

Research Article

EFFECT ON CLIMATE CHANGE IN INDUSTRIALIZATION OF BANGLADESH

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ABSTRACT

The main objective of this study was to effect on climatic parameters for the green industrialization of Bangladesh of the entrepreneurs participating with green industry activities and to look at the relationship between industrialization of the entrepreneurs and their selected characteristics. The climatic effect on Green industrialization of Bangladesh was measured by computing change in building and structural integrity of the factory, water and water re use work place environment and safety, transport and source of energy, factors which affected in green industry, operational and maintenance cost of the factory. Data were collected from a sample of randomly selected 58 green factories in Dhaka, Narayanganj and Chittagong District. Simple and direct questions with different scales were used to obtain information. Person's Product Moment Co-efficient of Correlation (r) was computed in order to explore relationship between the concerned variables and comparative change was measured by "t" test. Findings indicate that the in building and structural integrity of the factory, water and water re use work place environment and safety, transport and source of energy, factors which affected in green industry, operational and maintenance cost of the factory and Their Contribution Towards Green industry of the respondents increased significantly due to participation with green industrialization. Step-wise multiple regressions were used to explore the contribution and effect of the selected characteristics of the RMG factory and to/on their green industrialization of RMG factory. The standardized partial 'b' co-efficient of the above 14 independent variables formed the equation contributing to 51.8 percent of the total variation in green industry of RMG. The average building and structural integrity of the factory of the RMG entrepreneurs increased 3.095, water and water re use in the green industry of the factory of the RMG entrepreneurs increased 3.071, work place environment and safety in the green industry of the factory of the RMG entrepreneurs increased 2.304, transport and source of energy in the green industry of the factory of the RMG entrepreneur increased 2.548 and factors which affected in green industry in the green industry of the factory of the RMG entrepreneurs increased 7.182 after involvement of green industry activities. The building ownership type, factory category, number of worker, factory Production type, operation period, duration of involvement of green industry, building type, building slab type, raw water Source, factory installed different meters, alternative transportation, high solar reflection and fresh air in factory areas had significant positive.

Keywords: Climate change, Environment, Factory, Green Industry, Solar Energy.

INTRODUCTION

The greening of industries has become a core determinant of economic competitiveness and sustainable growth of the Sustainable Development Goals (SDGs) oriented activities. Since resource inputs represent an important production cost for industries, improving efficiency gives industries a competitive advantage. The greening of industries also plays vital role in poverty alleviation of the country as well as eco-friendly environment through promoting energy security, occupational health and safety, jobs creation, and reducing costs through increased productivity of the RMG sectors of Bangladesh. Bangladesh economy has performed quite moderately against the backdrop of the global economic slowdown and various obstacles over the recent past. The economy is flourishing as a rapidly developing one with a growth rate around 6 % over the last one and half decades. The macroeconomic situation in Bangladesh has been quite stable for a considerable period of time in recent years (Bangladesh bank Report 2018). Recently Bangladesh gets status of developed country of the developed country. There are three criteria a country must fulfillment before graduating from low-income country status to developing country status. The first one is having a Gross National Income (GNI) per capita of \$1,242. Bangladesh's current per capita income is \$1,610. The second one is Human Assets Index (HAI), which has to be 66 or above. Bangladesh's HAI is 72.9 and the last one is having an Economic Vulnerability Index below 32.

Bangladesh's EVI is 25. Having fulfilled all three criteria, the country now awaits a formal approval for inclusion in the list of developing countries. Bangladesh will formally become a developing country with the approval of United Nations Economic and Social Council. As the world faces an environmental crisis that affects in many facets, economic progress is to be done in such a way that environmental considerations must be deliberated. As the world is moving forward towards a greener economy, industries are adopting policies that strive towards this goal. Bangladesh is falling in line with these policies and adopting green principles for different industries, namely the garments sector. One of the main tools towards achieving this goal is by certain guidelines that aid in the betterment of the industry for eco friendly in the RMG sectors of Bangladesh. The scarcity of natural resources and environmental pollution in regards to air and water are one of the major constraints towards sustainable future growth. In Bangladesh, some major concerns are ground water depletion, production processes that use finite resources inefficiently, unavailability of natural gas, lack of waste management and occupational health and safety measures (Ahmed and Islam, 2014). If environmental degradation is allowed to be aggregated, cleaning up or controlling any negative ramifications might end up being unfeasible. Indubitably, for the Bangladesh economic growth, this has become one of the major concerns of the government, policy makers, and environmentalists (BELA, 2017).

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MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY

Use Eco friendly Building Construction Materials

Building Construction materials that will emit less CO₂ Emission in Factory (to use recycled brick, cement, and prefabricated steel to accomplish construction) This is one indicator of used for building construction materials which emit less CO₂ emission in the factory. This is a measure of the use of amount of recycled brick, cement, and prefabricated steel to accomplish construction during construction of the building. Each respondent was asked to mention the construction materials during the build the factory. A score of one (1) was assigned for each materials used for the factory and 0 (zero) for non used the materials.

Water and Waste re use:

It was measured on the basis of the extent of change occurred in 5 selected dimensions. This five dimensions had two situation- 'before' and 'after' all before situation's score had added together and same case for after situation. Finally change in water use ad re use score was measured by computing between 'before' and 'after' situation. A score of one (1) was assigned for each materials used for the factory and 0 (zero) for non used the materials.

Workplace Environment & Safety issue:

It was measured on the basis of the extent of change occurred in 5 selected dimensions. It referred to the condition of environmental safety issue of the beneficiaries factory both "before" and "after" involvement with Green industry. These responses were scored as 0 for "no", 1 for "yes". The change in Environment & Safety issue was measured on the basis of housing unit score of the respondents between "before" and "after" involvement with Green industry.

Transports and Source of Energy

It was measured on the basis of the extent of change occurred in 5 selected dimensions. It referred to the type of toilet facilities of the respondents both "before" and "after" involvement with green industry. Each respondent was asked to indicate whether the transport facilities were squatting "alternative transport", "staff bus" and "on foot". The Source of Energy used in Factory was measured on the basis of transport and energy score of the respondents between "before" and "after" involvement with green industry in RMG sectors. A score of one (1) was assigned for each materials used for the factory and 0 (zero) for non used the materials.

Factors affected in industrialization

According to USGBC 9 (nine) factors affected to establish in green industry of RMG sectors. Building Construction materials that will emit less CO₂ Emission in your Factory (to use recycled brick, cement, and prefabricated steel to accomplish construction), Assure factory workers housing facilities, Assure schools for children's for Workers, Nearby market for shopping for workers, Assure Bus or tempo stand for transportation between 500 square meters from factory building, Ensure enough sunlight and solar power utilization to reduce the cost of electricity, To reduce the use of underground water, need to encourage for rainwater reservoir and water-saving faucet, Keep about 50% free space of total factory premises, To ensure enough trees in the factory ground. keep enough ventilation facilities to protect heat and Ensure self anti-fire instrument and training facilities. The score of the respondents between "before" and "after" involvement with green industry in RMG sectors. A score of one (1)

was assigned for each materials used for the factory and 0 (zero) for non used the materials.

Knowledge on Climate Smart Agriculture (CSA) practices to established green industry in RMG

Knowledge level on Climate Change: Knowledge is those behavior and test situations which emphasized the remembering either by recognition or recall of idea, material or phenomenon (Bloom *et al.*, 1956). In this study Climate change knowledge would be indicated by the extent of understanding harmful effects of climate change. It will be measured as evident from his responses to a set of questions related to climate change those would be logically and scientifically prepared for this purpose at the time of interview. Score (01) will be given for each of the correct answer and (0) will be given for no or incorrect answer.

Field pre-test

During the training of the Field Investigators, field test was conducted to assess the appropriateness of the developed data collection tools. The field visit was conducted at five factories from Dhaka and Narayanganj. During the field test, the Investigators filled in and checked the data collection tools. Based on observations in the field practice and suggestions made by the supervisor, data collection tools were further modified and finalized.

Field data collection

After completion of the pre test researcher re arranged the interview schedule to collect the data in this study, Field Investigators were briefed about their field assignment and overall management of data collection activities. Two teams were formed for the survey purposes. A well-designed field movement plan for effective implementation of the survey was developed and all the team members were briefed about the field action plan properly. Prior to the study in the field, necessary documents were collected from the BKMEA, BGMEA and concerned offices. The study survey has been conducted from April 2018 to July 2018 in the 3 clusters namely Dhaka, Narayanganj, and Chittagram where there are over 58 export-oriented RMG factories which established green industry according to USGBC standard. Distribution of targeted and completed interviews of both quantitative and qualitative investigations has been presented in Table 6.

Distribution of targeted and completed survey data collection of both quantitative and qualitative investigations

Survey techniques	Targeted (N)	Completed (N)	Achieved (%)
Individual interview	50	58	
Key Informant Interviews	8	8	

Instrument for Collection of Data

An interview schedule was carefully prepared in English keeping in mind the objectives of the research and following the procedures of measurement of different variables. Simple and direct questions and different scales were used to obtain information. Direct questions were included to collect information on such variables. Appropriate scales were developed to operationalize the dependent and independent variables of the study. The draft interview schedule prepared in English was pre-tested with 10 green industry owners. This pre-test facilitated the researcher to examine the suitability of different questions and statements in general. On the basis of pre-test result, corrections and modifications were done in the interview schedule.

FINDINGS AND DISCUSSION

The function of this Chapter is to explain the findings of the present study following some discussion on the significant findings. The study investigated the green industry of RMG sectors of Bangladesh, through contribution with RMG sectors and related matters. In accordance with the objectives of the study, presentation of this Chapter has been made in five sections. In the first section, 14 selected characteristics of the factory have been discussed. In the second section, the extent of building and structural integrity of the factory, water and water re use work place environment and safety, transport and source of energy, factors which affected in green industry, operational and maintenance cost of the factory and contribution towards green industry are presented. The third section, dealt with the relationships between the green industries of their selected characteristics. The fourth section, has dealt with paired t-test in relation to building and structural integrity of the factory, water and water re use work place environment and safety, transport and source of energy, factors which affected in green industry, operational and maintenance cost of the factory between "before" and "after" involvement with green industry of RMG sectors of Bangladesh and their contribution. Finally, the fifth section contained the problems faced by the Green industry entrepreneurs to established green industry.

Selected Characteristics of the Industries

The section deals with the classification of the of RMG entrepreneurs according to their Fourteen characteristics. It was, therefore, assumed that poverty alleviation, employment generation and change their agro climate due to their participation with Green Industrialization of Bangladesh activities is expected to influence by their characteristics. A Brief summary of the measuring unit, categories and distribution.

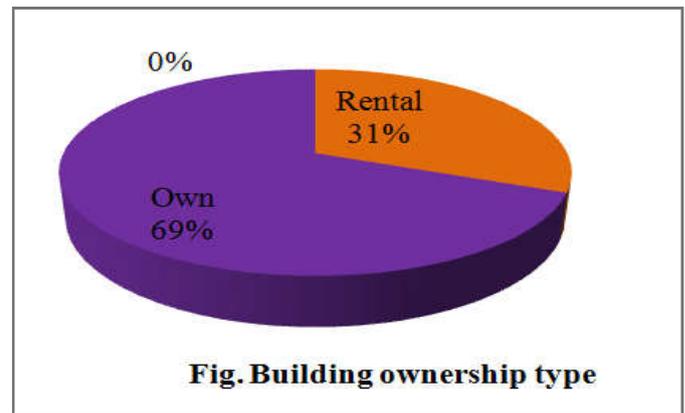
Building ownership type:

The building ownership type of the factory ranged from rental type of 18 and own 40 and a standard deviation of 0.467. The highest proportion (69 percent) of the Green industry of Bangladesh were own building ownerships to 31 percent of the being rental factories of RMG in the study area. A close up look into the data indicates that decision-making regarding impact on green industrialization of RMG Sector of Bangladesh were mostly in the hands of own building type entrepreneurs in this sectors. This is quite logical. On the basis of their building type ownerships the factory classified were classified into two categories as shown in Table 1.

Table 1. Building ownership type

Ownership type	Frequency	Percentage	Mean	Median	Mode	Std. Deviation
Rental	18	31.00	1.69	2.00	2	.467
Own	40	69.00				
Total	58	100.0				

The data were shown in the graphical type in the below

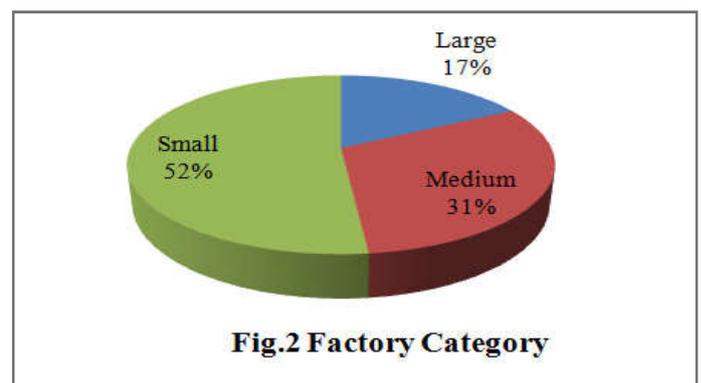


Factory Category:

The level of Green industry factory category of RMG Sectors ranged from 10 to 30 frequencies having standard deviation of .762. Based on their green industry in RMG sectors were classified into three categories as shown in Table 1. The highest proportion (51.70 percent) of the factories had small factories in the green industry of RMG sector of Bangladesh, while 31.10 percent medium factory, 17.20 percent had large factories in the RMG sector of Bangladesh. During collection of data it was observed of the large factory of Green industry of RMG sector to the contribution green climate or eco friendly environment of Bangladesh. So, the green industrialization of RMG sector of Bangladesh is necessary for proper understanding of the information and development of skills for green environment.

Table 2. Factory Category

Factory Category	Frequency	Percentage	Mean	Median	Mode	Std. Deviation
Large	10	17.20	2.34	3.00	3	.762
Medium	18	31.10				
Small	30	51.70				
Total	58	100.00				



No. of workers:

The number of factory workers was male and female of Green industry. The workers category of RMG Sectors ranged from 6350 to 7870 frequencies having standard deviation of 1371.81 to 1474.65 in respectively male and female. Based on their number of workers on green industry in RMG sectors were classified into two categories as shown in Table 2 The highest proportion (50.41 percent) of the factories had female workers in the green industry of RMG sector of Bangladesh, while 49.59 percent male workers in the RMG sector of Bangladesh. During collection of data it was observed of the large factory of Green industry of RMG sector to the contribution green climate or eco friendly environment of Bangladesh. So, the green

industrialization of RMG sector of Bangladesh is necessary for proper understanding of the information and development of skills for green environment.

Table 3 Distribution of workers by gender

Gender	N	Range	Minimum	Maximum	Mean	Std. Deviation	Percent	Total
Male	58	635	50	6400	1334.47	1371.81	49.59	7739
Female	58	787	130	8000	1356.72	1474.65	50.41	7869
Valid N (listwise)	58							156089

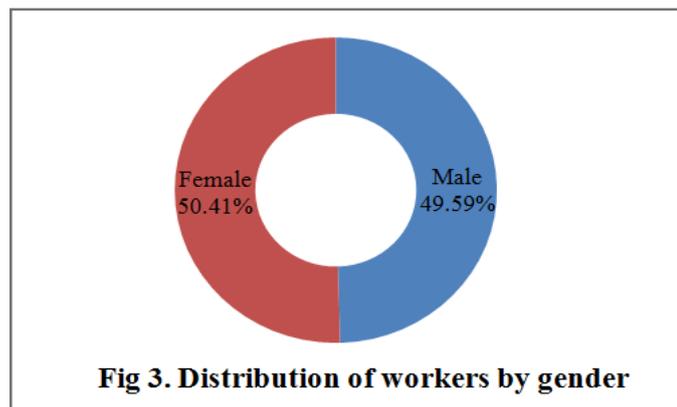


Fig 3. Distribution of workers by gender

Factory Production Type:

The factory production type of the green industry of RMG sectors of Bangladesh ranged from 13 to 30 with a standard deviation of 0.817. Based on the factory production type the factories were classified into three categories as shown in Table 4. Data presented in Table 4 show that the highest proportion (51.70 percent) of the factories are knitwear, while 25.90 percent of factories are woven and the remaining 22.40 percent of factories are sweaters for green industrialization of RMG sectors of Bangladesh. Thus, more than fifty percent of knit factories of green industry are Ready Made Garments factories.

Table 4. Factory Production Type

Production Type	Frequency	Valid Percent	Mean	Median	Mode	Std. Deviation
Knit	30	51.70				
Woven	15	25.90	1.71	1.00	1	.817
Sweater	13	22.40				
Total	58	100.00				

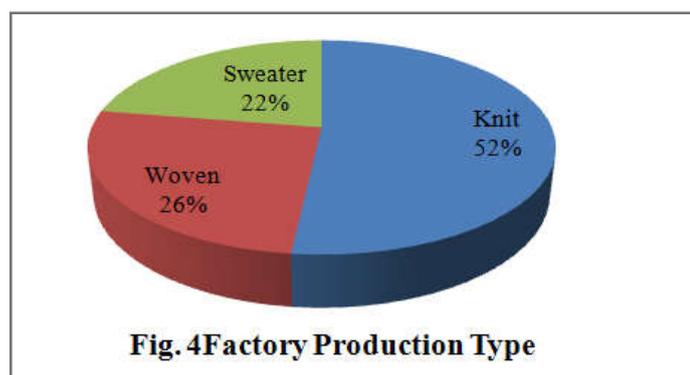


Fig. 4 Factory Production Type

Operating periods:

The factory operating period's scores of the respondents ranged from 5 to 30 years of operation. The operating periods 0-5 years was 1.72 percent of the green industry established, 6-10 years was 6.90 percent, 11-15 years was 32.76 percent, 16-20 years was 31.03 percent, 21-25 years was 24.14 percent and 26-30 years was 3.45 percent the year of established the RMG factory. The operating periods scores were classified into six categories as shown in Table 4.5. Data presented in Table 4.5 shows that 32.76 percent of the factory and 31.03 percent of the factory year of operation periods were 11 to 20 years of established which was the best impact assessment of green industry of RMG sectors in Bangladesh.

Table 5. Operating Period

Year	Frequency	Valid Percent	Mean	Median	Mode	Std. Deviation
0-5	1	1.72				
6-10	4	6.90				
11-15	19	32.76				
16-20	18	31.03	3.79	4.00	3	1.056
21-25	14	24.14				
26-30	2	3.45				
Total	58	100.00				

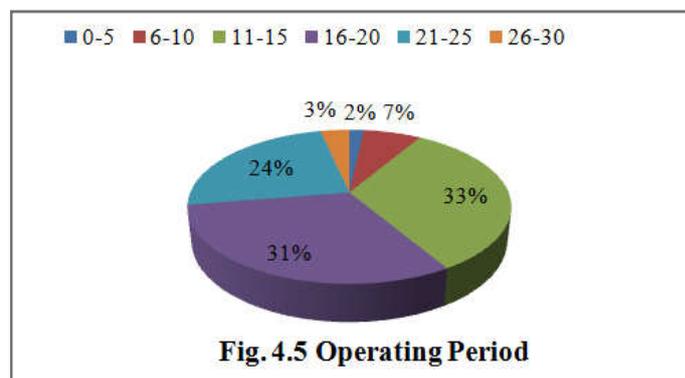


Fig. 4.5 Operating Period

Duration of involvement with Green Industry

Duration of involvement with green industry is a major way of green industrialization of RMG sectors of Bangladesh which are components of smart climate in nature. Their involvement with Green industry ranged from 1 to 29 years a standard deviation of 0.696. On the basis of Green industry involvement, the respondents were classified into four categories as shown in Table 6. The involvement of green industry 0-5 years was 39.70 percent of the green industry established, 6-10 years was 50.00 percent, 11-15 years was 8.60 percent, 16-20 years was 1.70 percent year of RMG factory. Data presented in Table 4.6 shows that 50.00 percent of the factories had duration of involvement with green industry of RMG sectors of Bangladesh which is the best result of impact analysis of the study.

Table 6. Duration of Involvement with green Industry

Year	Frequency	Valid Percent	Mean	Median	Mode	Std. Deviation
0-5	23	39.70				
6-10	29	50.00				
11-15	5	8.60	1.72	2.00	2	.696
16-20	1	1.70				
Total	58	100.00				

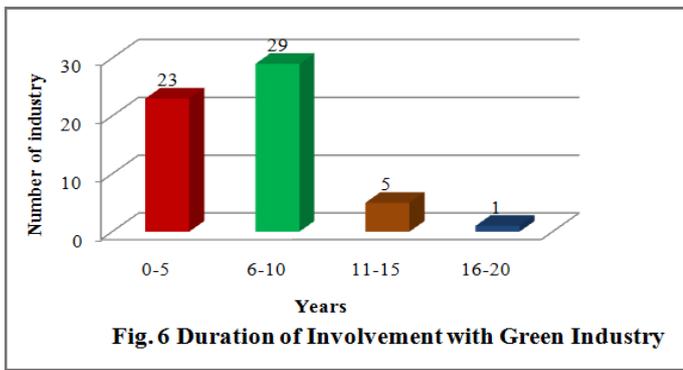


Fig. 6 Duration of Involvement with Green Industry

Building type:

The building type of the RMG sectors with green industry is a major attribution of eco friendly environment of nature. The building type of Green industry ranged from 9 to 18 score and standard deviation of 1.354. On the basis of factory building type, the factories were classified five categories as shown in Table 7. The building type of green industry were Single Building 15.52 per cent, Campus type of green industry was 31.03 per cent, shed type of factory was 17.24 per cent, Concrete Structure was 18.97 per cent and Steel Structure was 17.24 per cent of green industry of RMG factory. Data presented in Table 7 shows that campus type of building 31.03 percent of the factory had play a significant role of green industrialization of RMG sectors of Bangladesh.

Table 7. Building Type

Building Type	Frequency	Valid Percent	Mean	Median	Mode	Std. Deviation
Single Building	9	15.52	2.91	3.00	2	1.354
Campus	18	31.03				
Shed	10	17.24				
Concrete Structure	11	18.97				
Steel Structure	10	17.24				
Total	58	100.00				

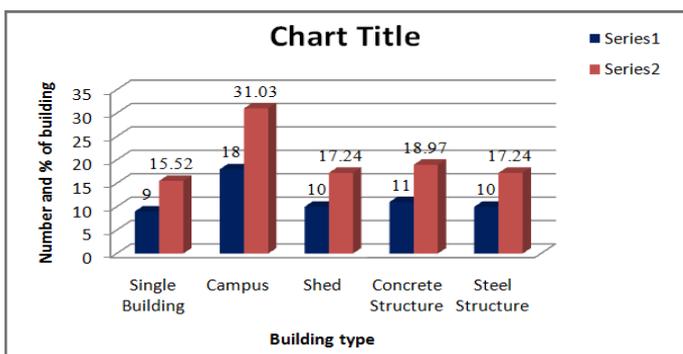


Fig: 7 Building Type of the green industry of RMG factory

Building Slab type:

The building slab type of the RMG sectors with green industry is a major attribution of eco friendly environment of nature. The building slab type of Green industry ranged from 15 to 24 score and standard deviation of 0.812. On the basis of factory building slab type, the factories were classified four categories as shown in Table 8. The building slab type of green industry were flat slab 25.86 per cent, beam supported slab was 32.76 per cent, and combined type was 41.38 per cent of green industry of RMG factory. Data presented

in Table 8 shows that combined type of building slab 41.38 percent of the factory had play a significant role of green industrialization of RMG sectors of Bangladesh.

Table 8. Building Slab Type

Slab Type	Frequency	Valid Percent	Mean	Median	Mode	Std. Deviation
Flat Slab	15	25.86				
Beam	19	32.76	2.16	2.00	3	.812
Supported						
Combined	24	41.38				
Total	58	100.00				

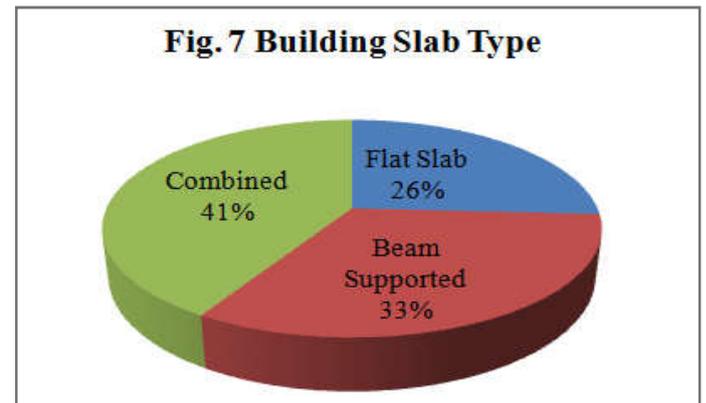


Fig:8 Building Slab type of green industry of RMG

Raw Water source (s):

The raw water sources of the RMG factory ranged from 2 to 38 score and standard deviation of 0.523. On the basis of factory raw water source the factories were classified three categories as shown in Table 9. The source of water in the factory were 65.52 per cent of ground water which is used rain water harvest and underground water source of green industry of RMG factory. Data presented in Table 9 shows that ground water as well as rain water harvest system play a significant role of green industrialization of RMG sectors of Bangladesh.

Table 9. Raw Water Source

Sources of Water	Frequency	Valid Percent	Mean	Median	Mode	Std. Deviation
No water source	2	3.45	1.28	1.00	1	.523
Ground Water	38	65.52				
Municipal Supply	18	31.03				
Total	58	100.00				

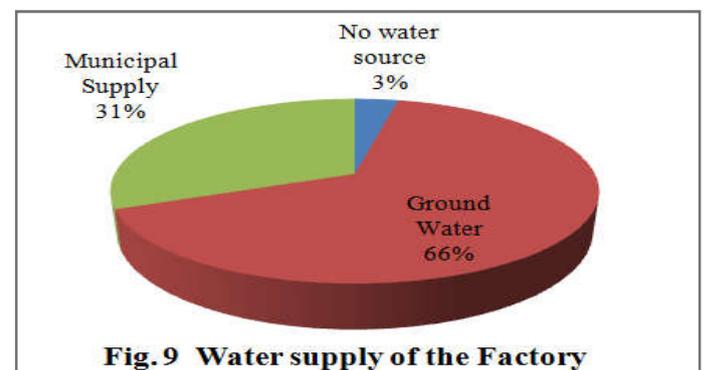


Fig. 9 Water supply of the Factory

4 Indoor Air Quality Building Educations and Assessment:

The Indoor Air Quality Building Educations and Assessment of the RMG factory ranged from 23 to 35 score and standard deviation of 0.493. On the basis of factory indoor air quality were classified two categories as shown in Table 10. The source of fresh air in the factory were 65.52 per cent of ground water which is used rain water harvest and underground water source of green industry of RMG factory. Data presented in Table 9 shows that ground water as well as rain water harvest system play a significant role of green industrialization of RMG sectors of Bangladesh.

Table 10 Indoor Air Quality Building Education and Assessment Model

Air Quality	Frequency	Valid Percent	Mean	Median	Mode	Std. Deviation
No	23	39.66				
Yes	35	60.34	.60	1.00	1	.493
Total	58	100.00				

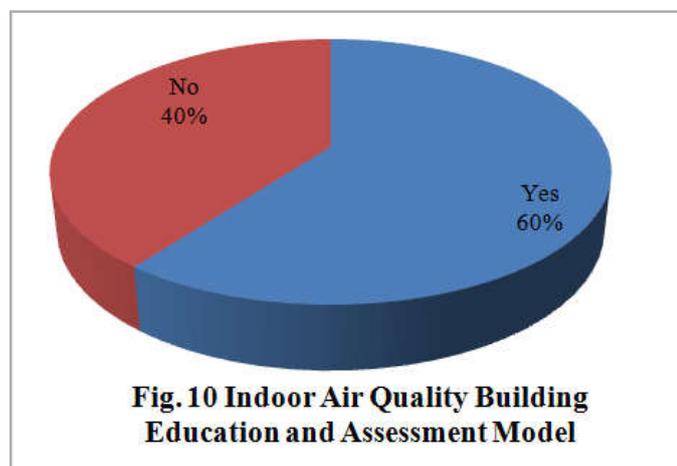


Fig. 10 Indoor Air Quality Building Education and Assessment Model

Factory installed the meters:

The Factory installed the meters of the RMG factory ranged from 2 to 24 score and standard deviation of 1.339. On the basis of factory installed different type of meters were classified five categories as shown in Table 11. The source of different type of measuring meters for eco friendly environment CO2 meter 22.41 per cent, temperature meter were 41.38 per cent, Particulate Matter were 3.45 per cent Humidity meter were 22.41 per cent and sound meter were 10.34 per cent of green industry of RMG factory. Data presented in Table 11 shows that temperature meter, CO2 meter and Humidity meter play a significant role of green industrialization of RMG sectors of Bangladesh.

Table 11.Installed Meters

Meters	Frequency	Valid Percent	Mean	Median	Mode	Std. Deviation
CO2	13	22.41				
Temperature	24	41.38				
Particulate Matter	2	3.45	2.57	2.00	2	1.339
Humidity	13	22.41				
Sound	6	10.34				
Total	58	100.00				

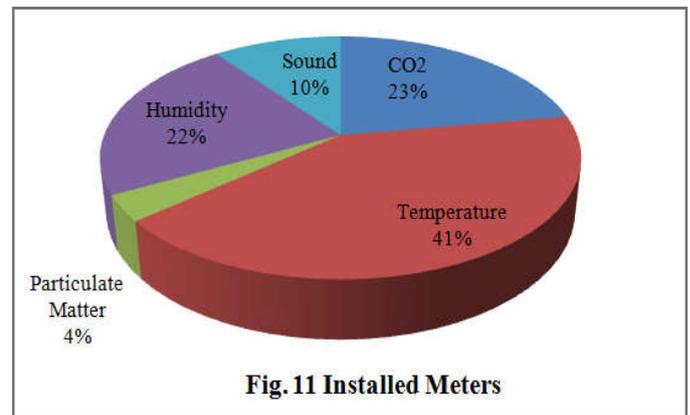


Fig. 11 Installed Meters

Promote alternative transportation:

The Promote alternative transportation of the RMG factory ranged from 20 to 38 score and standard deviation of 0.479. On the basis of factory used transportation were classified two categories as shown in Table 12. The sources of different type of transportation were used 65.50 percent among the employee of green industry of RMG factory. Data presented in Table 12 shows used of transportation that temperature meter, CO2 meter and Humidity meter play a significant role of green industrialization of RMG sectors of Bangladesh.

Table 12. Factory promoted alternative transportation and rideshare amongst employee

Alternative transportation	Frequency	Valid Percent	Mean	Median	Mode	Std. Deviation
Yes	38	65.50	.66	1.00	1	.479
No	20	34.50				
Total	58	100.00				

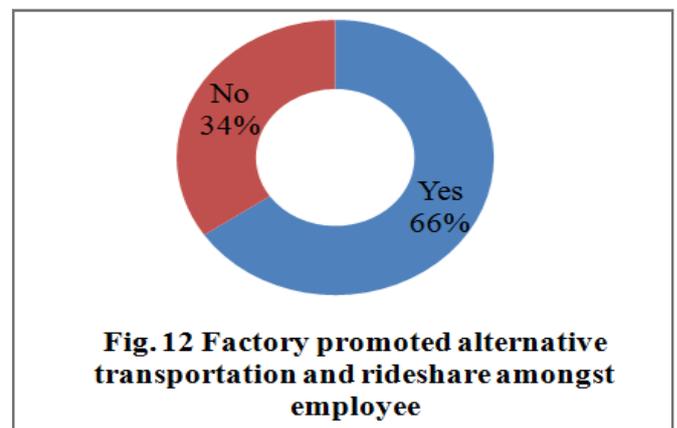


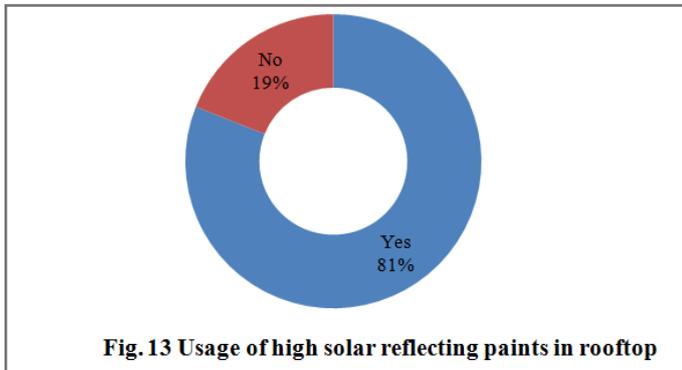
Fig. 12 Factory promoted alternative transportation and rideshare amongst employee

Usage of high solar reflecting paints in rooftop

The usage of high solar reflecting paints in rooftop of the RMG factory ranged from 11 to 47 score and standard deviation of 0.395. On the basis of Usage of high solar reflecting paints in rooftop were classified two categories as shown in Table 13. The sources of different type of transportation were used 65.50 percent among the employee of green industry of RMG factory. Data presented in Table 4.13 shows usage of high solar reflecting paints in rooftop 81 per cent use rooftop high solar energy factory requirements to establishment green industry. Usage of high solar reflecting paints in rooftop play a significant role of green industrialization of RMG sectors of Bangladesh.

Table 13. Usage of high solar reflecting paints in rooftop

Solar Reflection	Frequency	Valid Percent	Mean	Median	Mode	Std. Deviation
Yes	47	81.0				
No	11	19.0	.81	1.00	1	.395
Total	58	100.0				

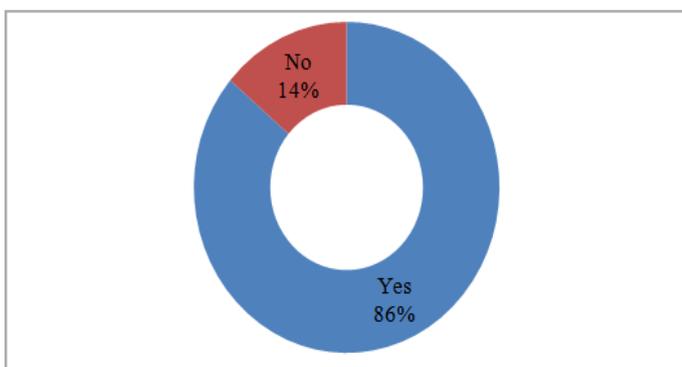


Factory meets the fresh air requirement in each of the working zone

The Factory meets the fresh air requirement in each of the working zone of the RMG factory ranged from 8 to 50 score and standard deviation of 0.348. On the basis of Factory meets the fresh air requirements in each of the working zone were classified two categories as shown in Table 14. The sources of fresh air were used 86.2 per cent available in the factory working place the employee of green industry of RMG factory. Data presented in Table 14 shows used Factory meets the fresh air requirement in each of the working zone play a significant role of green industrialization of RMG sectors of Bangladesh.

Table 14. Factory meets the fresh air requirement in each of the working zone

Fresh air requirement	Frequency	Valid Percent	Mean	Median	Mode	Std. Deviation
Yes	50	86.2				
No	8	13.8	.86	1.00	1	.348
Total	58	100.0				



CONCLUSIONS

On the basis of the findings of the study and the logical interpretation of their meaning in the light of the other relevant facts enabled the researcher to draw the following conclusions: Government of Bangladesh has already taken several programs to address the Coherently addressing the 17 Sustainable Development Goals (SDGs) requires planning tools that guide policy makers. Among the 17 Goals this study adopt SDG6 Ensure access to water and sanitation for all, SDG7 Ensure access to affordable, reliable, sustainable and modern energy, SDGs 8 Decent Work and Economic Growth, SDG12 Ensure sustainable consumption and production patterns and SDG13 Take urgent action to combat climate and its impacts to green industrialization of RMG Sectors of Bangladesh should consider objectives earnestly to formulate its future policy. Green industrialization of RMG Sectors of the RMG beneficiaries was conducted in Dhaka, Narayanganj and Chittagong District. Findings of the study may be verified and compared by similar study in the other district of Bangladesh

Acknowledgement

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