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Introductory Chapter: The Need to Change the Paradigm - Sustainability and Development at the 21st Century

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1. Introduction

Since the second half of the twentieth century, the big processes of globalization of the economy, coupled with the development of new technologies and the increase of the population, have led to the emergence of major environmental problems whose importance transcends beyond the limits of the countries, in a manner that we could say that they are global impacts. These problems include, among others, the ozone layer depletion, the climate change due to the greenhouse gas emission, or the depletion of natural resources.

Industry, as well as modern societies, must face this challenge, changing their consumption patterns, increasing product life, banishing the concept of “use and throw away,” and changing from the traditional productive systems to a more sustainable ones.

Sustainable Development's most recognized definition was established at the publication *Our Common Future*, known as *Brundtland Report* [1], as:

“development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

- The concept of ‘needs’, in particular, the essential needs of the world's poor, to which overriding priority should be given; and
- The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.”

Traditionally, Sustainable Development concept has been symbolized as three circles representing the triple bottom line of sustainability: society, economy, and environment. Nevertheless, different authors have proposed alternative representations, to consolidate the concept of society, environment, and economy as pillars of the sustainability, as can be seen in **Figure 1**.

In 2015, the United Nations adopted the 2030 Agenda for Sustainable Development, which went into force on 1 January 2016, after the Paris Agreement was adopted at UN Conference of Climate Change held in Paris in November 2015. This Agenda includes the 17 Sustainable Development Goals (SDGs), which have the aim to end poverty, to fight inequality, and to help countries to promote prosperity while preserving the environment at the same time (**Figure 2**).

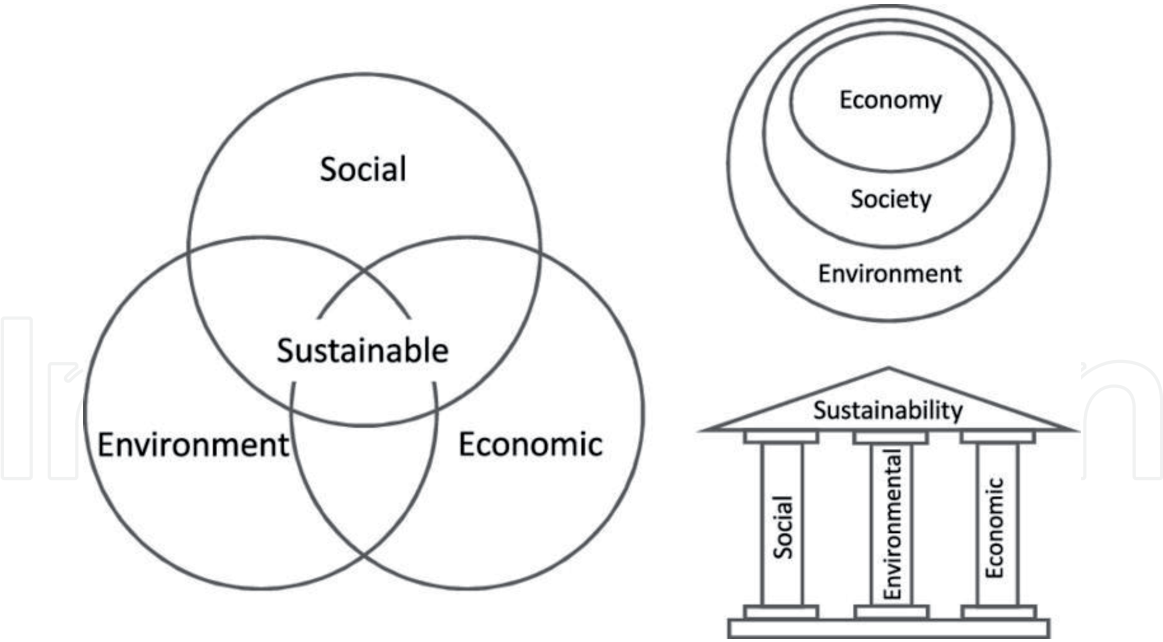


Figure 1. Different representations of sustainability concept: as three intersecting circle, literal “pillars” and a concentric circles approach [2].



Figure 2. The 17 sustainable development goals [3].

The UN SDGs aim ambitions and necessary targets across a wide range of socio-economic, environmental, and governance issues in order to reduce the significant gaps between high-income countries and emerging economies in terms of population access to critical services (health, education, public utilities, infrastructure) and to limit the extreme poverty among the most vulnerable populations from Asia, Africa, Latin America, or Eastern Europe.

By the twenty-first century, humankind has fallen into a very complex global human-ecological crisis which endangers not only its economic system, general welfare, peace, and development but its long-term survival and mere existence as well. This crisis requires effective international action and coordinated joint

work, but the humankind has reached this time torn to 195 independent national states without having an authorized global organization or effective cooperation system which would represent common interests of humankind efficiently. Natural processes are basically global, since climate change, overpopulation, and contamination of oceans, rivers, and atmosphere do not know state borders.

Sustainable society is an aimed global way of cooperation which ensures the survival of humanity, the constant preservation of our living conditions, the protection of the regulation capacity of the biosphere and its high biodiversity (as the guarantee of reliable natural operation), the good operation of the global economic system, the reduction of social tensions (e.g., inequality, famine, extreme poverty, crime, riots, terrorism, aggression, wars), the scientific and technological development, as well as the preservation and development of our natural and cultural heritage in the long term. The establishment of a sustainable society depends on macro-level (law, political will, consensus, public support) and micro-level conditions (affecting the everyday operation of individuals, families, companies, and small communities). When scientists make an effort in order to save, for example, an endangered species [4, 5], they might not consider this abovementioned complexity of the whole problem, which would make the work necessary.

The sustainability of the human society is endangered by the global human-ecological crisis and a lot of global problems, which are in close relationship with each other. In this phenomenon, the global population explosion (overpopulation of our planet) has a central role, because more people have a larger ecological footprint, a larger consumption, and more intensive pollution, occupy more space from natural ecosystems, and emit more carbon dioxide through their activities of course.

At the same time, higher population density directly enhances aggression (crime, riots, revolutions, demonstrations, wars, and terrorism) and the risk of public health problems, epidemics, pandemics, and the change of land use [6]. Climate change results in significant transformation of the biosphere and biological diversity pattern of the Earth [7, 8]. Biodiversity crisis (extinction of key species and the reduction of habitats) and climate change induce each other in a positive feedback loop, since through the biosphere, climate-regulating ecosystem services are weakened. Overpopulation and social crisis are in a similar positive feedback loop, since it is proven that poverty and hopelessness increase the number of offspring. People living in extreme poverty have nothing to distribute and nothing to base the future on; that is why many of them change from “K” to “r” reproduction strategy, trusting that some of their offspring will survive. Social crisis and public health crisis as well as social crisis and aggression (violence, crime, terrorism, riots, and civil war) are in a similar feedback loop.

2. The role of circular economy in achieving SDGs

Linear economy (“take-make-consume-dispose”) has significant limitations in terms of sustainability through exploitation of natural resources, destroying natural ecosystems and promoting excessive consumption patterns while generating huge amounts of solid waste and wastewater (municipal, industrial, and agricultural sources) which pollute environment through illegal waste dumping sites, landfills, incinerators, and lack or poor wastewater treatment plants.

Economic growth must be provided based on sustainability main pillars such as economic, social, and environmental nexus in a multi-scale context from global standards toward regional and local levels. Future predictions show that population growth and rural–urban migration will emerge in these regions and human pressures on environment in terms of energy and water supply demands, agricultural

land reclamation, urbanization process, biodiversity loss, waste production, and plastic pollution are likely to increase to alarming levels. Both developed and emerging economies must cope with effects of climate change, water shortage risks, industrial pollution, food security, demographic challenges, and socioeconomic inequalities. In this context, linear economy is clearly unsustainable in the medium and long terms, and shifting transition toward circular economy is quite necessary. This type of economy aims to cut as much as possible the natural resource depletion through reusing of secondary materials and closing the production and consumption loops by avoiding further waste generation and their disposal in landfills. In fact, waste management sector must be replaced by resource management (e.g., “end of waste”), and in this regard, a new paradigm is born such as “zero waste cities” as ultimate sustainability goals.

The 3R policy (reduce-reuse-recycle) based on waste hierarchy concept (where landfill and waste incineration are regarded as the least favorable options) is supplemented by product life expansion alternatives (repair-recovery-refurbish-repurpose-remanufacture) and to rethink our consumption patterns and to refuse to buy nonrecyclable items. These actions are more suitable than material recycling where additional raw materials and energy are needed for making new products. However, secondary materials and renewable energy sources should feed the new circular economy system instead of raw materials and fossil fuels. Composting of biowaste fraction or anaerobic digestion must be used to produce organic fertilizers and biofuels instead to be landfilled. Upcycling or creative reuse and sharing economy are other mechanisms that lead to responsible consumption patterns. The circular economy is strongly related to SDG9, industry, innovation, and infrastructure; SDG11, sustainable cities and communities; and SDG12—responsible production and consumption. Also, circular economy is interconnected to green economy (promoting clean energy sources, sustainable waste management practices, organic agriculture, etc.) or blue economy (sustainable management of marine resources and conservation). Full access of the population (urban and rural) to improved sanitation, solid waste, and wastewater management practices is critical to fulfilling SDG3 (good health and well-being), SDG6 (clean water and sanitation), and SDG10 (reducing inequalities) and to be able to make transition from linear to circular economy.

New digital technologies and Internet networks provide new tools for urban areas to increase their resource efficiency and reduce their ecological footprint that is becoming the so-called smart cities. A key aspect is to use the “Internet of things” (IoT) and big data to manage future megacities in a sustainable manner. According to Ellen McArthur foundation, “A circular economy is based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems” [9]. In other words, circular economy plays a key role in sustainability of cities and rural communities. EU policies recognize the key role of future circular economy in Europe by dedicating a special package document [10]. This will enforce waste reduction targets and high rates for packaging materials such as plastic, glass, paper and cardboard, wood, aluminum, and ferrous materials with specific deadlines for 2025 and 2030. The ultimate goal is to reach 70% of packaging materials by 2030 and recycling 65% of municipal waste stream by 2035 [11]. On the other side, many developing countries must upgrade their waste management infrastructure and increase the collection efficiency in the context of rapid urbanization and demographic explosion expected to happen in Africa and Asia. Developed countries must invest and expand their waste recovery and recycling facilities and stop the export of packaging waste or e-waste items into developing countries (e.g., Malaysia, Indonesia, Ghana, and so on). Urban mining, which focuses on recovery process of valuable materials from used items (e.g.,

e-waste flows), and construction and demolition waste stream have a great potential to feed industry with reliable secondary materials. New product design and production systems and less reliance on packaging materials are required to be enabled across the manufacturing industry. Therefore, the transition of current societies to a circular economy model constitutes a critical pathway toward sustainability.

This book presents a vision of the current state of sustainability and intends to provide the reader with and make a critical perspective of how the twenty-first century societies must change their development model facing the new challenges (globalization, Internet of things, industry 4.0, smart cities, and so on), in order to achieve the SDGs of Agenda 2030.

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