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INDUSTRIES IN SYLHET, WASTE MANAGEMENT SCENARIO AND FEASIBILITY OF NEW INDUSTRIAL ESTABLISHMENT

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ABSTRACT- *Bangladesh is one of the fastest developing countries in the south Asia. Industrial growth and development is one of the pre-requisites for economic progress here. But, Sylhet as a north eastern region is not industrially rich inspite of having several resources including natural gas. Moreover the ratio of industrial loan in Sylhet division is very low: 4.61% for working capital financing and 8.72% for industry (other than working capital) (obtained from Bangladesh Bank, Sylhet in 2009). This paper elucidates an attempt to study the reasons behind it. Again the existing industries produce waste products that unless treated or mitigated in some way will be harmful to the human or natural environment .This paper presents an overview of industrial waste management (IWM) for both technical and regulatory arrangements in the Sylhet region. Industrial waste management in Sylhet has long way to go before it can reach a good level of compliance to regulations and for the capacity to manage this waste to match the volume of waste generated. According to environment bureau- Sylhet, more than 5% of regional waste generates from industry and only 30% of industrial waste is treated. This paper discusses the primary findings of contribution on the waste drivers that are influencing the progress in compliance and capacity development in industrial waste management in Sylhet. Information from more than 13 industrial regions including multinational companies, BSCIC, BCIC industries and other local firms was collected to get the present waste management scenario. A feasibility study has also been conducted for setting up new industries in sylhet based on geographical region, availability of raw material insisting on natural gas and waste minimization criteria including 3R(reuse-recovery-recycle) policy. In addition to the survey, several in-depth interviews were also conducted with selected individuals for their in-sights and opinions on the matter. The awareness to the potential impacts from the waste they generate, their thinking to improve management system, and to the desired rank in the environmental ratings and revelation program against the conditions of the Government's command and intension to adopt 3R type waste solutions form the variables in this interacting system are also considered. These findings are suggested to the responsible investors and policy makers for developing strategies to manage industrial development and waste minimization.*

Key words: Industrial waste, minimization, feasibility, environment, employee satisfaction

1. INTRODUCTION

Industrial development is an inherent pre-requisite for the socio-economic development of the nation. Industry growth is one of the most influencing factors on GDP in Bangladesh. An outlook on GDP composition for 2010 is shown on figure-1. Industrial growth in Sylhet city is not in a good look [1]. Sylhet, as a prospective region for industrialization, had been neglected by the government and other local stakeholders. Only the tea industry has been developed in that region, mainly at the hands of multinational companies in the private sector. Several industries especially textile sectors had to face unexpected closure due to lack of facilities and Government help. The region 'Sylhet' does not seem to have serious consideration for industrial purpose including export processing zone (EPZ).

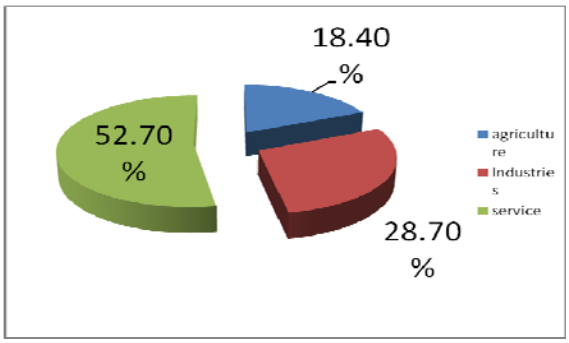


Fig. 1: GDP dependency on industry, 2010

Although natural gas, the country's most valuable natural resource, is available in that region, a nominal attempt has so far been made since the independence to capitalize such resources in industrialization of the Sylhet region with minimum cost and effort. The present industrial growth rate has been estimated as 35% with 611 industries for last seven years from the survey.

Again the existing industries are used to generate a large volume of waste that is much toxical.So industrial treatment must be environmentally friendly at a time. Now-a-days, mushrooming expansion of industrial waste in Bangladesh results an extensive environmental hazard. The massive toxic waste products from these industries are thrown in the environment without treatment and this affects health of human and animals and causes serious economic and other welfare losses. According to EPA (1990)[2], waste is any substance which constitutes scraps material or other unwanted surplus substance arising from the application of any process. WHO (2000) defined solid waste as useless, unwanted or discarded materials and are not free flowing [3]. Typically one to two third of the generated solid waste are not collected (World Resources Institute, 1996) [4]. According to Pongrazc et al (2004) "The Theory of Waste Management is a unified body of knowledge about waste and waste management, and it is founded on the expectation that waste management is to prevent waste to cause harm to human health and the environment and promote resource use optimization" .

Open dumping is very common rather than incineration or composting in developing countries like Bangladesh as it is cheap and requires no planning. Generally, the low-lying areas and outskirts of the towns and cities are used for this purpose. Thus pollution from industrial purpose is in now at an extreme level. Characteristics and the amount of waste differ according to the climate and category of industries.

According to Pongrazc et al (2004), a reductionist approach is favorable in terms of industrial ecology. They propose a complex web of interactions in which Industrial Ecology exists as an overarching envelope in which elements of both design theory and social theory combine to inform waste management theory, which itself guides the development of tool, goals, values and restrictions of the waste management process.

As a part of Industrial Geography study, this paper deals with the special dimension of these industrial establishments in the north eastern region of Bangladesh and types of industrial solid and hazardous wastes that are untreatably dumped. It also analyzes the existing national regulation with their effectiveness in application according to the environmental impact. This study proposes an alternative approach towards the industrial waste minimization as well as a feasibility analysis for setting up new industries in Sylhet.

2. RESEARCH METHODOLOGY

The following methods are used in the study.

2.1.1 Literature review

There is indistinct information regarding industrial waste. Consult has been made with key personnel of research institutions, government and non-government organizations associated with industrial waste management. A questionnaire survey and field observation has been conducted among the informal sector and then cross checked.

2.1.2 Analytical study

The study was an exploratory in nature**.** Analytical study was based on the primary data collected through in-depth interviews and observations. These surveys were focused on industrial scenario, waste management practices, motivations and barriers behind, and the adoption of waste minimization practices in the targeted industrial zone.

2.1.3 Observation

Qualitative and quantitative data could be gathered through primary and secondary sources. The drawback of secondary data, however, is lack of sufficient details about environmental and socio-economic variables. Important details could be missed for various reasons like confidentiality and sensitivity, fear of negative repercussions and mostly awareness barrier on the area or subject matter under discussion. Therefore, information was collected based on observations for clarity and to learn facts. Thus data were captured and validated either before or after physical observation, and measurements taken if deemed necessary.

2.1.4 Study Area

Sylhet, on the edge of the river surma, is the north eastern city of Bangladesh. It is located at 24°53′ N latitude and 91°53′ E longitude with an estimated population of 0.6 million and a high migration rate especially a population growth rate of 4% per annum [5] in comparison to the annual average growth rate of 2.01% in Bangladesh [6]. This increasing population results rapid and mushrooming expansion of waste products in the city that causes a long chain of hazardous problems. Now-a-days the waste generated per day throughout the city is approximately 215 tons.

The important spot where the analysis has been conducted is presented by the table 1 (source- field survey and SCC). A discussion has also made with "Bangladesh environment bureau, at uposohar, sylhet" and "Bangladesh Standard Testing Institute (BSTI)." at khadim nogor, Sylhet.

Table 1: different spots of study area

Category of industry	Name	Locations	Area (Acre)
Metal (MI)	Alim Industries Ltd.	Gotatikor	1.5
Ceramic (CeI)	Khadim Ceramics Ltd.	Khadimnogor	10
Ply-wood (PlI)	Ply wood industry	Hingazia, Kulaura	0.1
Rubber (RI)	Malnichhara Agro-processing Industry	Malnichhara	0.5

Cement (CI)	Chhatak Cement Company Ltd.,	Chhatak	155
	Lafarge-Surma Cement Company Ltd.	Chhatak	100
Fertilizer (FI)	Natural Gas Fertilizer Factory Ltd.	Fenchugong	192.76
Food and beverage (FBI)	Bonoful, fulkoli, modhubon	BSCIC, Khadimnogor	0.5 (avg)
Pharmaceutical and chemical (PCI)	Silco Pharmaceuticals Ltd.	BSCIC, Khadimnogor,	0.5
	Oyester Pharmaceuticals Ltd.	Sadipur	0.3
	Saaj Chemicals Ltd	BSCIC, Gotatikor	0.3
Textile (TxI)	Islam Textile ktd.	BSCIC, Khadimnogor	1.0
Stone crusher (SCI)	Several	Jaflong and Volagonj	0.5 (avg)
Concrete slipper (CSI)	Prestressed Concrete Slipper Factory Ltd.	Chhatak	15
Brick (BrI)	M,M Brick Industries	Tukerbazar	1.0
Tea (TI)	BTRI	Srimangal	1.0
Battery (BI)	Suntec Energy Ltd.	BSCIC, Khadimnogor,	0.5
Polythene packaging (PPI)	Sonar Bangla Enterprise	BSCIC, Gotatikor	0.8
Plastic(PI)	Ripon plastic	Kodomtoli	1
	Vuya plastic	Bi-pass road	0.8

There is a huge number of food and stone crushing factories at a small scale all over the Sylhet. That is why the study area has been averaged for those factories.

3. Result and Discussion

3.1 Present scenario of industry in Sylhet

3.1.1 Growth of different scale industry

From last 20 years there have been a significant expansion of the total number of industrial establishments from 23 establishments in 1980 to 611 in 2010 (figure 1). Over the same period, the number of workers employed in these establishments increased from 37000 to more than 223063. (Source-survey)

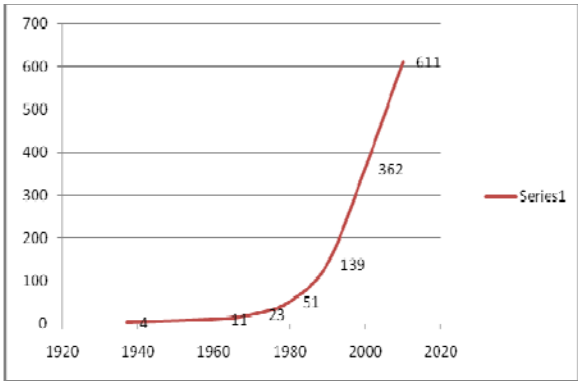


Figure 1 (Year vs. No. of industries)

3.1.2 Activity test based on employee number and satisfaction

An activity test among the employees has been conducted based on their involvement with respect to the requirement at different industries. Their demand and satisfaction level has also been included in order to get a clear view of the activity status of industries. An outstanding activity status has been observed for small scale industries including battery, ply-wood and ceramics with respect to BCIC industries.

Table 2: Activity status regarding employee involvement (source-survey)

Industry category	Employee (Permanent)		Activity (%)	Employee Satisfaction (%)		
	present	required		Low	Moderate	high
CSI	40	50	80	20	70	10
FI	584	905	64	25	60	15
CeI	400	500	80	10	75	15
PI	884	1200	73	70	30	05
PlI	100	115	86	35	55	10
MI	400	615	65	45	50	05
PCI	200	200	100	20	60	20
TI	124150	180000	68	25	70	O5
BrI	75000	90000	83	60	40	-
RI	6375	8000	80	40	50	10
FBI	3600	4000	90	25	65	10
BI	100	110	90	15	75	10
SCI	9000	10000	90	80	20	-
CI	1200	1500	80	25	65	10
PPI	30	30	100	35	60	05

3.1.3 Particular industry with product specification

The product types of both large and small scale industries produced in Sylhet is mentioned on table 3.

Table 3: Types of each product and raw material with their amounts (source-survey)

Industry category No. of industries		Raw materials		Production	
		Type	Amount per day(avg)	Type	Capacity per day (avg)
TI	120-125	Green tea leaves	0.005 million kg	Tea	0.0012million kg
BrI	300-360	Mud	85 ton	Brick	60 ton
RI	85	Synthetic rubber, rubber refuse, calcium powder, silicate and zinc oxide.	0.55 ton	Rubber	0.5 ton
FBI	60	Wheat sugar, palm oil, water	11000 kg	Biscuit, bread, sweets, spices	8.13 ton
CeI	01	Clay, mineral (additives)	60 ton	Green product	53 ton
				Finished product	25-27 ton
ScI	400-500	Stones	20 ton	Crushed stone	17.5 ton
PCI	02	Chemicals, antibiotics	8 ton	Tablet, capsule, Liquid suspension, Dry powder	5 ton
MI	7-8	Aluminum sheet, iron sheet, angle flat bar,	5 ton	Power trailer,	24 pieces
				power thrasher,	12 pieces
				Utensils	190 kg
PoI	04	Natural gas	9.865 mmft	Electricity	60.25 MW
BI	01	Lead,	1 ton	Battery	40 pieces
		Lead-oxide,	800kg-1 ton		
		Hydrochloric acid,	irregular		
		sodium hydroxide	200 kg		
		demy water,	500 L		
		sulfur	1.33 kg		
TxI	02	Thread	200 lb	cloth	1800 gauge
PPI	01	Polythene resin	0.5 ton	Food product's packaging	0.485 ton
PlI	01	Natural gas	200 m^3	Ply wood	1.9 ton
		Soft wood	2 ton		
CI	02	Lime stone,	1601.706 ton	Clinker (intermediate)	1953.3 ton
		Gypsum,	97.665 ton		
		Shell or clay,	292.995 ton	Cement	2619 ton
		sand,	48.832 ton		
		iron ore,	9.756 ton		
FI	01	Natural gas	192000 m^3	Urea	200 M.ton
		Water	31200 M.ton	Liquid Ammonia	117.8 M.ton
CSI	01	Rapid hardening cement, stones, sand, high tensile strength wire	1000-1200 sft	Concrete sleeper	800-950 sft
PI	03	Plastic granules and waste plastic	2.11 ton	Finished plastic materials	1.81 ton

3.2 Industrial waste management scenario

3.2.1. Fraction of liquid waste obtained per unit of production capacity

A significant amount of industrial liquid waste is being generated everyday in Sylhet city. According to environment bureau in Sylhet, the amount of liquid waste is 35-50% compared to the total industrial waste. Composition of industrial liquid waste generated in Sylhet city is shown on table-5 with their amount.

Table: 5- amount of liquid waste produced per unit capacity of different industries

Industry	Generated waste stream(average)		Amount of waste produced per unit capacity (m^3/ton)
	Composition	amount(m^3/ day)	
1.FI	Waste water(ammoniacal N_2, oil, chloride, grease, Dissolved solid)	40000	200
2.PCI	Liquid chemicals and antibiotics	0.750	0.3
3. PPI	Polymer resin	0.0125	0.025
4. BI	Demineralized water with H_2SO_4	0.5	0.5
5. CSI	Grease, mould oil	0.02	0.0006

Source-survey

3.2.2 Fraction of solid waste obtained per unit of production capacity

Amount of industrial solid waste generated in Sylhet everyday is almost 40 %(according to environment bureau, Sylhet) of the total Industrial waste. The solid waste generation with per unit production capacity is shown on table 6.

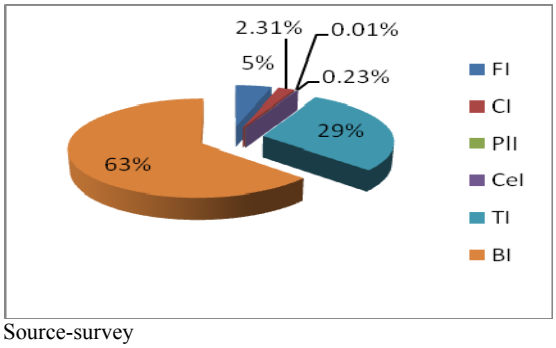
Table: 6-Obtained solid waste per unit production

Industry	Generated waste stream(average)		Fraction waste produced per unit capacity
	composition	Amount (ton/day)	
1. SI	Steel and metal chips	0.50	0.05
2. TxI	Bobbin, wear-waste	0.02	0.05
3. CSI	Stone chips, sand, steel wire, MCL insert	0.225	0.0075
4. CI	Dust	597.6	0.23
5.TI	Fiber of tea leaves, dust	0.05	0.042
6. PII	Fire wood	0.10	0.053
7. SI	Powdered stone	0.75	0.10
8. BI	Mud, burned coal	20	0.33
9. RI	Rubber refuse, calcium powder	0.032	0.055

Source-survey

3.2.3 Comparison of gaseous emission in Sylhet

About 30% industrial waste is gaseous according to environment bureau. But it is not practised to observe the exact amount of gaseous waste in the local industries**.** An analytical comparison of gaseous emission is shown on figure 2 which consists of 63% waste from brick sector.



Source-survey

Fig.2:- Comparison of gaseous emission

In general the gaseous waste from almost all industries are composed of CO, CO_2, SO_x, NO_x and other particulate suspension material.

3.3 Present look on forgoing industrial waste management system

An average figure of waste treatment can be estimated from the field survey for the local industries in Sylhet region at figure 3 which shows about 35% waste are being land filled.

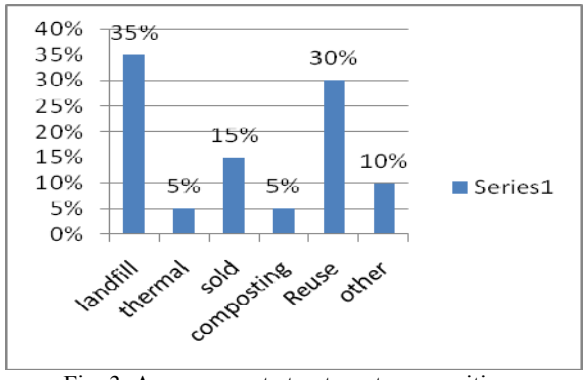


Fig. 3: Average waste treatment composition

Present scenario of waste treatment from various industries is shown on table 7. It includes the material

recovery for useful purposes and also indicates an average amount of 58.85% untreated waste that is land filled.

Table 7: Present waste management scenario

Type of Industry	Waste management system			
	Landfill Disposal (100%)		Recovery (100%)	
			Material/energy (%)	Useful purposes
	Treated	Untreated		
1.FI	100 (L)	0 (L)	0	No use
2.PCI	33	67	0	No use
3. MI	0	100(S)	20%(S)	Sales revenue
4. FBI	0	100(S)	3%	Feed stock
5. TI	95(L)	5(L)	1%	In composting
6. CSI	30	70	20%	Sales revenue
7. CI	65(L)	35(L)	90(S)	Main process
8. CeI	0	0	93(S)	Main steam
			98(L)	Lubricating oil

Source-survey

3.4 Findings and proposal for industrial sector

3.4.1 Reasons behind low industrial development in Sylhet

Remittance users of the region spend a substantial portion of their funds in non-productive sectors like conspicuous consumption, construction of luxury buildings for housing and community center purposes (especially in rural areas), land purchase etc. The ratio of advance loan is in a miserable figure in Sylhet with respect to other cities (Bangladesh bank, 2007). It is shown on the figure (4).

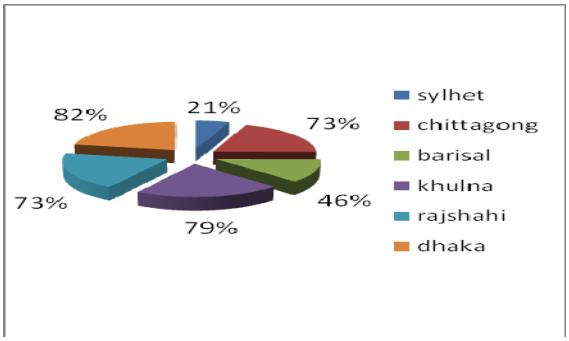


Fig. 4: Poor deposit distribution in Sylhet

Moreover the ratio of industrial loan in Sylhet division is very low: 4.61% for working capital financing and 8.72% for industry (other than working capital) (obtained from Bangladesh Bank, Sylhet in 2009), while the corresponding national figures for the same variable were 17.99% and 21.44% respectively in December 2007 (Bangladesh Bank, 2007).[7] Such a situation demands analysis of the factors causing this particular financial environment, through stakeholders involvement, especially in the context of productive investment and sustainable development.

3.4.2 The future opportunity of productive investment in the Sylhet region

If the local resources can be utilized more efficiently, productivity will increase significantly. Natural gas, the country's most valuable natural resource, is available in the region; a nominal attempt has so far been made. To capitalize such resources in industrialization of the Sylhet region with minimum cost and effort the criteria consists of

a) Local patriotism
b) Availability of capital
c) Cheap labor cost
d) Availability of land
e) Available raw materials

A number of feasible industries in Sylhet are listed on table (8) with their respective reasons for establishment.

Table 8: Probable feasibility of industries in Sylhet

Industry	Reason
Tea , rubber, coffee	Availability of land and trees, produces non-hazardous waste
Ply wood	Available fertile land for soft wood
Fertilizer and power	Availability of natural gas
Ceramic and battery	High demand, profitable and environmentally low toxic.
Food	Generate biological waste that can be composted and profitable
Glass	Availability of silica sand in Sunamganj
Cement	Availability of rock, river transportation facility

3.4.3 Industrial waste minimization barriers

Industries in sylhet are a major source of pollution emitting all sorts of wastes. In addition, they are source

of noise pollution (MI and SCI). Most of industries don't seem to have serious consideration about their waste management system due to equipment-shortage except some multi-national companies. The fundamental reasons behind this poor waste management system are:
1) Lack of technological knowledge about Industrial Waste Management (IWM)
2) Lack of knowledge to overcome present waste management barriers.
3) Lack of modern technologies (e.g Bangladesh has no close-system to reduce sound pollution)
4) Lack of creativity & awareness among potential investors (e.g BSCIC has no concern on having a central ETP for all the industries running under it)
5) Lack of a regional policy regarding industry installation.
6) Though Bangladesh Environment Conservation Act (1995) has seen its root in Sylhet after the establishment of environmental bureau in 2004, the industries installed before that year still remains out of the act.

3.4.4 An alternative proposal to minimization of existing industrial waste

There are many industries that dispose off their wastes in a haphazard and unsafe manner in low lying areas, nearby wetlands and rivers (FI, FBI and PCI). So, it seems that the manner in which industries deal with wastes is to ignore the problem. As environmental regulations have started to be tightened, the tendency is to tackle the problem by *Dilute and Disperse*. As pollution starts to build up in surface water, land and air, the dispersion technique is no longer acceptable, and treatment should be the preferred approach. A waste hierarchy model is shown on figure 5.

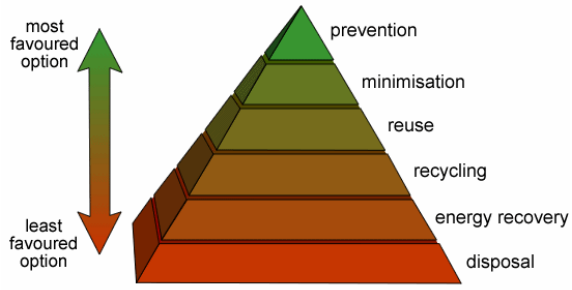


Fig 5- waste hierarchy [8]

Eventually the higher concepts of waste management, such as *3R and Cleaner Production* must take their roots, and industries need to be moving towards **Prevention**. 3R stands for, **Reduce, Reuse and Recycle**

• *Reducing* means choosing to use items with care to reduce the amount of waste generated
• *Reusing* involves the repeated use of items or part of items which still have some useful aspects.
• *Recycling* means the use of waste itself as a resource.

The following is a hierarchy of steps that can be followed to achieve 3R for industries in Sylhet.

1. Waste Audit and Housekeeping
2. Change Raw Materials
3. Existing Process Modification and updating of inventories
4. Processes that Produce Less Waste
5. Product Design: to produce less waste

A number of technological barriers have to be overcome to achieve the 3R goals. The strategies to be adopted here are:

• It should be made mandatory on the part of industries to report changes/additions in hazardous waste generation and steps are to be taken to reduce generation of waste per unit of production (especially for MI, TxI, and CI).
• Low cost multiple technological options for waste treatment with greater emphasis on resource recovery and recycling. (e.g. BI must be taken under compliance to follow any of three technologies: ZIGZAK, HOFFMAN and VERTICAL SHAFT).
• Decentralized technologies of waste treatment or recycling should be preferred for large-scale industries (e.g CI, FI, TxI) and centralized technologies for the smaller ones (e.g BSCIC industries).

4. CONCLUSION

The study was conducted in 16 categories of industries including BSCIC areas towards a quantitative estimation of production level and wastes generation. Medium and small scale industries are found to have a good productivity including tea, ply-wood and rubber industry. A good probable region can be developed here for textile and natural gas derived production by improving the transportation and power supply system. The impacts of the generated wastes in the environment from the existing industries and its management practices are also observed. The solid waste generations from the rubber, packaging polythene and plastic industries were partly recycled during the manufacturing process. Most of the solid wastes are disposed either indiscriminately on the open ground or dumped on the road side and sometimes used for land filling purpose. Very few amounts of solid wastes generated by tea and ceramic industries are fully recycled. Liquid waste is found very rare to be recycled except fertilizer and a multinational cement company. Gaseous emissions are not objectionable in general except some brick industries. There were no severe complain from the associated colonies regarding the presence and operation of those industries. Safety issues are found in an alarming condition for the workers working in BCIC industries. The government should establish an industrial region here for proper investment of remittances in industrial section rather than housing and other purposes. Environment bureau should be enriched through proper budgeting and manpower. Several waste concern groups should be introduced by private-public partnership in order to get a proper waste treatment. This paper concludes with a suggestion to check the waste from brick and rice industries in sylhet.

5. REFFERENCE

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