Challenges for The Circular Economy in Manufacturing

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ABSTRACT

The introduction of the circular economy (CE) in production, minimizing waste, maximizing resource use, reducing environmental impact, conservation, and safety for society. The main objective is to choose appropriate methods that influence product design, process design, service design, and production design. 1.5 °C Supply chain leaders have taken the initiative to reduce greenhouse gas emissions throughout the value chain, halving them by 2030 and reducing emissions to zero by 2050. Achieving a circular economy requires the integration of the three critical elements of products, processes, and systems across the three dimensions of environment, economy and social. CE has become a major paradigm shift in the way companies interact with society and the environment. The implementation of CE initiatives aims to conserve scarce resources, close energy, and material loops, and enable sustainable development at various levels of business processes. The United Nations Sustainable Development Goals (SDG) target 12.5 aims to significantly reduce waste generation through prevention, reduction, recycling, and reuse by 2030, which will require actions and strategies from various stakeholders to achieve the goals. It may take time to see the impact on the organization and society, but the timeline has already begun.

Keywords: Circular Economy, Environmental, Economic, and Social

Overview: The circular economy (CE) has become increasingly important to the manufacturing sector as customers, governments, and investors demand more sustainable products in the future. CE is a growing topic that promotes the responsible and cyclical use of resources and potentially contributes to sustainable development. CE is the new way to create shared value and promote inclusive and sustainable development. The concept of CE has gained attention from scholars and practitioners around the world. Recently, environmental pressures have made it increasingly important to promote corporate sustainability through technological innovation to improve the design, implementation, and evaluation of sustainable strategies. In such a scenario, a major challenge for enterprises is to balance economic needs with environmental sustainability. Many companies seek to apply circular economy principles to their business practices to achieve positive economic, environmental, and social benefits. However, these companies often struggle to transform their existing linear business models into circular models because the steps required for successful transformation are not yet well understood. Achieving the circular model requires cyclical and regenerative environmental innovation at all levels of the corporate value chain. Given the alarming level of concern about resource depletion and corporate sustainability, it is critical to create a global platform to discuss the emerging issues in implementing the circular economy at the micro and macro levels. This paper aims to discuss critical issues in promoting the principles of CE and achieving corporate sustainability. "Climate change is wrecking our path to sustainability. We live in a world with looming challenges and increasingly limited resources. Sustainable development offers the best chance to correct our course." - Ban Ki moon, United Nations Secretary-General.

Figure 1: Products, Processes, and Systems, in three dimensions of Environmental, Economic, and Social.

India is the second most populous country in the world, with a population of more than 1.35 billion in 2020. With an average annual gross domestic product (GDP) growth rate of 6-8%, India is also the fastest growing major economy in the last decade, contributing $3.05 trillion to global GDP in 2021. Although the COVID -19 pandemic has significantly affected the economy and people's lives, GDP declined to -7.3 in 2020 and is expected to be 9.5% and 8.5% in 2021 and 2022, respectively. However, India's contribution to global GDP and international trade is moderately small in contrast to its population and size. The country also faces numerous social, economic, and environmental problems compared to developed countries.

The manufacturing sector is one of the most important components in creating a balance between employment, economic growth, and environmental sustainability. For this reason, it is considered the backbone of the country's economy, as it contributes significantly to GDP and job creation. Globalization continues to impact it through the driving forces of outsourcing and distributed manufacturing with technological advances. However, the declining share of GDP and shrinking employment in manufacturing has become a concern.

Micro, small, and medium enterprises (MSMEs) are the major players in the manufacturing sector as they produce a lot, export, and create jobs. However, in India, MSMEs are not well equipped with new technologies and do not adhere to quality and environmental standards.

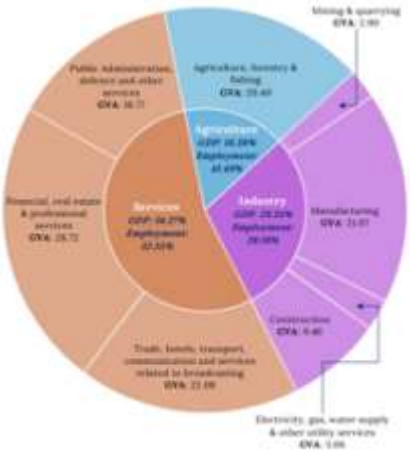

Figure 2: Sector wise GDP in India
GVA – Gross Value Addition, GDP – Gross Domestic Product
Source: https://statisticstimes.com/economy/country/india-gdp-sectorwise.php

Another factor of concern is environmental degradation, and a 2018 report ranked India 168th out of 180 countries in the Environmental Performance Index (EPI). Even Indian products do not meet international requirement standards as they are manufactured using outdated technologies or jugaad innovations that result in inferior products, import-export deficit, and promotion of cheaper imports. As a result, India was ranked 68th out of 141 countries on the Global Competitiveness Index (GCI) in 2019. In short, India needs to adopt a new technologically equipped production system by considering the practical impact on the industrial sector, which is consistent with several triple-bottom-line sustainability requirements. Moreover, India presents a great opportunity as it is the only South Asian country ranked 30th and 31st in terms of manufacturing structure and manufacturing drivers, respectively, in a World Economic Forum report on Industry 4.0 preparedness. Therefore, we are confident that the development of systems will be a breakthrough in achieving the goal and vision of "Make in India" and the Indian Century - 21st Century.

Rank	GCI	GMO	GMRI	Net Export	GMCI	CIPI	GDP
1	Singapore – 84.8	China – 28.7%	China	China	China -100	Germany	US – 19.5
2	US – 83.7	US – 16.8%	India	Germany	US – 99.5	China	China – 12.2
3	Hong Kong – 83.1	Japan – 7.5%	US	Ireland	Germany – 93.9	South Korea	Japan – 4.8
4	Netherland – 82.4	Germany – 5.3%	Canada	Russia	Japan – 80.4	US	Germany – 3.7
5	Switzerland – 82.3	India – 3.1 %	Czech Republic	South Korea	South Korea – 76.7	Japan	UK – 2.7
India	**68th – 61.4**	**5th**	**2nd**	**108th**	**11th – 67.2**	**42nd**	**6th – 2.6**

Figure 3: The Rank of India in comparison to other developed countries

GCI - Global Competitiveness Index (Score)
GMO - Global Manufacturing Output (Percentage)
GMRI - Global Manufacturing Risk Index (Rank)
GMCI - Global Manufacturing Competitiveness Index (Score)
CIPI - Competitive Industrial Performance index (Rank)
GDP - Gross Domestic Product Nominal (in Trillion USD)

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"We must develop a comprehensive and globally shared view of how technology is affecting our lives and reshaping our economic, social, cultural, and human environments. There has never been a time of greater promise, or greater peril." - Dr. Klaus Schwab, Founder and Executive Chairman, World Economic Forum

1. Challenges for the Circular Economy

1.1 Environmental Policies and Standards

Environmental degradation has been recognized as a major concern by world-level organizations such as the United Nations, the International Finance Corporation, and the governments of several countries. Various environmental policies have been described to combat air pollution, water pollution, waste management, soil pollution, and climate change, which must also be considered by manufacturing companies. To support this policy, the International Organization for Standardization (ISO) has set some international standards for the manufacturing sector, such as the ISO 14000 series. In India, the authorities have introduced the Environmental Protection Act of 1986, the Water (Prevention & Control of Pollution Act, 1974), the Air (Prevention & Control of Pollution Act, 1981) and the Environmental Impact Assessment Notification 2006 to protect the environment.

1.2 Economic Policies

Manufacturing is the backbone of any economy as it contributes to GDP and job creation. The Government of India has pursued many ambitious goals under the Make in India plan, such as Foreign Direct Investment (FDI), Goods and Services Tax (GST 2017), and Foreign Trade Policy (2016-2020) to reach the level of a developed economy. MSMEs will contribute significantly to a fully developed advanced production system through efficient and systematic management of taxes and transactions.

1.3 Societal Laws and Policies

Since the first industrial revolution, social problems have been observed, such as overtime, inadequate distribution of labor, wage differentials, protection claims, health care, and essential facilities. The Indian government has enacted several laws to protect workers' rights and improve living standards, such as the Trade Union Act and the Industrial Employment Act. Labor laws and policies should be binding guidelines for MSME registration.

1.4 Quality Standards

The quality of a product plays a crucial role in attracting the customer's attention. Due to inferior quality and lack of standardization, many Indian products are rejected several times in the international market, resulting in huge costs, which are called quality costs. The reason for this inadequate quality is inadequate monitoring of quality standards by the manufacturer. For quality control, International Organization for Standards (ISO 9000 series), American Society for Quality (ASQ) and Bureau of Indian Standards (BIS) are considered as the most important institutions in the world, USA, and India respectively, which must be followed by Indian manufacturers to expand cross border trade. Low quality also invites cheaper imports from competing countries.

2. Proposed Model Inclusive Manufacturing System (ims) for the Circular Economy

MSMEs are the backbone of populous countries like China and India, but most of these MSMEs are not well equipped with new technologies. They are also not fully aware of regulatory compliance, legal

requirements, policies, and innovations. Considering the current situation in populous developing countries, especially in India, a new manufacturing paradigm has been introduced, the Inclusive Manufacturing System (IMS), as shown in Figure 4. Inclusive manufacturing can be defined as: "incorporating innovations and advances in manufacturing to address societal (employment, education, health care, and labour), economic (cross-border business, trade policy, cost of products and services, and contribution of manufacturing to GDP), and environmental (natural resources, energy, air quality, clean water availability, recyclable and sustainable products) solutions by bringing together resources in a geographically distributed environment with the support of advanced manufacturing technologies (IT systems, Artificial Intelligence, High-Performance computation, and CPSs) through the integration of the semantic web and the Internet of Things to achieve the goal of minimal market time, better quality, lower cost, faster services, and greener manufacturing."

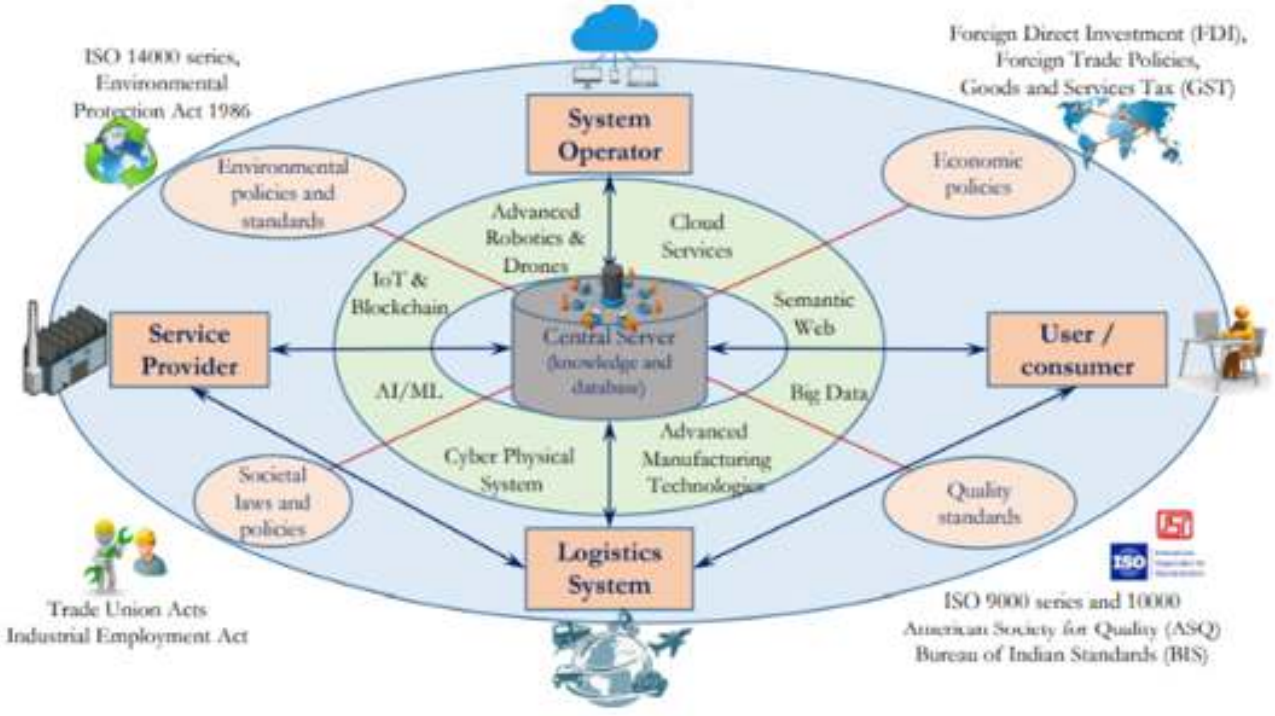

Figure 4. Inclusive Manufacturing System Source: Singh et al. (2019).

2.1 System Operator: A leading IMS member operates and manages the entire system with support from platform providers. Essential assistance is provided to service providers and customers by making the latest technologies available. System operators and platform providers work as brokers because they are the third parties connecting consumers and service providers.

2.2 Service Provider: Production resources and capabilities are provided by this participant in the form of services. Service providers fulfill the technical requirements of a physical item or design activity requested by customers.

2.3 Logistics System: The logistics system is the fourth partner in the proposed integrative production system. It is used to provide transportation and physical movement of goods from one place to another, storage, and warehousing activities by using real-time data monitoring and tracking technologies.

2.4 User or Organization: Consumers are crucial players in a business that purchases and consumes manufactured goods and related services.

The figure shows the framework of the IMS considering four participants that perform different activities from order initialization to final delivery. These include the user or customer (end user and organization), the system operator, the service providers (software services, suppliers, manufacturing

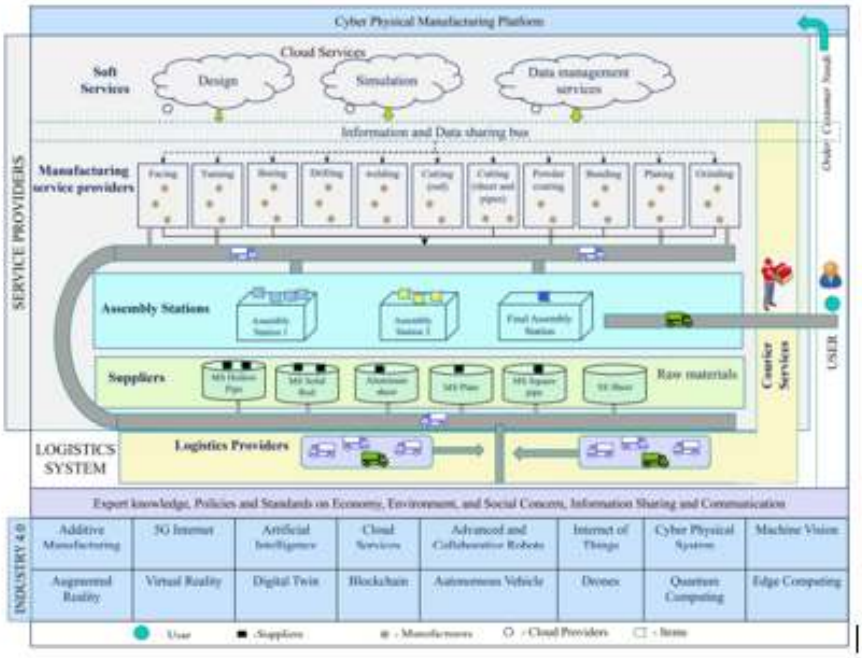

Figure 5: Cyber Physical Manufacturing Platform Source: Singh et al. (2019).

services, and assembly stations), and the logistics system (transportation and courier services). The suppliers provide raw materials and semi-finished products (e.g., only raw materials in this study). Logistics service providers help connect suppliers with manufacturers, manufacturers with other production units and assembly stations, and assembly stations with customers through courier services. Various manufacturers perform numerous operations (e.g., facing, drilling, boring) to process the original raw material through subsequent production steps (e.g., operations) into a final product. Depending on the available resources, i.e., machines, several manufacturing steps can be carried out in a company. Assembly stations put the product into its final form by picking up parts and assemblies from manufacturers. Finally, courier service providers take care of the delivery of the products to the customers by using logistics service providers.

3. Resource Recovery

Resource recovery is the systematic detour of waste that was destined for disposal for a specific reuse. It is the processing of recyclables to recover or reclaim materials and resources or convert them to energy. These activities are carried out in a recovery facility. Resource recovery is not only environmentally important, but also cost effective. It reduces the amount of waste requiring disposal, saves landfill space, and conserves natural resources.

Resource recovery (as opposed to waste management) uses LCA (life cycle analysis) and attempts to provide alternatives to waste management. For mixed MSW, several broad studies have found that management, source separation and collection, followed by reuse and recycling of the non-organic portion and energy and compost/fertilizer production from the organic material through anaerobic digestion is the preferred path.

An example of the benefits of resource recycling is that many discarded items contain metals that can be profitably recycled, such as the components of circuit boards. Wood French fries in pallets and other packaging materials can be recycled into useful products for horticulture. Recycled wood French fries can be used as surfacing for paths, walkways or play areas.

Application of rational and consistent waste management practices can yield a range of benefits including:

3.1 Economic:

Improving economic efficiency through the means of resource use, treatment, and disposal and creating markets for recyclables can lead to efficient practices in the production and consumption of products and materials, resulting in the recovery of valuable materials for reuse and the potential for new jobs and new business opportunities.

3.2 Social:

By reducing negative health impacts through proper waste management, the resulting impacts are more

attractive to civic communities. Better social benefits can lead to new employment opportunities and potentially lift communities out of poverty, especially in some of the poorer developing countries and cities.

3.3 Environmental:

Reducing or eliminating negative impacts on the environment by reducing, reusing, recycling, and minimizing resource extraction can lead to improved air and water quality and help reduce greenhouse gas emissions.

3.3.1 Waste reducing, reusing, and recycling (3R) Waste Hierarchy

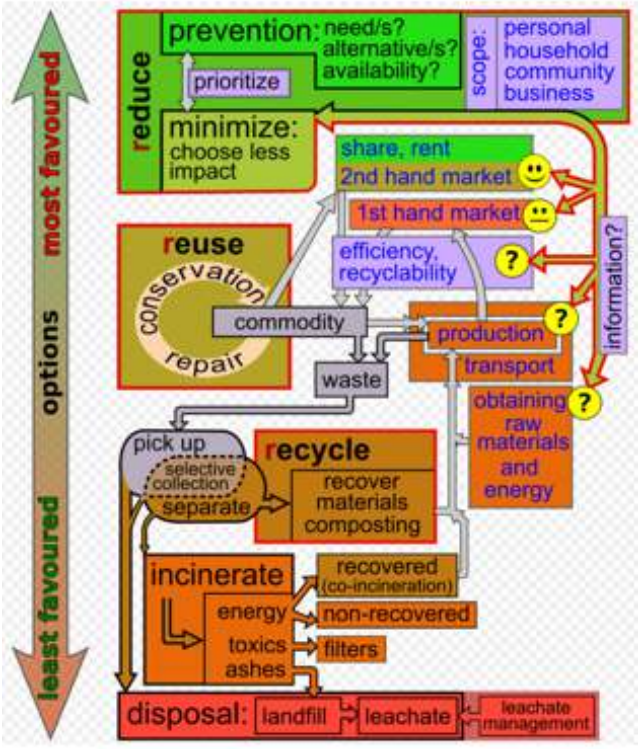

Figure 6: waste hierarchy the 3 Rs (reduce, reuse, recycle)

Source:https://en.wikipedia.org/wiki/Waste_management#/media/File:Waste_hierarchy_rect-en.svg

The philosophy of today's society is "take-make-use-dispose", i.e., we use resources, process them into products and throw them away as waste after use. This leads to two problems: one is the scarcity of resources on the earth, and the other is the increase of waste on the earth, because the earth has limited resources and a finite capacity to absorb waste, and with the increase of population and luxurious lifestyle, this problem is getting bigger. Manufacturers are making efforts to use resources efficiently. They are continuously working to minimize costs and waste. However, this is limited only to production and not to the whole system. There are some research practices toward end-of-use/end-of-life (EOU/EOL) that are not currently accepted by manufacturers. Our interest must be to close the loop of manufacturing by recycling and reusing the materials. So, we can say that remanufacturing is not accepted by companies, although its benefits are highlighted by researchers. The United Nations Development Program (UNDP) - Responsible Consumption and Production (RCP-12) focuses on the efficient management of our common natural resources and the disposal of toxic waste and pollutants. The goal is to encourage industry, businesses, and consumers to recycle or reduce waste, and to help developing countries shift to more sustainable consumption patterns by 2030. To reduce the burden of waste and pollution, both industrial and municipal waste should be recycled and reused. Therefore, circular economy or circulation systems should be implemented in the production process to minimize the use of raw materials and waste generation (Hysa et al., 2020).

In addition, hazardous and infectious medical waste should be properly disposed of according to guidelines (WHO, 2020c). It is now clear that the majority of people (especially in developing countries) are not adequately informed about waste segregation and disposal (Rahman et al., 2020). Therefore, the government should conduct comprehensive awareness campaigns on proper waste separation, treatment, and disposal through various mass media.

For example, India is the country with the fifth largest e-waste generation (Bandela, 2018) and generated 3230 kilotons of e-waste in 2019, which is equivalent to 2.4 kg per capita (Forti et al., 2020). Figure 6 shows the growth of e-waste in India.

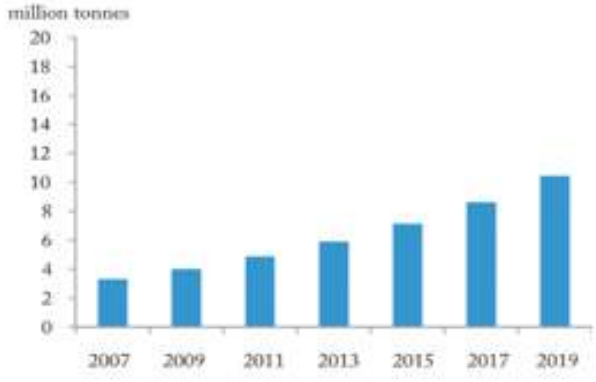

Figure 6: E-waste in India {Source: Annamalai (2015)}

Although laws requiring manufacturers to collect and properly recycle e-waste have been in place in India since 2011 (Kaur, 2019), only 1.5 percent of India's total e-waste is recycled by certified recyclers (Pandit, 2016). Pandit (2016) notes that improper dismantling by the unorganized sector and scrap dealers has resulted in e-waste concentrations in Indian soil that are twice the global average.

For example, Advert Foundation launched an e-waste management campaign in Delhi (TNN, 2014). Nokia, in turn, launched its e-waste "take back" campaign through its Priority Dealers and Nokia Care Centers in New Delhi (Sadia, 2013). However, in the absence of formal collection mechanisms, "unused" products are stored in homes in both cities. These "unused" products stored in houses could eventually end up in the unorganized sector (Gautam, 2016) if the public is not educated to dispose of e-waste properly. Kwatra et al. (2014) found that 74 percent of households sold e-waste to scrap dealers. Therefore, there is a need to raise awareness and establish proper collection points to reduce the problem of e-waste.

There is an increasing need for end-of-life management of products by manufacturers. ninety-five percent of e-waste is collected and recycled by the informal sector (Agarwal et al., 2021). Manufacturers should establish a take-back mechanism for e-waste collection.

From the end-user perspective, the following is needed: education on the 3Rs (reduce, reuse, recycle) and awareness of collection points.

In this context, there is a need to improve skills and provide certification for repair work (Gautam, 2016). There is an urgent need to improve the infrastructure of recycling facilities to reduce the amount of e-waste that ends up in landfills and to raise awareness in the informal sector to reduce processes such as open burning and acid bleeding (Manish and Chakraborty, 2019).

Finally, there is a need to involve local nongovernmental organizations in e-waste collection (Central Pollution Control Board, 2011) and to integrate informal e-waste collectors into formal e-waste processing facilities (Turraga and Bhaskar, 2017).

3.3.2 Challenges in developing countries like India related to waste.

In areas with developing economies, waste collection services are often depleted, and landfills are inadequately managed and uncontrolled. The problems are exacerbated. Problems with management complicate the situation. Waste management in these countries and cities is an ongoing challenge due to weak institutions, chronically inadequate resources, and rapid urbanization. All these challenges, along with a lack of understanding of the various factors that contribute to the waste management hierarchy, impact waste treatment.

In developing countries, waste management is usually done by the poor to ensure their survival. It is estimated that 2% of the population in Asia, Latin America, and Africa rely on waste for their livelihoods. Family-based or individual manual waste pickers are often engaged in waste management practices for which there are few support networks and facilities, putting them at increased risk for health consequences. In addition, this practice prevents their children from further education. Participation of most citizens in waste management is low, and residents of urban areas are not actively involved in the waste management process.

3.3.3 Wastewater treatment and reuse The world is facing increased water stress, driven by population and economic growth, land use changes, increased climate variability, and change, growing industries declining groundwater supplies, and water quality. Water pollution due to toxic metals and organic compounds remains a serious environmental and public problem. Moreover, faced more and more stringent regulations. Water pollution has also become a major source of concern and a priority for most industrial sectors. It is important to know the potential threats to source water and human beings from wastewater discharged by industrial or commercial activities prior to its release into the environment. Wastewater treatment is closely related to the standards and/or expectations set for effluent quality.

Industrial wastewater treatment describes the processes used for treating wastewater that is produced by industries as an undesirable by-product. After treatment, the treated industrial wastewater (or effluent) may be reused or released to a sanitary sewer or to surface water in the environment. Some industrial facilities generate wastewater that can be treated in sewage treatment plants. Most industrial processes, such as petroleum refineries, and chemical and petrochemical plants have their own specialized facilities to treat their wastewater so that the pollutant concentrations in the treated wastewater comply with the regulations regarding disposal of wastewater into sewers or into rivers, lakes, or oceans. This applies to industries that generate wastewater with high

concentrations of organic matter (e.g., oil and grease), toxic pollutants (e.g., heavy metals, volatile organic compounds), or nutrients such as ammonia. Some industries install a pre-treatment system to remove some pollutants (e.g., toxic compounds), and then discharge the partially treated wastewater to the municipal sewer system.

Most industries produce some wastewater. Recent trends have been to minimize such production or to recycle treated wastewater within the production process. Some industries have been successful at redesigning their manufacturing processes to reduce or eliminate pollutants. Sources of industrial wastewater include battery manufacturing, chemical manufacturing, electric power plants, the food industry, the iron and steel industry, metal working, mines and quarries, the nuclear industry, oil, and gas extraction, petroleum refining and petrochemicals, pharmaceutical manufacturing, pulp, and paper industry, smelters, textile mills, industrial oil contamination, water treatment, and wood preserving. Treatment processes include brine treatment, solids removal (e.g., chemical precipitation, filtration), oils and grease removal, removal of biodegradable organics, removal of other organics, removal of acids and alkalis, and removal of toxic materials.

To control the challenges of water pollution, both industrial and municipal wastewater should be properly treated before discharge. Besides, the reuse of treated wastewater in non-production processes like toilet flushing and road cleaning can reduce the burden of excess water withdrawal.

Case Study: Water harvesting and conservation by reuse of runoff water.

Hindalco has always focused on aspects of resource criticalities. Water, being a scarce resource, Hindalco takes various initiatives to reduce its freshwater consumption. This is evident through the initiatives taken at our plant, which are described below:

Our plant location is a low-lying area compared to our locality. The wastewater of the community is being entered into our premises through seepage into the stormwater drain. We have taken the initiative towards water reuse by collecting that stormwater in our stormwater collection pit as runoff water. We took this runoff water as an opportunity for us. We have laid down a pipeline from the stormwater pit to our effluent treatment plant (ETP). At ETP, we have a clarifier and reverse osmosis (RO) system to treat this runoff water. To monitor this runoff water, we have installed one level sensor at the stormwater pit and one flow meter at ETP for monitoring the quantity of utilized runoff water.

Benefits and impact on business

- A step ahead to sustainable development through natural resource conservation.
- There is a possibility to multiply water conservation practices in other areas also.
- Reduction in freshwater consumption.

3.3.4 Solutions for waste reducing, reusing, and recycling (3R)

3.3.4a Behavioral change in daily life

To reduce the carbon footmark and global carbon emigration, it's necessary to change the mindset in our diurnal life and optimum consumption or coffers like; avoiding reused and take locally grown food, making compost from food waste, switching off or freeing electronic bias when not used, and use a bike rather of a auto for shorter distances.

3.3.4b International cooperation

To meet the sustainable environmental pretensions and protection of global environmental coffers, similar as the global climate and natural diversity, combined transnational trouble is essential(ICIMOD, 2020). Hence, a responsible transnational authority like united nations terrain programme (UNEP) should take an effective part to prepare time-acquainted programs, arranging transnational conventions, and coordinating global leaders for proper perpetration. Science and Technology play a vital part in the socio- profitable development of a nation. Rapid advances in technology have led to significant enhancement in all sectors of frugality. With the emergence of the rearmost technologies, there has been a drastic shift in the way we suppose, work, and unite with others. Also, access to new technologies has fully converted the nature/ operation of work. The entire world has become a global village. On the one hand, it has increased the effectiveness and effectiveness of associations, on the other hand, it has rebounded in increased complexity, query, and competition in the internal and external terrain of the associations. To manage this turbulence in the terrain, enterprises have to make judicious relinquishment and prolixity of technologies, which may lead to improvement of productivity, enhancement in living conditions, and profitable growth of the country. More specifically, enterprises need to map their technological capability and capability so that innovative products and services may be produced, thereby leading to the inclusive and

sustainable development of the nation.

3.4 Inter-generational Equity: Following effective waste management practices can provide subsequent generations with a more robust economy, a fairer and more inclusive society, and a cleaner environment.

4 Prospects and Scope of IMS

To achieve the sustainable pretensions of UNDP, the target of' Make in India', Inclusive growth of the frugality, arising trends of the current marketing strategy, and changing client actions and conditions, tremendous openings are envisaged for the Inclusive Manufacturing System. Many of the reasons are mentioned herewith IMS perpetration provides a centralized platform to Micro, Small, and Medium Enterprises(MSMEs) for their collaboration with resource composition. Grounded on literal data and client demand, substantiated and customized orders can be fulfilled. colorful environmental, profitable, and societal issues can be resolved with the perpetration of associated programs and norms, and it helps in maintaining the sustainability aspects. Continued monitoring and selection of the stylish players from the request through the system, perfecting product quality and effective services that lead to significant growth in cross-border business and donation of the manufacturing sector. New inventions, implicit openings, job creation, perfecting life, and inclusive growth can be witnessed with the expansion of the manufacturing sector. Eventually, similar generalities can play a big part and come the backbone of Atmanirbhar Bharat(Self- reliant India), giving the ideas of' oral for original',' original for global',' make for the world', and' brain drain to brain gain'.

Conclusion

To meet the sustainable environmental pretensions and protection of global environmental coffers, similar as the global climate and natural diversity, combined transnational trouble is essential(ICIMOD, 2020). Hence, a responsible transnational authority like united nations terrain programme(UN Environment) should take an effective part to prepare time- acquainted programs, arranging transnational conventions, and in order to achieve profitable, social, and ecological impacts, a paradigm shift is needed. This necessitates companies redefining resource use, product processes, and their relationship with business mates along the entire value chain. In 1784, the first artificial revolution began with water- powered machines. Electricity (2.0) made mass product possible. With the help of IT and electronics (3.0), robotization was advanced up to the moment's digitalization (4.0). With indirect frugality, we want to drive the urgently necessary Revolution5.0, creating a positive influence on people and our terrain. The ideal of the indirect frugality powered by Cradle to Cradle is to ensure that the coffers used can serve as starting accoutrements for new, pollutant-free products after they've been used. This allows them to circulate continuously in product cycles rather of" downcycling", the end is to enable the" upcycling" of products. Current results like participating generalities or play are formerly a way in the right direction on the road to indirect frugality. Still, the thing is to produce a positive footmark with optimized nutrient cycles through results that are suitable for the biosphere and the technosphere. It isn't enough if only many deals with these motifs and only individual product groups are optimized. However, there's no way around the indirect frugality, If companies want to make a really conspicuous donation to climate protection and resource conservation. Everyone can make a donation and be part of the result. Together, we're driving a 5th artificial revolution, with Cradle to Cradle as a new approach for products, processes, structures, and metropolises.

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