



# Responsible consumption and production: a roadmap to sustainable development

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Unsustainable consumption and production patterns have been one of the greatest challenges over the past few years. They are the main drivers of triple planetary crises of climate change, biodiversity loss and pollution, threatening human lives, environment and targets of SDGs. The present consumption and production system adds to pollution and generation of waste that in turn puts stress on carrying capacity of ecosystems. According to World Economic Forum (2020) report, although, humans represent only 0.01% of all living beings by weight, yet are responsible for destruction of 83% of wild mammals and half of all plant species. Current extinction rates are tens to hundreds times higher than the average of past 10 million years. Furthermore, human activities have negatively altered 75% of land and 66% of marine environments. This has resulted in decline of global ecosystems by 47%, both in size and in conditions, as compared to estimated baselines.<sup>1</sup> This is an alarming situation for renewable and non-renewable resources as it can make them collapse due to over-exploitation. Moreover, the ever-growing population, which is projected to cross 9 billion by 2050, will further increase the pressure on natural resources for food and energy demands. Hence novel, innovative and responsible patterns of consumption and production must be promoted or implemented in order to mitigate environmental degradation. Sustainable Development Goal (SDG) 12 aims to ensure responsible consumption and production, which is the key to sustain livelihoods in present as well as for future generations. It reflects a global consensus on the need to fundamentally change the way we produce and consume. If

the targets are achieved it will help in achieving social and economic development within planetary boundaries. However, this requires worldwide cooperation, collaboration and coordination.

The first and foremost target of SDG 12 i.e. 12.1 is to implement the 10-year framework of programs (commonly referred to as 10YFP) on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries.<sup>2</sup> It is a global agreement of decades of multilateral cooperation on sustainable development to speed up the shift towards sustainable consumption and production in both developing and developed world. This will help in capacity building and contribute in accessing financial and technical aid in these areas, especially in developing countries. According to a report of United States Environmental Protection Agency (USEPA), the One Planet network, a multi-stakeholder partnership for sustainable development was established to execute 10YFP so as to accelerate resource efficiency and sustainability and the United Nations Environment Programme (UNEP) serves as the One Planet network Secretariat.<sup>3</sup> 10YFP is directed towards development, replication and scaling up of sustainable consumption and production (SCP) and setting resource efficiency initiatives at national and regional levels in order to decouple environmental degradation. This will also facilitate the net contribution of economic activities to resource efficiency and productivity, elimination of poverty, social development and will promote sustainability of environment. The framework consists of six programs: Sustainable Public Procurement, Consumer Information for SCP, Sustainable Tourism, Sustainable Lifestyles and Education, Sustainable Buildings and Construction, and Sustainable Food Systems.

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<sup>1</sup> [https://www3.weforum.org/docs/WEF\\_New\\_Nature\\_Economy\\_Report\\_2020.pdf](https://www3.weforum.org/docs/WEF_New_Nature_Economy_Report_2020.pdf).

<sup>2</sup> <https://www.un.org/sustainabledevelopment/sustainable-consumption-production/>.

<sup>3</sup> <https://www.epa.gov/international-cooperation/10-year-framework-programmes-sustainable-consumption-and-production>.

In addition, a newly developed online application called SCP Hotspots Analysis Tool (SCP-HAT) has also been set up. The application allows countries in identification of hotspots at national and sector level and provides necessary information about relevant policy questions. Over the last 25 years, it has provided data about environmental socio-economic performance of 171 countries<sup>4</sup>. Similarly, ‘SDG 12 Hub’ is established that contributes in direct and transparent access to data and linkages reported by Member States on SDG 12 with governments, businesses, civil society and public. It also provides support to Member States in achieving targets of SDSG 12 and acts as a central location to access official government reporting for SDG 12 indicators thus providing help in visualizing and consolidating national reporting on SDG 12 indicators allowing progress on SDG 12.<sup>4</sup>

Target 12.2 is to achieve the sustainable management and efficient use of natural resources by 2030. Over-exploitation of natural resources compromises the health of ecosystems and overall well-being and livelihoods of people as well as economy. The increased reliance on natural resources has set us on an unsustainable path, exacerbating the pressure on sensitive and fragile ecosystems. There are number of drivers that are involved in degradation of natural resources including population explosion, overconsumption, poor farming practices, logging, pollution, industrial and technological development, and natural disasters. As per estimates of Global Resource Outlook (2019), utilization of natural resources has more than tripled since 1970 and is continuously growing<sup>5</sup>. This increase is triggered by ever-increasing extraction of materials to meet the demand. This is exerting a unprecedented pressure on natural habitats and ecosystems. The report further states that the annual global extraction of material has increased from 27 billion tons to 92 billion tons in last fifty years or so, whereas the annual average material demand has grown from 7 tons to over 12 tons per capita. Data and estimates suggest that the extraction of natural resources will continue to grow by 110% reaching 190 billion tons per year by 2060.<sup>5</sup> Domestic Material Consumption (DMC) and Material Footprint (MF) are the features that cover the economy, production and consumption. The amount of materials that are directly being used within a national economy come under DMC while MF gives additional perspective of account materials required across the whole global supply chain to produce a good/service and allot them to the final demand.<sup>6</sup> According to

Sustainable Development Goals Report (2022), total DMC increased by more than 65% from 2000 to 2019 worldwide and amounted to 95.1 billion metric tons in 2019 that translates to 12.3 tons per person. Eastern and South-Eastern Asia and Europe and Northern America accounted for about 70% of global DMC.<sup>7</sup>

Target 12.3 is to halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses by 2030. Food loss and waste is a global issue that poses a threat to food security, food safety, economy and overall sustainability of environment. According to a report by United Nations (UN) (2022), 14% of the global food is lost during harvest and retail. Not only this, 17% of world’s total food produced is wasted, of which 11% accounts for households, 5% in the food service and 2% in retail.<sup>8</sup> World Economic Forum (2021) reported that food loss and waste accounts for \$936 billions of global economy per year.<sup>9</sup> Much of this lost or wasted food ends up in landfills and gets composted and is responsible for substantial greenhouse gas (GHG) emissions. UNEP Food Waste Index Report (2021) reveals that 8–10% of GHG emissions are linked with food that is not consumed.<sup>10</sup> Report by Food and Agriculture Organization (FAO) (2023) estimates that carbon footprint of food wastage is about 3.3 billion tons of CO<sub>2</sub> released into the atmosphere per year. The report further states that to produce this lost or wasted food, 1.4 billion hectares of land and 28% of the world’s agricultural area is consumed. It has also been stated that developing and poor countries bear more food losses during agriculture production, whereas in middle and high-income regions, food waste at the retail and consumer level are higher.<sup>11</sup>

Target 12.4 is concerned with responsible management of chemicals and waste by 2020 and Target 12.5 is to substantially reduce waste generation through prevention, reduction, recycling and reuse by 2030. Waste is an inevitable byproduct generated by societies as a result of creation and consumption of goods. Worldwide, 7–10 billion tons of wastes are produced per year that include 300–500 million tons of hazardous waste (explosive, flammable, toxic, corrosive, and of biological risk) (Martínez et al. 2022). Estimates suggest that global waste generation is expected to reach 27 billion tons per year by 2050 (Kaza et al. 2018). World Bank has

<sup>4</sup> <https://www.unep.org/explore-topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/goal-12>.

<sup>5</sup> [https://www.resourcepanel.org/sites/default/files/documents/document/media/unep\\_252\\_global\\_resource\\_outlook\\_2019\\_web.pdf](https://www.resourcepanel.org/sites/default/files/documents/document/media/unep_252_global_resource_outlook_2019_web.pdf).

<sup>6</sup> <https://sdg12hub.org/sdg-12-hub/see-progress-on-sdg-12-by-target-122-natural-resources#indicator-item-12.2.2>.

<sup>7</sup> <https://unstats.un.org/sdgs/report/2022/The-Sustainable-Development-Goals-Report-2022.pdf>.

<sup>8</sup> <https://www.un.org/en/observances/end-food-waste-day>.

<sup>9</sup> <https://www.weforum.org/agenda/2021/03/global-food-waste-solutions>.

<sup>10</sup> <https://www.unep.org/resources/report/unep-food-waste-index-report-2021>.

<sup>11</sup> <https://www.fao.org/news/story/en/item/196402/icode/>.

reported that more than half of the global waste is due to food (44%) and plastic (12%). Some other categories include paper and cardboard (17%), glass (5%), metals (4%) and others (14%).<sup>12</sup> Of them all, plastic pollution is the most serious planetary threat causing adverse impacts on environment including land and marine pollution. A report by Borrelle et al. (2020) reveals that 19 to 23 million metric tons (i.e. 11%) of global plastic waste produced in 2016 entered aquatic systems. If the present pattern of plastic generation continues, it will reach up to 53 million metric tons per year by 2030. E-waste is another major environmental issue that needs urgent attention. According to Sustainable Development Goals Report (2022) about 7.3 kg per capita of global e-waste was generated in 2019, of which only 1.7 kg was managed in an eco-friendly manner. E-waste generation is disproportionate around the globe. Poor or low income countries produce very less e-waste in comparison to high and middle income nations. For example, sub-Saharan Africa produces only 1.6% while Latin America and the Caribbean 1.2% of global e-waste<sup>7</sup>. The aforementioned data explains why it has become so important to minimize the generation of waste, and treat it safely where possible, before disposing off. For this to obviate, reducing, reusing and recycling can minimize significant resource footprint and GHG emissions.

Target 12.6 is to encourage companies, especially large and trans-national companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle. The target recognizes the crucial role of ‘corporate sustainability reporting’ in order to improve and strengthen the SDGs. This target can be achieved by the assessment of economic, environmental and social impact of companies. Inter-Agency Expert Group on Sustainable Development Goal Indicators (IAEG-SDG) is working in this direction and is monitoring the companies for taking such measures. Publishing sustainability reports is an indicator to check the progress of the target.<sup>13</sup> Sustainability reporting will enable transparency and responsibility among corporates as well as develop awareness in customer towards sustainable development. Latest global trends on sustainability reporting have shown that world’s top 250 companies are involved in sustainability reporting with 96% rate in 2022<sup>14</sup>, which was 45% in 2002.<sup>14</sup> To further develop core corporate sustainability indicators, concerted efforts are required with overall SDG monitoring.

Target 12.7 deals with promotion of public procurement practices that are sustainable, and in accordance with

national policies and priorities. Public procurement holds huge purchasing powers that accounts for about 12% Gross Domestic Product (GDP) in ‘The Organization for Economic Cooperation and Development’ (OECD) countries and up to 30% GDP in several developing countries.<sup>15</sup> Using purchasing power through sustainable public procurement practices in accordance with national policies and priorities plays a critical role in sustainable production and consumption. A global multi-stakeholder platform called One Planet Programme on Sustainable Public Procurement (SPP) supports the implementation of SPP around the world and is co-lead by UNEP. Every four years, UNEP reviews the status of SPP at global level to examine the trends and challenges. Moreover, UNEP has also formulated methodology to provide assistance to countries to develop designs and implement policies related to SPP<sup>15</sup>.

Target 12.8 aims to ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature by 2030. It is important to make relevant information and skills accessible for individuals so that they can adapt their behavior and lifestyles in such ways that ensure promotion of sustainable development and environmental protection. According to the data of SDG report (2022), 90% of the countries showed partially mainstreamed ‘Education for Sustainable Development and Global Citizenship Education’ in national education laws and policies, curricula, teacher education or student assessments in primary and secondary schools. Furthermore, for technical and vocational education, only 57% of mainstreaming rates were reported, while for adult education, rate was much lower i.e. 51%. Moreover, global data shows that one in four of primary and secondary teachers are not ready to teach the themes related to above topics<sup>7</sup>. However, United Nations Educational, Scientific and Cultural Organization (UNESCO), the custodian agency of this target along with UN agencies and inter-governmental organizations is devoted to educate people and to disseminate global citizenship education about sustainable consumption and production.<sup>16</sup>

Target 12.A is focused on supporting developing countries’ scientific and technological capacity for sustainable consumption and production. At present there is no such concrete data available to quantify the technological capacities of the developing countries. However, number of patents and intellectual property rights held by countries can give an idea about the trends and measure of activities or research done in the direction of the goal. Some common indicators

<sup>12</sup> <https://datatopics.worldbank.org/sdgatlas/goal-12-responsible-consumption-and-production/>.

<sup>13</sup> [https://stats.unctad.org/Dgff2016/planet/goal12/target\\_12\\_6.html](https://stats.unctad.org/Dgff2016/planet/goal12/target_12_6.html).

<sup>14</sup> <https://kpmg.com/xx/en/home/insights/2022/09/survey-of-sustainability-reporting-2022/global-trends.html>.

<sup>15</sup> <https://www.unep.org/explore-topics/resource-efficiency/what-we-do/sustainable-public-procurement>.

<sup>16</sup> <https://sdg12hub.org/sdg-12-hub/see-progress-on-sdg-12-by-target/128-lifestyles-education>.

that are used to monitor resources dedicated to research and development globally are gross domestic expenditure on research and development (GERD).<sup>17</sup> There is need to further intensify the research on technologies related to sustainable production, consumption and circular economy. This can only be achieved by investing in this direction and transfer of already developed technologies to the developing and poor nations.

Target 12.B is to develop and implement tools to monitor sustainable tourism. The target is set to measure level of statistical capacity at national and global level to monitor sustainability of tourism particularly the economic and environmental aspects. The progress of the target is assessed based on the implementation of two standard accounting tools relevant for sustainable tourism (the Tourism Satellite Account (TSA) and the System of Environmental-Economic Accounting (SEEA). Statistical Framework for Measuring the Sustainability of Tourism (SF-MST) provides the structure for statistical analysis of economic, environmental and social dimensions of sustainable tourism. Ecotourism can play a very crucial role in protecting the natural resources/habitats and improving the local economy. Recent data indicates that we are moving in a right direction as far as sustainable tourism is concerned. The availability of TSA and SEEA data has considerably grown in last decade or so depicting a positive indication.<sup>18</sup> However, lot more work can be done, particularly in developing and poor countries to sensitize the people about responsible and sustainable tourism. Transition towards carbon neutral tourism with proper indications and assessments will be very important to achieve the targets of SDG 12. Development of novel tools to assess the situation at local and global level is required.

The last target i.e. 12.C is to remove market distortions that encourage wasteful consumption. This calls for rationalizing, restructuring and phasing out harmful and inefficient fossil fuel subsidies to reflect their environmental impact. As per report of Our World in Data (2022) global fossil fuel consumption in 2021 was estimated to be 136,018 terrawatt-hours (TWH). Although use of fossil fuels (petroleum, coal and natural gas) plays a dominant role in energy production but causes adverse environmental impacts including ocean acidification, extreme weather events, sea level rise, environmental pollution (land, air, water) and health concerns (Arora and Arora 2023). UN report states that fossil fuels are regarded as the major contributors of global warming accounting for 75% of total GHG emissions and 90% of all

carbon emissions.<sup>19</sup> Moreover, fossil fuel subsidies cause environmental degradation and exacerbate climate change as these boost wasteful energy consumption and production. Estimate of International Monetary Fund (IMF) (2022) suggests that globally, fossil fuel subsidies accounted for \$5.9 trillion or 6.8% of GDP in 2020, which is expected to rise up to 7.4% of GDP in 2025 due to increasing share of fuel consumption in emerging markets.<sup>20</sup> Removing these subsidies could allow government funds in contributing towards health, education, climate adaptation and development. To end the subsidies in order to sustain consumption, we need to enhance the production of clean energy. In this context, World Health Organization (WHO) (2022) data estimates that one third of global population i.e. 2.4 billion people of the world still lack access to clean cooking.<sup>21</sup> However, data by World Energy Outlook (2022) states that clean energy will be gaining strong ground in near future with clean energy investment propelling to more than USD 2 trillion by 2030.<sup>22</sup>

Implementation of SDG 12 is related to achievement of overall developmental plans, building economic competitiveness, cutting future environmental, social and economic costs and mitigation of poverty. It is important to adopt a system approach that will help in improving well-being of people and planet. Starting with simple changes in consumer behavior like shifting towards nutritious, safe and low carbon footprint diets, choosing reusable or eco-friendly products, reducing plastic waste can be the first few steps to bring the change. According to Cattaneo et al. (2021), growing interest in using block-chains will help to address the challenge of food losses in a commodity-specific manner and in real time. Also, addressing food loss and wastage through monitoring policies like Food Loss Index and Food Loss and Waste Protocol will help in traceability along food supply chains. In a recent study by Wołos et al. (2022), computerized waste-to-valuable algorithm can advance the effective reuse of chemicals that would otherwise pose environmental hazards. Adoption of circular economy based industrial production instead of existing linear models has become urgent need to promote sustainable and economic development. It is possible through smart design of products that comprises recycling, reusing, re-manufacturing and development of inclusive and efficient infrastructure (Schöggel et al. 2020). Also, close collaboration between retailers and consumers

<sup>17</sup> [https://stats.unctad.org/Dgff2016/planet/goal12/target\\_12\\_a.html](https://stats.unctad.org/Dgff2016/planet/goal12/target_12_a.html).

<sup>18</sup> <https://sdg12hub.org/sdg-12-hub/see-progress-on-sdg-12-by-target/12b-tourism>.

<sup>19</sup> <https://www.un.org/en/climatechange/science/causes-effects-climate-change>.

<sup>20</sup> <https://www.imf.org/en/Topics/climate-change/energy-subsidies>.

<sup>21</sup> <https://www.who.int/news/item/20-01-2022-who-publishes-new-global-data-on-the-use-of-clean-and-polluting-fuels-for-cooking-by-fuel-type>.

<sup>22</sup> <https://iea.blob.core.windows.net/assets/7e42db90-d8ea-459d-be1e-1256acd11330/WorldEnergyOutlook2022.pdf>

in the value chains is needed. European Union (EU) has set target limits of minimum 65% recycling and maximum of 10% of landfilling of all Municipal Solid Waste (MSW) by 2030 (European Commission 2015). Recently, bio-based valorization of waste for management of MSWs has come up that helps in reducing the amount of waste disposal and turns it into valuable products such as composts and fertilizers for plant growth promotion (Chaga's et al. 2023). Potentiating plastic waste circularity through biotechnology tools, like chemo-enzymatic technique (mainly based on microbial enzyme applications) for plastic bio-recycling, is also gaining interest (Orlando et al. 2023). Similarly, food waste valorization is being exploited by using enzyme stabilization and immobilization technologies to convert waste into useful high value added products like biofuel or other functional products. Furthermore, concept of Corporate Social Responsibility (CSR) and its implementation will facilitate conscious product choice and in shaping the attitude of consumers for promoting sustainable consumption. It can also increase transparency of companies with consumers about their products, facilitate dialogues and cooperation with stakeholders and will also help in identifying risk managements related to social, environmental and ethical aspects. On the other hand, innovative Information and Communication Technologies (ICTs) like cloud computing, smart grids, smart metering, and reduced energy consumption will have positive impacts on minimizing e-waste generation. UNEP has established a global science-policy platform called 'International Resource Panel' (IRP) about improving the natural resources. This knowledge can be further shared among scientists, governments (from both developed and developing regions), industrial and international organizations<sup>6</sup>. Strategies such as spatial planning and nature-based, circular solutions and satellite services are already being successfully exploited to mitigate over-exploitation of natural resources and reverse biodiversity losses.<sup>23</sup> Emerging green technologies like marine energy, hydrogen power, grid batteries, cellulosic ethanol and concentrated solar photovoltaic must be encouraged to further cut down on carbon emissions (Arora and Mishra 2022). Initiatives towards supporting forest-dependent livelihoods can also bring positive outcomes towards progress of the SDG 12 agenda. Governments, large companies and consumers involved in global value chains have come up with schemes and certification such as Forest Stewardship Council (FSC) certification and the Programme for the Endorsement of Forest Certification (PEFC) that will yield social benefits such as management, learning, community empowerment and governance (Yamamoto and Matsumoto 2022). Large

corporates must also come forward to generate revenues to adopt policies regarding nature losses. Recently, eco-tourism has become a prominent adaptation strategy to promote sustainability, mitigate climate change, improve biodiversity recovery as well as enhance livelihood and economy. Education can be another cornerstone that can enable skills to contribute towards sustainable development. Clear and accessible information about environmental labeling and product information can make consumers to make responsible choices of their products. Partnerships between academia, environmental campaigners, activists and private philanthropists must coalesce into one umbrella for overall progress of the agenda and its targets. Future urban policies, governance mechanisms and collaboration from multi-stakeholders must be addressed to create synergies across various domains and to enable citizen oriented initiatives that drive sustainability transformation.

Transition towards sustainable consumption and production will reduce negative impacts on climate, environment as well as on people's health and is a pre-requisite to achieve green economy. SDG 12 is linked to the success of almost all other SDGs. The nexus between food loss/waste and zero hunger is well known and by transforming how the world produces and consumes food will be a game-changer for achieving food security (SDG 2). Moreover, sustainable management of natural resources will directly influence life below water (SDG 14) and life on land (SDG 15) by mitigating the over exploitation of terrestrial and marine ecosystems and its biodiversity as well restoring and conserving them. Managing chemicals and waste will further help in improving water efficiency and its quality (SDG 6). Shift from fossil fuels towards clean sources of energy will contribute towards use of reliable and sustainable energy (SDG 7), improve health and well-being of people (SDG 3) and will create new job opportunities thus mitigating poverty and inequality (SDG 1 and 10). This will also contribute towards success of SDG 9 i.e. promotion of resilient infrastructure, SDG 11 i.e. sustainable urbanization and transportation and thus will enable economic growth (SDG 8). Quality education is another crucial aspect that will encourage behavioral change for both producers and consumers to promote a more sustainable pattern of consumption and production (SDG 4). With less than a decade remaining until the 2030 deadline, strong support and partnerships from governments, organizations, policy makers, stakeholders, business owners and NGOs (SDG 17) play a very crucial role. They can make a big difference to set the track record of SDGs on a right path and in capacity building. With all these concerted efforts and approaches it will become possible to use and produce in sustainable ways and restore the ecosystems of planet back to normalcy.

<sup>23</sup> <https://www.weforum.org/agenda/2021/05/natural-resource-management-reverse-biodiversity-loss/>.

## Declarations

**Conflict of interest** All authors declare that they have no conflicts of interest.

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