959.14	3068578.04	149897379.25
70. Munshigonj	4669581.61	110690.98	4927687.23	0.00	9707959.82
37. Sonargaon	140344699.12	597935.82	127081775.67	10954462.00	278978872.61
Total =	203680246.48	2667575.91	232314545.56	14023040.04	452685407.99

5.2 Quantities of Gas Supplied, Billed Consumption and Estimation of System Loss.

For the purpose of the study, system loss has been defined as the difference between amount of gas supplied and the total amount of gas consumed (billed consumption). This difference then represents the amount of gas that is unaccounted for.

Table 5.2.1 shows the Gas Consumed, Gas supplied and the estimated system loss in the project areas for the month of January, 2014. Table shows that the estimated system loss for the month of January, 2014 for area-1 and area-2 respectively are 11.813 and 12.494 million cubic meter of gas. The total loss appears to be as high as 24.307 million cubic meter. In percentage terms these are 17.20, 11.84 and 13.96 percent of the total gas supplied.

Table 5.2.2 shows consumption of gas (billed) matched against total gas supplied and estimated system loss in these two areas for the month of February, 2014. The table reveals that system loss for area-1 and area-2, respectively, are 2.975 and 9.903 million cubic meter (mmcm) which appear to be 4.97 percent and 9.85 percent of the total gas supplied in these two areas. The total system loss for areas 1 and 2 in 12.878 million cubic meter (mmcm) which is about 8.03 percent of the total gas supplied in these two areas.

Table 5.2.3 shows the estimated system loss for areas 1 and 2 along with amount of gas consumed and gas supplied for the month of March 2014. Table shows that the system loss for area 1 and area 2, respectively, are 3.512 and 2.753 million cubic meter (mmcm) of gas which are respectively, 5.53 percent and 2.81 percent of total gas supplied in the respectively areas. The total system loss for these areas is 6.265 million cubic meter (mmcm) which turns out to be 3.88 percent of the total gas supplied in these areas.

One will also notice from these tables, system loss in absolute terms has declined from January to March 2014 for both area 1 (Narayanganj, Fatullah and Munshiganj) and area-2 (Sonargaon). Estimated system loss for area-1 has declined from 11.813 mmcm in January 2014 to about 3.512 mmcm in March, 2014. In percentage terms it declined from 17.2 percent January 2014 to about 5.53 percent in March, 2014. Similar feature is also observed for area-2, where system loss of 12.494 mmcm in January has declined to about 2.753 mmcm in March, 2014. Which means that it declined from 11.84 percent to about 2.81 percent of the total supply.

Table 5.2.4 shows the aggregate gas supplied and estimated system loss for the months of January, February and March 2014 for these two areas. One will notice from the table that the aggregate system loss for three months for area-1 (Narayanganj, Fatullah and Munshiganj) appears to be 18.360 mmcm while the same for area-2 (Sonargaon) is about 25.149 mmcm. The aggregate for three months for both areas is 43.509 mmcm. The system loss as percentage of total supply in area-1 appears to be 9.56 percent (which is the weighted average of all the three months) while the same for area-2 (Sonargaon) is 8.27 percent. The overall weighted average of the system loss is about 8.77 percent.

Table 5.2.1: Gas Consumed, Gas Supplied and Estimation of System Loss in the Project area for the Month of January, 2014.

Table 5.2.1: January, 2014 (in million cubic meter (mmcm))

Location (1)		Billed Consumption (2)	Supply (3)	System Loss (Col.3–Col.2)	System Loss as % of total supply
Area - 1	Narayanganj	48.673	68.686	11.813	17.2
	Fatullah	4.520			
	Munshiganj	3.680			
	Total	56.873			
Area - 2	Sonargaon	93.001	105.495	12.494	11.84
Area 1 & 2: Total		149.874	174.181	24.307	13.96

Table 5.2.2: February, 2014 (Figures in million cubic meter (mmcm))

Location (1)		Billed Consumption (2)	Supply (3)	System Loss (Col.3–Col.2)	System Loss as % of total supply
Area - 1	Narayanganj	49.450	59.839	2.975	4.97
	Fatullah	4.515			
	Munshiganj	2.899			
	Total	56.864			
Area - 2	Sonargaon	90.639	100.542	9.903	9.85
Area 1 & 2: Total		147.503	160.381	12.878	8.03

Table 5.2.3: March, 2014 (Figures in million cubic meter (mmcm))

Location (1)		Billed Consumption (2)	Supply (3)	System Loss (Col.3–Col.2)	System Loss as % of total supply
Area - 1	Narayanganj	51.775	63.541	3.512	5.53
	Fatullah	5.065			
	Munshiganj	3.189			
	Total	60.029			
Area - 2	Sonargaon	95.338	98.091	2.753	2.81
Area 1 & 2: Total		155.367	161.632	6.265	3.88

Table 5.2.4: Aggregate gas consumed, gas supplied and estimation of system loss for the months of January, February and March, 2014 (in million cubic meter (mmcm))

Location (1)		Billed Consumption (2)	Supply (3)	System Loss (Col.3–Col.2)	System Loss as % of total supply
Area - 1	Narayanganj	149.897	192.066	18.360	9.56
	Fatullah	14.101			
	Munshiganj	9.708			
	Total	173.706			
Area - 2	Sonargaon	278.979	304.128	25.149	8.27
Area 1 & 2: Total		452.685	496.194	43.509	8.77

5.3 Factors Causing System Loss

System Loss may occur due to several factors. Major ones are:

- i. Due to inaccuracy of the metering system and equipment (meter tampering tempering variation).
- ii. Due to leakages in the distribution net work including customer service line, leakage in metering station, gas condensations, etc.
- iii. Illegal unmetered connection, illegal meter by-pass, etc.

One will admit that estimation of inaccuracy in billing is a difficult task. For this one requires close monitoring of bills for consumption and actual consumption for the beneficiaries and then assess the discrepancy. However, such an effort could not be undertaken for lack of resources and time.

Similarly, it is also very difficult to determine accurately the gas lost due to leakages. For this one requires to perform leak tests to hundreds of kilometers of secondary and tertiary distribution networks which could not be done due to lack of resources and time constraints. Gas leakages in riser and pipe lines are quite high and are regularly reported to respective Titas authority.

In order to get some notional figures on these two accounts we adopted a somewhat different strategy. This was to elicit some information regarding gas lost due to inaccuracy of billing and leakages. Our strategy was to ask a sample of beneficiaries to candidly assign some notional figure on these two accounts. However, this strategy is not entirely legitimate but some figures, be it notional, are always better than no figures at all.

During collection of sample data of the beneficiaries, it was noticed that gas consumption bills are prepared without taking into consideration of meter reading. This leaves some scope of inaccurate billing. In order to assess the extent of total gas that is unaccounted for due to inaccurate billing and leakages of different kinds, we took a sample survey of 30 beneficiaries: 15 from area-1 (Fatullah, Narayanganj, Munshiganj) and 15 from area-2 (Sonargaon). We asked each respondent to candidly assign a number in percentage which he thinks appropriate to account for total gas lost due to inaccurate billing and a number in percentage which he considers appropriate to account for gas lost due to leakages of different kinds. They did. The following table 5.3.1 shows the estimated averages.

Table 5.3.1: inaccurate billing and leakages as percentage of total system loss.

Area	Inaccurate billing as % of total supply	Leakages % of the total supply
Area- 1	1.467 (SE = 0.396) (t = 3.70)	1.533 (SE = 0.442) (t = 3.46)
Area-2	1.267 (SE = 0.370) (t = 3.42)	1.30 (SE = 0.414) (t = 3.14)
Area-1 1 & 2	1.367 (SE = 0.391) (t = 3.49)	1.417 (SE = 0.436) (t = 3.25)

❖ t-statistics are significant at more than 5% level

Estimation of figures for gas lost due to illegal and unmetered connection were obtained as a residual of total system loss after subtracting losses for inaccurate billing and leakages.

Indeed, it was found that local influential leaders with political clouts, in connivance with gas line contractors, gave tens of thousands of domestic connections in exchange for substantial sums of money. The households seeking gas line would try to procure gas connection at any costs as this clean energy has enormous excess demands for it and in this event, TGTDC officials remain as helpless on-lookers.

Table 5.3.2 shows the estimated system loss by different factors on the basis of aggregate of three months.

Table 5.3.2: Factors Causing System Loss on the basis of aggregate of three months

Area	Inaccurate billing as % of total supply	Leakages as % of total supply	Illegal and unmetered connection as % total supply	Total system loss as % of total supply
Area-1	1.467	1.533	6.56	9.56
Area-2	1.267	1.300	5.703	8.27
Area 1&2	1.367	1.417	5.986	8.77

For both areas 1 and 2, of the total system loss of 43.509 mmcm, inaccurate billing, leakages and illegal and unmetered connections, respectively, account for 6.782 mmcm, 7.030 mmcm and 29.697 mmcm.

As mentioned earlier, these figures may be interpreted as notional, rather than actual. If the system loss of 43.509 mmcm is valued as TK. 6 per meter cube, it stands at TK. 261.05 million or 26.1 crores in three months (January – March, 2014).

If loss figures do not increase, this would mean an amount of TK. 104.44 crores in a year-a huge loss to the national exchequer.

5.4 Whether System Loss Is Reduced Due To Implementation of the Project

In order to get an idea, whether system loss is reduced, we needed data for monthly consumption and supply from January, 2011 through March, 2014 for the areas 1 and 2. However, the data was unavailable from TGTDCCL despite month-long endeavor. In the following table 5.4.1, compare aggregate gas consumption and supply data for January – February, 2011 with the aggregate consumption and supply data for January – February, 2014.

Table 5.4.1: Comparison Between Aggregate consumption and gas supply data for January – February, 2011 and Aggregate Consumption – Supply data for January – February, 2014.

Area	January – February, 2011				January – February, 2014	
	Consumption (mmcm)	Supply (mmcm)	System Loss (mmcm)	System Loss as % Total Supply	System Loss (mmcm)	System Loss as % of Total Supply
Area -1	103.954	111.602	7.648	6.85	14.788	11.51
Area – 2	153.422	144.872	- 8.550	- 5.90	22.397	10.87
Area 1 & 2	257.376	256.472	- 0.92	- 0.03	37.186	11.11

Comparison of Two – Months aggregate data for Jan – Feb, 2011 with that of 2014, shows that in terms of volume of gas, system loss has increased and also interims of system loss as percentage of total supply has also increased.

CHAPTER – 6: MAJOR FINDINGS, RECOMMENDATIONS AND CONCLUSION

6.1 Major Findings

6.1.1 Findings of the Implementation Status of SLRP Works

The physical visit was carried out from Sonargaon TGTDC area to Fatullah TGTDC area; and lastly the physical visit was Narayanganj TGTDC area. The major findings regarding the implementation status of system loss reduction works under all the selected project area have been presented below:

- All system loss reduction works under four selected areas of TGTDC had been found similar during physical visit of the project areas as records found in PCR.
- Procurement of packages (e.g., EVC meters, mobile calibration equipment) under the project was done following the PPR 2008 and donors (ADB) procurement guidelines on the basis of set of predetermined indicators. The tender documents were prepared and floated following PPR 2008. They were evaluated by a committee. ADB took the initiatives of examining Technical specifications of the equipment (e.g., accuracy of measurement, durability, battery life of the machine, ease of procurement of spare parts, training of local Titas gas personnel to carry out repairs locally, etc) and gave a go ahead signal. The financial proposal was good and TGTDC procured the packages. No set rules of PPR 2008 and ADB procurement guideline were broken. However, unfortunately inferior quality equipment was procured which was evident later. Had there been higher standards set for accuracy, durability, battery life, ease of procurement of spare parts, training of locals to carry out repairs locally at the tenderers expense, etc, the decision could have been otherwise. This is mentioned here because high quality EVC meters if used properly could have saved millions.
- Specialized training on skill development of 140 TGTDC personnel by the project did not bear any fruits. They were not utilized in the project. Finding them was a futile exercise. They were either transferred or left TGTDC for better options.
- The metering station is under the customer custody even for commercial and industrial case.
- The supply gas pressures were found lower than the rated pressure in most cases.
- Many Gas flow meters were found inoperative and stored in the Department Workshop.

6.1.2 Survey Findings from Project Beneficiaries

The impact of the system loss reduction works under all four areas of TGTDCCL, Bangladesh was evaluated by the responses of the project beneficiaries and gas users in the project areas through the pre-tested questionnaire. The survey work was conducted among four areas of the project areas. The findings of the impact of the system loss reduction works on the major expected output in the project areas are given below:

- **Utility of using gas line in the project area:** In all four project areas of the TGTDCCL, gas were being used round the year for generator, captive power generation , CNG filling stations, industry and re-rolling mills and mobility of beneficiaries through which most of the project beneficiaries were benefited.

6.1.3 Beneficiary Survey Revealed the following

1. 88.3% of beneficiaries did not have any knowledge about repair and maintenance work. (table- 3.11).
2. 94.5 percent beneficiaries of Sonargaon have gas supply with pressure all the time while 46.4 percent of beneficiaries in Fatullah did not get gas supply with high pressure all the time.
3. 68.2 percent of all the respondents said gas supply did not improve after repair and maintenance. If including all the beneficiaries in Fatullah (100%), 63.0 percent of beneficiaries in Munshiganj and 47.9 percent of beneficiaries in Narayanganj.
4. Of the total beneficiaries 63 percent had EVC meters and the rest have manual meters. When meter is out of order, gas bills are prepared on the basis of 3 month load, average bill and on negotiation.
5. Meter readings are not used for preparation of bills for consumption so there is scope for inaccurate billing.
6. 63.9 percent of all the beneficiaries reports of that there was no regular repair and maintenance.
7. 41 beneficiaries reported that there were illegal connections in the area and the rest of beneficiaries did not know about it.

6.1.4 Household Survey Revealed The Following

1. 92% of households reported that gas supply did not improve after repair and maintenance of gas line.
2. 63% of household complained that gas was not available all the time. This includes 83.3% households in Narayanganj 78.3 percent in Munshiganj and 66.7% in Fatullah.
3. 25% of household reported illegal connections in the area.
4. 83% of all respondents reported that there were leakages in risers and distribution lines

6.1.5 Findings Regarding System Loss

- Estimated aggregate system loss for the months of January, February and March, 2014 (three months) for area – 1 (Narayanganj, Fatullah and Munshiganj) appears to be 18.360 mmcm (million cubic meter) while the same for area – 2 (Sonargaon) is about 25.149 mmcm. The aggregate for three months for both areas is 43.509 mmcm. The system loss as percentage of the total gas supply in area – 1, area – 2 and for both areas 1 and 2, respectively, are 9.56, 8.27 and 8.77 percent.
- Factors causing system loss are inaccurate billing, leakages and illegal connection which account for 1.367, 1.417 and 5.986 percent, respectively, of the total supply. For area 1 and 2 together it amounts to 8.77 percent of the total gas supply. This means that inaccurate billing, leakages and illegal unmetered connections, respectively, account for 6.782 mmcm, 7.030 mmcm and 29.967 mmcm. The distribution of system loss by these factors may be interpreted as notional, rather than actual. If the total system loss of 43.509 mmcm is valued at TK. 6 per cubic meter, it stands at TK. 261.05 million or TK. 26.10 crores in three months (January, February, and March, 2014). If loss figures do not increase, this would mean an amount of TK. 104.44 crores in a year – a huge loss to the national exchequer.
- Comparison of two-month aggregate data for Jan-Feb, 2011 with that of 2014 shows that in terms of volume gas, system loss has increased and system loss as percentage of total supply has also increased.

6.2 Findings of the Focus Group Discussion (FGD)

The Focus Group Discussion (FGD) for the “**Impact evaluation study for System Loss Reduction on Titas Gas Transmission and Distribution Company Limited (TGTDCL)**” in the project areas covering four selected areas of Area-1: Narayanganj, Fatullah, Munshiganj and Area-2: Sonargaon, (FGD-1&2 at Narayanganj, FGD-3 & 4 at Fatullah; FGD-5 & 6 at Munshiganj; FGD- 7 & 8 at Sonargaon), All FGDs were supported by e.Gen Consultants Ltd. and Creative Consulting Ltd., Dhaka, Bangladesh. Each FGD was done as per standard procedure. Two FGDs were organized for each area with 10 participants/respondents, covering the areas under the project altogether. Eighty respondents participated to express their opinion regarding the impact of the system loss reduction works.

The Focus Group Discussions were done in the study area in order to assess the major impact of the project activities’ expected outputs, system loss, sustainability of the project activities as well as to assess the quality of works as per the technical specification of the project, identifying the strengths and weaknesses of the project, recommending for future. The major findings of the FGD comprising focal points are briefly mentioned here.

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- i. Respondents participating in the Focus Group Discussion (FGD) under all four areas of the project, opined that the TGTDCCL gas was being used round the year. This finding revealed that the TGTDCCL gas in the project areas are being efficiently used for Industrial users of Gas, Re-rolling Mills, Captive Power Generations, Garments Industries and CNG Filling Stations.
 - ii. All the respondents said that the repair works were done periodically but these were not sufficient enough.
 - iii. The quality of the rehabilitation work had not been maintained properly.
 - iv. The Gas pressure in the distribution line is insufficient particularly in Narayangonj, Fatullah and Munshigonj. A good number of customers did not get the supply of gas round the clock.
 - v. Gas leakages in riser and pipe lines are quite high, which are observed during flood time, when the distribution pipe lines are under water.
 - vi. Meter readings are not required for the preparation of the consumption bills. They are based on ether load, three month average and through negotiations.
 - vii. Some Customers receive gas at higher pressure than their neighboring Customers.
 - viii. Many EVC flow meters were damaged. Some of them were damaged within a few days of installation.
 - ix. Instead of improving gas pressure to the rated value, new connections are allowed with the existing line, worsening the condition.

6.3 Strengths of the Project

- 575 gas flow meters with EVC correction facilities were procured and installed,
- 5 mobile meter calibration units were purchased for checking the accuracy of the meters
- 36 man-months of training to TDTGCL personnel were provided for the project
- The procurement, installation and commissioning of gas flow meters with EVC correction were done according to the specification of the contract.

6.4 Weaknesses of the Project

- Gas flow meters with EVC correction facilities were not used for preparation of the consumption bills of the beneficiaries.
- The mobile meter calibration units were hardly used of checking meters

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- Specialized training (36 man-month) on skill development of 140 TDTGCL personnel by the project did not bear any fruits. They were not utilized in the project. They were either transferred or left TDTGCL for better options.
 - Many of the newly installed meters went out of order soon after their installation mainly due to battery problem and inadequate repair and maintenance facility.

6.5 Limitation of the Present Impact Evaluation Study

The following technical factors responsible for the system loss were not taken in to account.

- Leakage in the distribution net work including customer service line,
- Leakage in the metering station.
- Gas blowing during commissioning and maintenance.
- Gas condensation.
- Inaccuracies due to unmetered connection in the domestic sector.

Non technical factors not considered are as follows:

- Illegal unmetered connection.
- Illegal extension of gas line in the customer premises.
- Illegal reconnection of meters after disconnection.
- Illegal meter tempering.
- Illegal meter bypass.
- Unapproved appliances.
- Unapproved excess load.
- Obstructing meter maintenance.
- Tempering meter indicators,
- Meter removal.
- Meter reversing.
- Set pressure manipulation.
- Using magnet to slow down or stop meter movement

6.6 Recommendations

1. In order to reduce system loss due to leakages, it is recommended that the old distribution net work including customer service line and riser be replaced after making leak test, particularly in Narayanganj, Fatullah and Munshiganj. Also, in the same areas, to ensure regular supply of gas with right pressure, supply capacity be increased by increasing the diameter of service pipe line.
2. In order to reduce inaccuracy of billing and thereby reduce system loss, it is recommended that all the EVC meters installed in the project area be made functional and gas bills be prepared using the meter readings within two months. Repair and maintenance of the installed meters be made regularly and to facilitate this, new contracts, if necessary, be made with the manufacturers with regard to replacement of flawed meters and supply of spare parts. TDTGCL personnel, who were trained as a part of skill

development in the project, be brought under the project and used for the purpose of repair and maintenance activities.

3. If the above recommendation (2) cannot be followed, it is recommended that high quality EVC meters be procured and installed for all the large customers and all the manual meters be replaced by new EVC meters. It is also recommended that contractual agreement be made with the manufacturer
 - i. To guarantee quick replacement of flawed meters,
 - ii. To supply spares and consumables, and
 - iii. To provide training to O&M personnel to carry out in-house repair and maintenance.

4. Illegal connection is a serious problem. Illegal intervention by influential people should be stopped and gas connections severed and responsible persons should be taken to task. However, this is easier said than done. Considering the reality (social price of gas much greater than administered price and there exists high excess demand for gas connection for the domestic users), all the illegal gas connections be legalized and owned by the company. In this way, company could get some revenue. For example, if 10,000 domestic connections are legalized, the yearly revenue would be about 5.40 crores (at the rate 450 per month).

6.7 Conclusion

The project appears to have been unsuccessful in bringing down system loss to its desired level, from 22 percent gradually to 2.5 percent. Although it was undertaken in good intention, it appears that procurement and installations of EVC meters to some (not all) customers did not work in reducing system loss.