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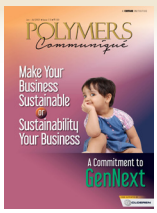
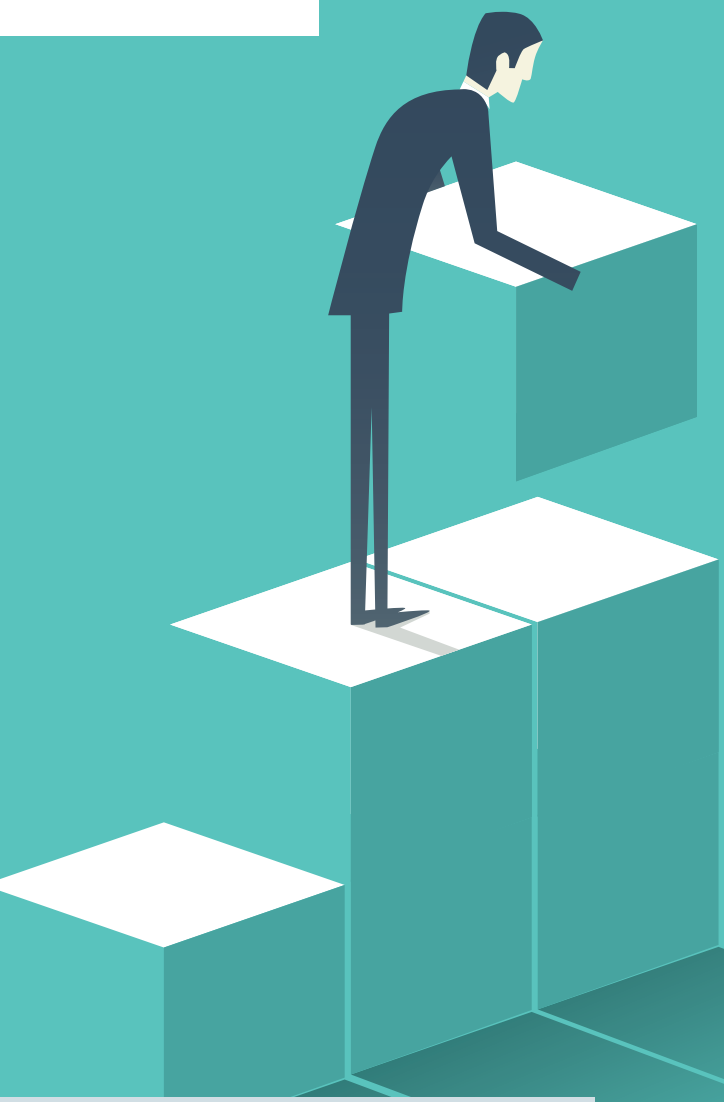


Plastics in Ecosystem Restoration



Despite being primarily derived from fossil carbon sources, plastics have the potential to reduce CO_2 emissions in multiple ways, thereby playing a positive role in preservation and restoration of the ecosystem.

On this Earth Day i.e. 5th June 2021, the 'Decade of Ecosystem Restoration' was launched worldwide. While it is an acknowledgement of the human-induced ecosystem crisis, it is also an expression of hope that restoring the ecosystem is possible with determined steps to preserve, halt further degradation as well as reverse it. Needless to say, the task on hand is urgent as the climate crisis is apparent all across.

Need to Reverse the Human-induced Ecosystem Crisis

What constitutes an ecosystem? It is a complex of living organisms, their physical environment, and all their interrelationships in a particular unit of space. This involves the lithosphere, hydrosphere, atmosphere and biosphere, constituted by living organisms such as animals, fungi, plants, bacteria, and viruses occupying centrestage. The complex relationship within and across these elements is mostly synergistic, but occasionally antagonistic. Humans play a decisive role in maintaining this delicate balance (Refer Figure 1).

Ecological changes are natural phenomena. However, scientists now believe that they are significantly impacted and accelerated by human activities. Global warming - caused by Green House Gases (GHGs), degradation of land and loss of biodiversity -

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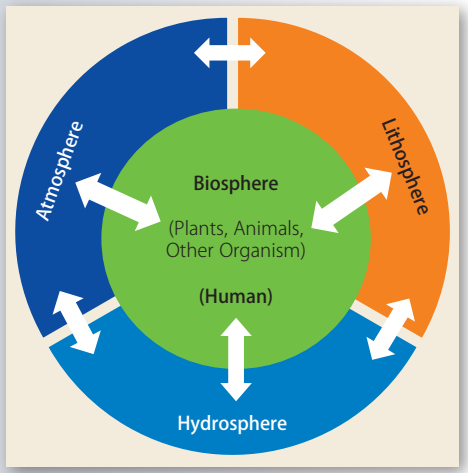

Figure 1: Constituents of our ecosystem.

is a manifestation of this. The changes will not only have severe implications for all forms of life but also for human beings' capacity to survive. Hence, there is an urgency to act and reverse the process. In this scheme of things, where does plastic fit in? While this may sound paradoxical, it does and in a positive way. Let us take a deep dive.

Over the past six decades beginning 1960, the global population has increased over 2.5-fold from 3 billion to the current 7.8 billion. During this period, we have also witnessed marked improvements in human well-being. The average per capita GDP, an indicator of the same, has also increased over 25-fold and average life expectancy has risen by almost a decade. To support this, we needed materials, water, energy, and other ecosystem offerings. Demand for steel has increased over 5-fold; for aluminum 11-fold; and plastics nearly 25-fold. Whether this is causal or casual is a matter of debate. Possibly it is a bit of both (Refer Figure 2).

A New Generation of Material

Plastics are new generation materials as compared to paper, metals, and glass. History is witness to the impact of any transformational changes - be it the transition from a pastoral to an agricultural economy or from an agricultural to industrial economy. The invention of plastics in the twentieth century was probably one such watershed moment. It brought unprecedented benefits in every sphere of human endeavour. It also brought in the need to handle this new generation of materials differently and more responsibly.

GHGs Responsible for Global Warming

Global warming and climate change are caused by GHGs, mainly CO_2, emitted predominantly during power generation, cement production and transportation. Methane, a more potent GHG as compared to CO_2, comes second followed by NO_2 and CFCs. CO_2 also contributes to acidification of the oceans, leading to drastic changes in marine biota.

According to one estimate, CO_2 concentration in the atmosphere has exceeded 417 ppm, up from the pre-industrial level of 278 ppm. Nearly 570 Gt of CO_2 has accumulated and approximately 41 Gt is being added every year. As a result, the average global temperature has risen by 1.1°C from the pre-industrial era. The world

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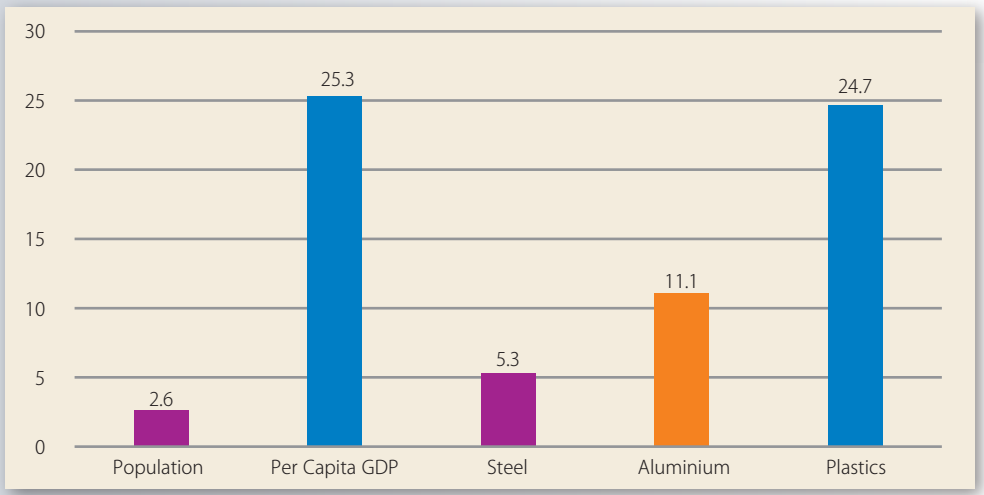

Figure 2: Times increase over 1960.

Plastic pollution, caused by callously discarded products, adversely impact the ecosystem. Solution lies not in eliminating, but by promoting multiple use and moving towards circular economy with source segregation and recycling. This new generation materials need new paradigm of usage and waste management to derive its full potential in restoring the ecosystem.

is striving to limit this to within 1.5°C as agreed in the Paris agreement.

There are multiple pathways to reduction in CO_2 emissions and sequestering the accumulated quantity. First, we need to drastically reduce our energy footprint and rapidly transit to renewables like solar, wind and other low carbon sources. At the same time, we should explore available options for sequestering CO_2, among which the Natural Climate Solution (NCS) of afforestation has the potential to naturally sequester an estimated 7 Gt of CO_2 every year. In addition it brings other benefits like curbing soil erosion, helping recharge ground water, promoting biodiversity, and reducing ambient temperature by transporting water from the ground and through the process of evaporation. Its capacity to convert CO_2 into oxygen and enrich the atmospheric air is well established.

Plastics in Reducing CO_2 Emission

Now, let us explore how plastics play a positive role. While starting from an unfavourable position, being primarily derived from fossil carbon sources, plastic has the potential to reduce CO_2 emission in multiple ways. First, being lighter in weight as compared to metals (nearly 1/8th of steel) and glass (nearly 1/3rd), plastic products have substantially lower material, water, and energy footprints during their conversion, handling, and use. Two independent studies conducted for the packaging sector in Europe and North America have observed that material footprint increases by 3.6 - 4.5 times if all plastic packaging is replaced with the next best alternatives. And the energy footprint increases by a factor ranging between 1.8 and 2.2 times. The resultant GHG emission reduces by a factor of 2.3 to 2.7 times (Refer Figure 3). Other benefits include protecting the quality and integrity and extending the shelf-life of the products packed. Are these not compelling reasons to use plastics and help reduce the CO_2 build-up in the atmosphere?

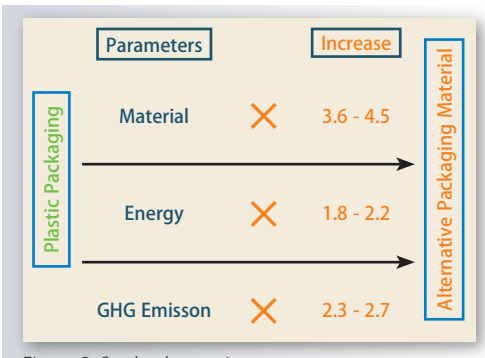

Figure 3: Study observations.
Sources: Denkstatt 2011 & Franklin Associates 2014

We have already seen the benefits of enhancing green cover by rapid afforestation. Thus, promoting paper as an alternative to plastic packaging, which depends primarily on wood pulp, would be a retrograde step when viewed through the lens of sustainability. To restore the ecosystem, we need more green cover, not less. For other alternatives like aluminum, the mining of bauxite to produce aluminum is mostly carried out in forested areas. In the process of smelting of bauxite, besides using very high temperature, a large quantity of highly alkaline waste - red mud - is produced; posing significant environmental hazards. It is estimated that nearly 3 billion tonnes of red mud has got accumulated and stored around such processing sites. Using glass is also not a friendly option. It not only needs high energy to produce, but also being substantially heavier than plastics (a litre of milk needs a 5 grams pouch vis-à-vis a glass bottle of 650 grams for packaging), results in higher environmental loads during handling and transportation.

Solution Lies in the Responsible Use of Plastics

It is, however, not an unalloyed benefit using plastic products. Plastic pollution, caused by callously discarded products, adversely impacts the ecosystem. The solution lies not in eliminating, but in promoting multiple-use and moving towards a circular economy with source segregation and recycling. This new generation material needs a new paradigm of usage and waste management to derive its full potential in restoring the ecosystem.