Supply Chain Insider
Volume 10, Issue 01, 201. 01-10-23
Article Received: 15-08-2023
Accepted: 05-19-2023
Available Online: 03-10-2023
ISSN: 2617-7420 (Print), 2617-7420 (Online)
DOI: 10.5281/zenodo.10030767
supplychaininsider.org

Effects of industrial waste management of Bangladesh on climate and its solution

Shafi Abdullah, Fatiha Akter Chowdhury, Md. Ehsan Habib
Fatin Nur Noushin

Department of Industrial and Production Engineering, Shahjalal University of Science and Technology, Sylhet, Bangladesh.

Abstract

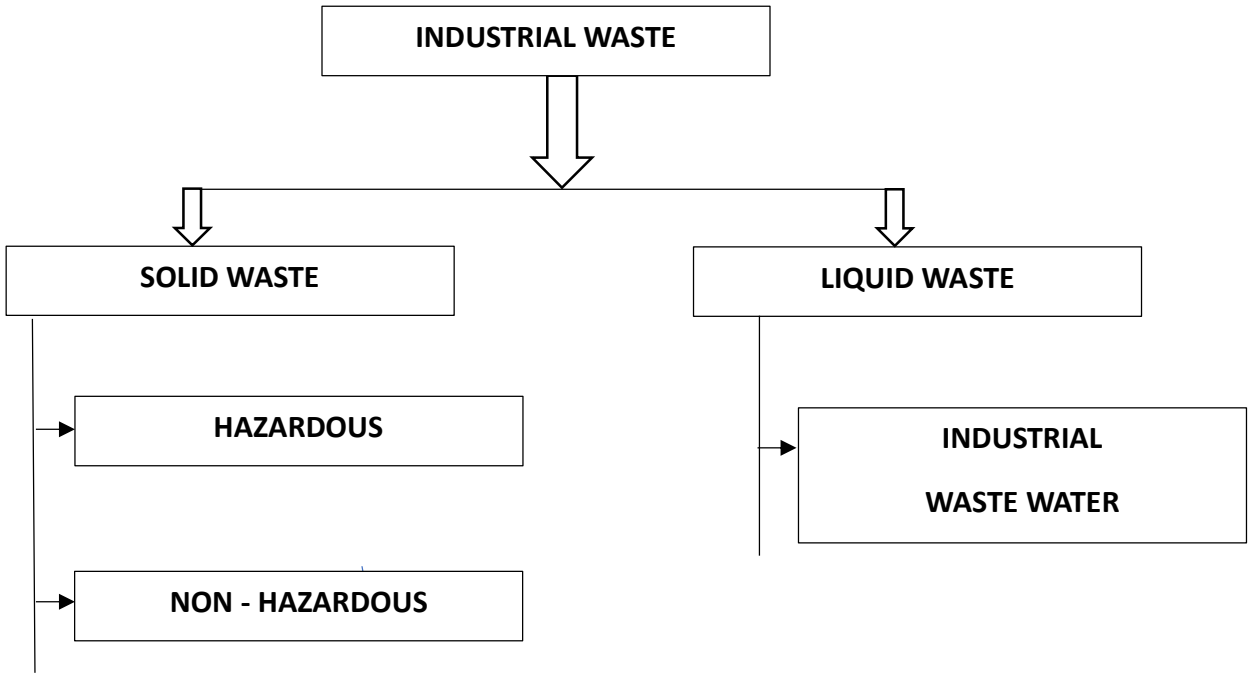
Industrial wastes are created during different manufacturing process in an industry. Most of the wastes are hazardous for the environment. As The number of industries are increasing gradually in our country, the waste management has to be improved by the industries. Otherwise, the waste the industries will create a chaos on the climate. The expectation is that eventually the waste prevention will be improved and our industries will be able to create a smart sustainable model for waste management. This expectation is to put that plan into action is through the 3 Rs of waste management — Reduce, Reuse, Recycle. At first, the current condition of waste management in the industries of Bangladesh will be outlined in this paper followed by the types of waste, source and how long it takes to compose. This paper emphasizes the concept of waste prevention through Sustainable waste management which will create a loop that will prevent the waste to be end up in the environment. Also, a case study on the Ecofriendly robotic machine of USA on Baltimore River, is displayed to illustrate the innovative ideas for waste management in the developed countries. The proper utilization of renewable energy and economic issues are discussed throughout the discussion. Additionally, the restrictions and opportunities of waste management will be discussed in this paper.

Keywords: Waste management, Climate, Supply chain, Bangladesh.

1.0. Introduction

Bangladesh is one of the fastest urbanizing economies in South Asia (The World Bank, 2020). Apart from the positive achievements through industrialization, the disorganized, unplanned waste management has created a serious threat to the climate. By discharging solid rubbish, liquid wastes, organic wastes, recyclable wastes, hazardous wastes into the ecosystem without considering the result are creating air pollution, water pollution, soil pollution etc. ***Striding for clean air : Air pollution and Public health in South Asia***, (http://www.worldbank.org/strivingforcleanair) presented today in Dhaka, says concentrations of fine particulate matter such as soot and small dust (PM2.5) in some of the region's most densely populated and poor areas are up to 20 times higher than WHO standard (5 µg/m^3).

Industrial waste can be classified as given below:



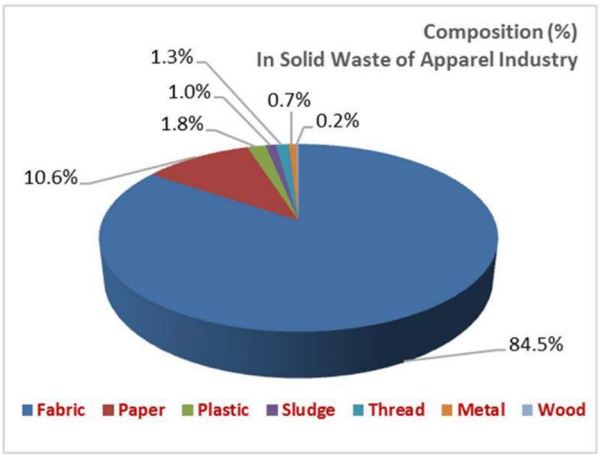
Industrial waste is manufacturing waste from a wide range of different processes, such as sludges, product residues, kiln dust, slags, and ashes. The majority of industrial waste comes from three types of industries: metallurgy, nonmetallurgy, and food processing industries. According to official records of the Bangladesh Inland Water Transport Authority (BIWTA), around 350,000 kilograms (350 metric tons) of toxic waste is dumped into rivers every day from about 7,000

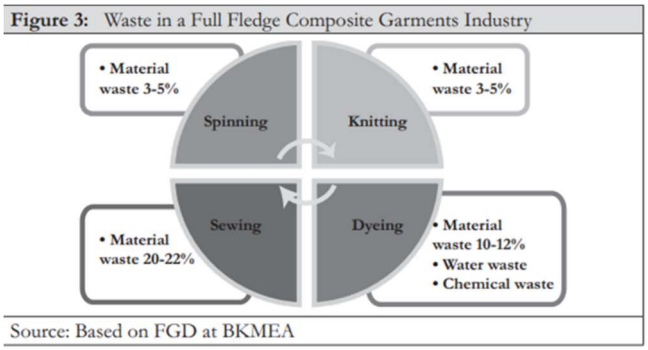
industries and other residential areas in greater Dhaka and adjacent areas. The World Bank has identified the Buriganga River as one of the world's 10 most polluted rivers which contains heavy metals like chromium, iron and zinc, while the condition of the other four rivers is nearly the same.

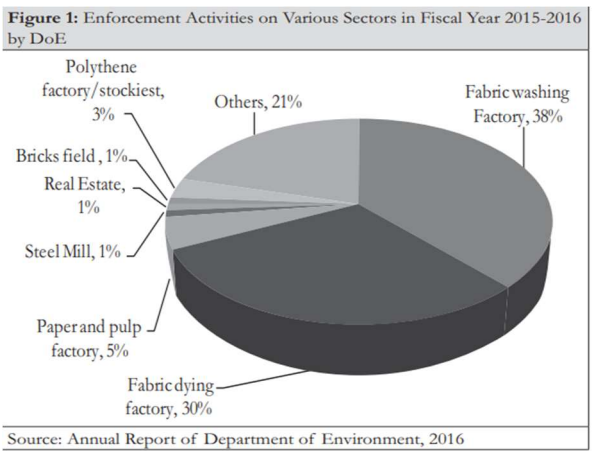
Bangladesh Environment Network (BEN) says that, "Industrial waste has now become the most important source of pollution for Bangladesh's land, water, and air. despite efforts on the part of the government and the civil society, most of the industrial plants of the country are yet to have the effluent treatment facilities (ETF)."

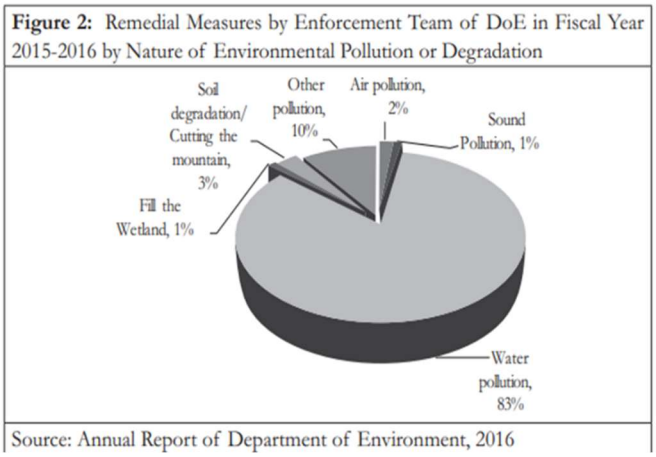
An average of 55% of solid waste remains uncollected in urban areas, with a variation of collection efficiency from 37% to 77% (Ahmed, 2019).

The industrial sector of Bangladesh has witnessed a huge success in the last 50 years. The number of factories has multiplied 150 times. As a result, the number of factories in production has increased to 46,110. Of these, about 3,000 are large factories. These are now the mainstay of the country's industrial sector. Although Bangladesh is now the world's third largest exporter of ready-made garments, in 2019, Bangladesh produced nearly 5,77,000 tons of Ready-Made Garment (RMG) waste. Almost half of this, 250,000 tons, was 100% pure cotton waste.









Liquid waste includes fats, oils, and grease (FOG), spent chemicals, liquids, gases, solids, or sludge. Liquid waste can be defined as such Liquids as wastewater, fats, oils or grease (FOG), used oil, liquids, solids, gases, or sludges and hazardous household liquids. These liquids that are hazardous or potentially harmful to human health or the environment.

1.1. Effects of Industrial waste on Climate change:

Climate change will hit poor and vulnerable people the hardest. Average tropical cyclones cost Bangladesh about $1 billion annually. By 2050, a third of agricultural GDP could be lost and 13 million people could become internal climate migrants. In case of a severe flooding, GDP could fall by as much as 9 percent.[12] Energy production, product consumption and irresponsible waste management contribute directly to climate change by adding carbon-based particles into the air,

which are produced during the burning of petroleum products. These results in rise in temperature, decreasing in production period, production cost.

Landfilling method of waste causes fires or explosions, contamination of soil and water, altering the fauna, reduce the value of the surrounding areas.

Incinerating of waste releases toxic chemicals such as lead and mercury into the open air and produces additional byproducts like dioxins. In turn, this process leads to respiratory issues and can be potentially carcinogenic. The more waste and plastics are sent to be burnt, the more our environment and health will suffer in parallel.

GHG (Green House Gas) are the main reason behind the global warming. Total Emissions in 2021 = 6,340 million Metric Tons of CO_2 equivalent. Percentages may not add up to 100% due to independent rounding. Land Use, Land-Use Change, and Forestry in the United States is a net sink and offsets 12% of these greenhouse gas emissions.[13]According to the EPA (Environmental Protection Agency) of USA in 2021 about 23% Green House Gas emission was done by the industries.

Current (2012) waste generation in Bangladesh is around 22.4 million tons per year or 150 kg/cap/year. There is an increasing rate of waste generation in Bangladesh and it is projected to reach 47, 064 tons per day by 2025. The rate of waste generation is expected to increase to 220 kg/cap/year in 2025. Landfills in most countries including in Bangladesh contribute to methane emissions which accelerates climate change.

1.2. What is waste management?

Waste management or waste disposal includes the processes and actions required to manage waste from its inception to its final disposal. This includes the collection, transport, treatment, and disposal of waste, together with monitoring and regulation of the waste management process and waste-related laws, technologies, and economic mechanisms.

1.3. Industrial Waste Management:

Industrial waste management includes source reduction, recycling/reuse/recovery of hazardous and nonhazardous wastes that are generated from industrial sectors (fly ash, mining) and manufacturing. Industrial waste comprises waste produced during the production process, and the industrial products become waste.

1.4. Landfilling Requirement

With the amount of waste generated increasing by the year, the demand for land available for landfilling is also increasing in Bangladesh. With the effects of climate change, an increasing population and a prevailing scarcity of available land, the issue of landfilling and land available for landfilling will be exacerbated in Bangladesh in the future years. For the purpose of this study, area required for landfilling is given in hectares, assuming a shallow 5m depth of landfill. Where otherwise specified, the amounts for area required also assume that 100% of generated waste is collected and that 100% of this collected waste reaches the landfill.

City	City Total Waste Generation (Tons per day)	Total Waste Generation (Tons per annum)	Landfill required annually	Landfill required annually (Unmanaged 5m depth)		
Composting Rate			No Composting	100%		
Collection Rate			100%	100%	75%	50%
Chittagong	1,008.81	368,215.65	6.69	1.63	1.22	0.82
Dhaka	3,347.74	1,221,925.10	22.22	5.41	4.06	2.71
Gazipur	48.29	17,625.85	0.32	0.08	0.06	0.04
Narayanganj	178.50	65	1.18	0.29	0.22	0.14
Sylhet	152.27	55,578.55	1.01	0.25	0.18	0.12

In 1991, 43.09 hectares of landfill area was required to accommodate the 2,369,945 tons of waste generated in the urban areas of Bangladesh that year, equivalent to 6,493 tons per day. By 2005, 88.46 hectares of landfill area was required, with waste generation reaching 4,865,450 tons per annum, or 13,330 tons per day. Nine years later, 157.20 hectares of landfill area were required to accommodate the 8,646,120 tons per annum, or 23,688 tons per day, of waste generated in 2014. With 17,155,000 tons of waste projected to be generated in the year 2025 in the urban areas of

Bangladesh, amounting to 47,000 tons per day, 311.91 hectares of landfill area is required to accommodate the waste generated in that given year. Increased waste generation and increased dependence on landfilling are having a significant impact on the greenhouse gas emissions of Bangladesh, contributing to climate change.

1.5. Current condition of waste management:

In the NDC (Nationally Determined Contribution), Bangladesh committed to reduce GHG (Green House Gas) emissions in the power, industry and transport sectors by 5% below 'business-as-usual' GHG emissions by 2030 using only domestic resources, or by 15% below 'business-as-usual' GHG emissions by 2030 if sufficient and appropriate support is received from developed countries. Bangladesh's NDC describes its plans for tackling greenhouse gas (GHG) emissions and adapting to unavoidable climate change. The government has formulated Solid Waste Management Rules 2021. Specific sub clauses have been added to the Solid Waste Management Rules 2021 for the proper management of solid waste under the Bangladesh Environmental Protection Act, 1995. Extended Producers Responsibility (EPR) has been included in the rules for the first time in Bangladesh.

The Environmental Conservation Rules, 1997 made under the Environment Conservation Act, 1995 have divided industries and projects into four categories.

These categories are:

1) Green,

2) Orange-A

3) Orange-B and

4) Red

The green category denotes a lower impact on the environment; yellow denotes a medium impact on the environment; orange denotes those that have a harmful effect on the environment and human health, and the effect must be reduced to maintain a healthy environment; and red denotes those in industries that have a severe impact on the environment and human health, which must be reduced to maintain a healthy environment.

The Factory Act,1965: The act address with cleanliness, disposal of wastes and polluted liquids, air circulation and temperature control, control of dust, sand and smoke, artificial ventilation,

heavy traffic arrangement of sufficient light, drinking water, toilet, latrines etc. within the mills and factories.

National Environment Management Action Plan (NEMAP): The Ministry of Environment and Forest (MoEF) has formulated this action plan. NEMAP has recommended for actions in the areas of sanitization, solid waste management, water supply and environmental awareness etc.

1.6. Data Analysis

Dhaka City is now seizing with the troubles of sky-scraping volumes of wastes. But, these troubles have also afforded a window of prospects for city to find solution. The community and all the sectors have to involve their innovative technologies and disposal methods and concerning behavior changes and awareness rising. A healthy planned waste management process will not only help of pledge a cleaner atmosphere but it also cost-effective for citizens. Dhaka City Corporations are mainly maintaining this responsibility. DCC separated its area into 10 zones for supervision of solid waste production. Following table shows total waste composition in Dhaka city every day

Table 1: Nature of waste composition in Bangladesh

Waste Composition	Bangladesh (Dhaka) (% By Weight)
Food and Vegetable	**70**
Paper Product	**4**
Plastics	**5**
Metals	**0.13**
Glass and Ceramics	**0.25**
Wood	**0.16**
Garden Waste	**11**
Other (Stone Dirt etc)	**5**
Moisture	**65**

Source: Ahmed, M.F., & Rahman, M.M, 2000

The total solid waste management involves 3 departments namely conservancy, transport and mechanical engineering. A number of studies were undertaken from time to time by the World Bank, Bangladesh Centre for Advanced Studies (BCAS), Japan International Cooperation Agency

and DCC itself for assessment of waste generation. JICA has prepared “Clean Dhaka Master Plan” that will address solid waste management of Dhaka city. Following table shows the growth rate of solid waste in Dhaka city from 1991 to 2025.The growth rate of waste is increasing dangerously.

2.0 Literature Review

Various types of waste effluents produced by two industries were studied to verify their environmental effects and to prepare a suggestion for management of those wastes. Two types of wastes were considered- wastewater and solid wastes. Analysis on three samples of wastewater was performed to determine the physical, chemical, organic and biological pollution. The pH values were 6.58, 6.75 & 6.64; amount of TDS was 235, 241 & 270 ppm; total hardness was 126, 123 & 144 ppm; calcium hardness was 105, 99 & 122 ppm, all the values of P-alkalinity were zero and values of M-alkalinity were 40, 40 & 45 mg/l. Iron concentrations were 0.21, 0.18 & 0.19 mg/l. Their Cl2 test proved absence of Cl2 Molecule. Only one sample was analyzed for bacterial viable count (44x105cfu/ml), fungal test (fungi were absent), DO (6.8 mg/l), BOD (156 mg/1) and COD (267 mg/1). Results suggested that iron concentrations, pH values, TDS and DO were within the standard range. (ALAM, A S M M, 2007)

Innovative (intelligent) safety installations for waste treatment plants will also be interesting. Especially in recent years, more and more fires occurred in treatment plants, because a higher amount of fire-promoting waste (e.g., lithium-ion batteries) occurs in waste streams (Nigl and Pomberger, 2018). Gundupalli et al. (2017a)

In recent decades, waste management has evolved from a pure logistics industry to a manufacturing industry due to the ever-increasing volume of waste and the trend towards recycling. Nevertheless, logistics continues to be an important means of linking the waste management sector with the rest of the industry. Ongoing new technical possibilities through digitalization make it possible to optimally further develop logistics in waste management. There are already various approaches, which are explained in more detail in the following sections of the article. In addition, several peer-reviewed papers have already been published which deal with the topic ‘‘Collection and logistics of waste” in so-called ‘‘smart cities” (Anagnostopoulos et al., 2017; Esmaeilian et al., 2018; Rovetta et al., 2009; Shah et al., 2018).

The food and beverage industries are not as polluting as some other sectors like metal or leather industries, they have been responsible for air, water and soil pollution by emitting dust and unpleasant odor in the air, discharging liquid effluent with high organic content and generating large quantities of sludge and solid waste (European Commission,1997). According to environmental report of Coca-Cola Company, 2004 (www2.coca-cola.com,2006), they do produce 1.72 liters of waste water and 11.67 grams solid wastes per 1 liter of drink production. Some potato starch processing companies produce 100,000 to 250,000 m3 of starch-containing sludge annually.

In the vegetable processing and preservation sector, up to one-third of the total quantity of raw materials may be rejected (UNEP, 1995).

The tannery industry's EIA report revealed a detrimental impact on physical and biological resources such as air quality, surface water quality, land quality, fisheries, aquatic biology, vegetative cover, biodiversity, and agriculture, concluding that soil and river water ambiance is impaired, as well as a disrupted ecological equilibrium. Total EIV obtained negative along with adverse impact on physical resources (air, water, and soil) and ecological resources (fisheries, forestry). Physical and ecological resources were found adversely affected as their EIV obtained negative due to washing and dyeing industries. (Umama Begum Ruba et al.,2021)

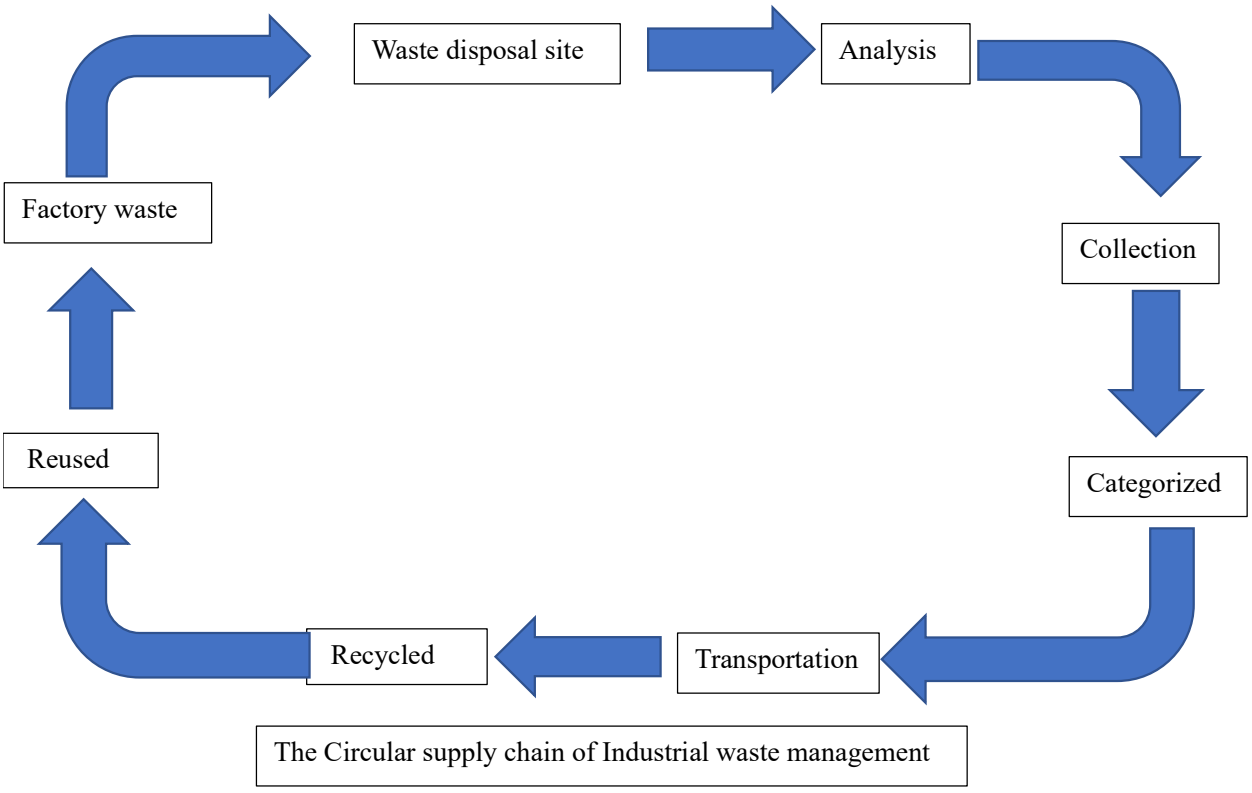
3.0. Methodology

Circular supply chains provide growth opportunities by recovering value from waste management systems through collaboration inside and between industries (Dulia et al., 2021).

The four most common types of waste management -

1) Landfills. A landfill is a specially designed pit or mound of earth where solid waste (trash, garbage, and other refuse) is buried.
2) Recycling.
3) Incineration.
4) Composting

A circular supply chain is a closed-loop system where products, materials, and resources are continuously reused, recycled, and regenerated. The objective of a circular supply chain is to minimize waste, reduce environmental impact, and create long-term value. It reuses and recycles products and materials, drastically reducing waste and carbon emissions. This is achieved through the seven Rs: Recycle, Rethink, Reduce, Reuse, Repair, Refurbish, and Recover.



The Circular supply chain of Industrial waste management

Effective waste management systems and circular economy principles must be adopted to reduce pollution levels while promoting economic growth. By introducing circular economy principles into our smart waste management strategies, anyone can reduce waste and learn how to reengineer processes for maximum efficiency. As per the condition of Bangladesh circular supply chain will be a suitable solution for industrial waste management. With limited materials Bangladesh's Industrial sector can increase their production and reduce their waste by proper analysis, recycling, reusing, repairing and recovering. The less they spend on their waste management the more they can increase their profit.

4.0. Case Study on Different countries waste management plan:

Specific innovations in USA, Germany, Australia, Brazil and Columbia are gearing towards sustainable waste management.

USA has an eco-friendly robotic machine in the Baltimore River, which is powered by the sun and river currents, and it cleans debris and waste from the river and deposits it in a dumpster barrage built into the machine.

Germany has a company which produces biodegradable leaf plates to curb plastic pollution.

There are SmartBelly bins in Australia are 'smart bins' which segregate waste at the collection point and then compost and treat the waste as well, and connect individual bins to garbage collectors, streamlining the waste management process efficiently.

Rosenbaum, a design studio in Brazil is encouraging people to use plastic waste to decorate and beautify their houses.

Columbia has ECOBOT-vending machines, which give rewards such as movie tickets and vouchers and monetary compensation for every time someone deposits a plastic bottle or bottle caps.

5.0. Results:

As Bangladesh is going through an Industrial Development, technical innovation and progress, modernization and structural transformation of the economy and diversification of the economic base, accelerated economic growth and employment creation, increase in incomes and standard of living of the people are growing rapidly. It results in the decaying organic matter—blood, grease, offal, and manure from slaughterhouses, meat packing plants, glue factories, tanneries, and fertilizer manufacturers. In addition, planing mills and sawmills sprayed copious amounts of wood dust into the air. In Bangladesh, industries are developed in an unplanned way and without following any particular guidelines. The poor waste management system of industries are polluting rivers and toxic emission is polluting the air as well. Natural resources are used by the industries, causing an imbalance in nature. Industrial pollution is contributing to ozone depletion, animal and human health concerns, and global warming. It can also contaminate drinking water sources, emit harmful pollutants into the air, and degrade soil quality. So, it is a must to do a proper waste management of the industries.

The supply chain model that is described before in this paper will be a better solution in industrial waste management of Bangladesh. It will ensure that the waste which were disposed on the landfill before, now those will be categorized and collected by the factories. Then the wastes will be recycled and reused again. These will be under a circular supply chain system which will ensure

that the waste disposal in the nature is minimum. As a result, the environmental pollution will be prevented and the torture on the climate will be less.

6.0. Conclusion:

A Sustainable environmental condition cannot be achieved without proper waste management. As a large proportion of the wastes comes directly from the industries, their waste management must be improved. It cannot be achieved unless proper funding is given into this sector. Government support, technical support, trained human resources and enabling standard legislations.

7.0. Reference:

1. https://www.businessworld.in/article/5-Best-Waste-Management-Practices-And-Innovations-Across-The-Globe/08-02-2018-140091/
2. https://www.knowwaste.net/Documents/1-s2.0-S0956053X0800442X-main.pdf
3. https://safetyculture.com/topics/waste-management-system/
4. https://asef.org/wp-content/uploads/2021/11/ASEFSU23-Background-Paper_Waste-Management-in-Bangladesh.pdf
5. file:///C:/Users/ASUS/Downloads/228-Article%20Text-444-1-10-20200703.pdf
6. https://www.aa.com.tr/en/asia-pacific/chemicals-industrial-waste-contamination-turn-6-bangladesh-rivers-untreatable/2534527
7. https://ben-global.net/issues/industrial-waste/
8. https://en.prothomalo.com/business/industries-see-growth-from-313-factories-to-46000
9. https://sdgs.un.org/partnerships/government-bangladesh-announces-its-solid-waste-management-rules-2021
10. https://www.ecomena.org/reverse-logistics/
11. https://www.plugandplaytechcenter.com/resources/circular-economy-principles-for-smart-waste-management/
12. https://www.worldbank.org/en/news/press-release/2022/10/31/urgent-climate-action-crucial-for-bangladesh-to-sustain-strong-growth
13. https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

14. https://en.wikipedia.org/wiki/Waste_management_in_Bangladesh
15. https://ojs.literacyinstitute.org/index.php/ijias/article/view/428
16. https://en.wikipedia.org/wiki/Waste_management
17. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/industrial-waste-management
18. https://www.ewastedisposal.net/liquid-waste/