

Bioeconomy and Circular Economy

Subjects: Economics

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The joint application of bioeconomy (BE) and circular economy (CE) promotes the sustainable use of natural resources, since by applying a systemic approach, it improves the efficiency of these resources and reduces the impact on the environment. Both strategies, which belong to the area of green economy, provide a global and integrated approach towards environmental sustainability, as regards the extraction of biological materials, the protection of biodiversity and even the primary function of food production in agriculture.

Keywords: bioeconomy ; circular economy ; sustainability

1. Background

For the last two decades, based on the work of the promoters of sustainable policies, a large fraction of society has become more aware of the climate emergency that challenges the future of the planet ^{[1][2]}. In a globalized world threatened by climate change, promoting an economy that respects the environment is considered an obligation ^{[3][4]}. Global warming and the depletion of natural resources requires the adoption of a new production and consumption system that certifies its own sustainability.

Actions like (1) the 2030 Agenda and the United Nations (UN) Sustainable Development Goals (SDGs) ^{[5][6]}; (2) the Paris Agreement within the framework of the United Nations Framework Convention on Climate Change (UNFCCC), effective as of November 4, 2016, to regulate the increase in global temperature ^{[7][8]}; or (3) the commitments of the European Union (EU) to achieve a climate neutral coalition by 2050, represent opportunities in the transition process towards a more sustainable economy ^{[9][10]}.

The generation of biomass through agriculture, livestock, fishing, and forestry, among others, depends on natural resources and the environment; thus, the depletion of these resources below sustainable limits would undermine the future of the generating sectors, directly influencing the benefits and functions that these perform for society ^{[11][12][13]}. Hence, the current situation demonstrates the fragility of the systems and values on which a civilization rests. In this environment, the sustainable and joint application of concepts such as bioeconomy (BE) and circular economy (CE) is a cross-cutting condition that affects all economic sectors.

2. Definition of Basic Concepts: Circular Economy, Bioeconomy and Sustainability

CE refers to the economic concept incorporated in the framework of sustainable development with the aim of producing goods and services while reducing consumption and waste of raw materials, water and energy sources ^{[14][15][16]}. The CE principles (reuse, repair and recycle) are a key part of the biological economy; thus, by reusing, repairing and recycling, the impact and total sum of waste is reduced ^{[17][18]}. Thereby, CE is modifying the current production and consumption systems towards regenerative ones, maintaining the value of resources and products but limiting the input of raw materials and energy. This scheme (1) prevents the generation of waste to a certain extent, (2) obviates the increase of the derived negative impact, and (3) reduces the unfavorable impact on the environment, climate and human health ^{[19][20][21][22]}. Achieving a CE model where the full value of the biomass resources obtained sustainably is used is the way to ensure economic growth, job creation and environmental sustainability ^[23].

Likewise, the BE concept spread in the 2000s after its acceptance by the EU and the Organization for Economic Cooperation and Development (OECD) to promote the use of biotechnology so as to obtain new products and markets ^{[24][25]}. BE emerges as a way of consuming, which responds to environmental and social challenges while generating opportunities for economic development and employment ^{[26][27]}. This concept describes knowledge-based production and the use of biological resources, processes, and methods to provide goods and services in a sustainable way in all economic sectors, according to the Food and Agriculture Organization (FAO) of the UN. BE refers to the production, use

and conservation of biological resources containing related knowledge, science, technology and innovation to provide information, products and services to all economic sectors, with the aim of advancing towards a sustainable economy [28][29].

In this context, BE provides solutions to current global challenges, highlighting that: (1) it guarantees food safety, (2) reduces water stress, (3) manages natural resources in a sustainable way to avoid their overuse, (4) decreases dependence on fossil fuels and boost renewable energy, (5) generates green jobs, and (6) maintains productivity and competitiveness [30][31][32]. The development of BE requires an action plan in which local and national governments and supranational organizations participate, in relation to (1) increased investment in research, innovation and training; (2) establishing synergies between policies, proposals and economic sectors; and (3) the improvement of markets and competitiveness, based on providing the knowledge base for BE sectors to be more sustainable, and promoting the development of clean energies [33][34].

Conceptually, sustainability suggests the ability to meet the needs of the present generation without compromising the ability of future generations to meet their own needs, to ensure a balance between economic growth, environmental protection and social inclusion [35]. Sustainable development is the progress mode that maintains this current balance without endangering it in the future [36]. The UN SDGs are tools derived from the 2015 agreement by the UN Member States. These are made up of 17 SDGs and 169 targets applied in the 2030 Agenda, which covers aspects of the social, economic and environmental challenges facing the world [37][38][39][40]. According to FAO, the SDGs can benefit from the application of BE, since (1) it impacts the achievement of the end of poverty, zero hunger and the decrease of disparities [41]; (2) it is related to the objectives of clean water and sanitation, sustainable cities and communities, and responsible consumption and production [42]; (3) it promotes sustainable industry and infrastructure [43]; (4) it encourages economic growth and honest work [44]; and (5) it endorses health and well-being together with climate action, which benefits underwater life and life in terrestrial ecosystems [45][46].

3. Sustainable Effects of the Joint Application of Bioeconomy and Circular Economy

The strategic integration of BE and CE favors both the transformation of the economic model and changes in current consumption habits. Hence, the joint practice of CE and BE encourages the sustainable use of natural resources; therefore, by applying a systems approach (the purpose of which is to study the principles applicable to systems at any level in all fields of research), the efficiency of natural resources is improved and the burden on the environment is reduced. If the planet continues to be based on a high consumption of natural resources (knowing that these are finite), the ecological crisis will be aggravated by the scarcity of said natural resources. Consequently, the excessive demand for food, feed, biomaterials and bioenergetic resources will lead to the overexploitation of natural resources [46][47][48].

By extending the useful life of recycled products and materials, a BE-based circular approach allows us to maintain the value/use of materials and avoid the waste of non-recycled natural waste [49]. Both CE and BE, as green economy activities, must pay global and integrated attention to environmental sustainability, in the sense that the removal of biological materials should not be detrimental to the protection of biodiversity and they should not change the primary food production function of agriculture [50][51]. In this sense, the concept of Circular Bioeconomy (CB) attempts to promote both sustainable development and circularity. The tendency towards CB, where biological resources are kept longer in the production chain to ensure that they do not go unused, will increase the efficient and sustainable use of biomass, circularly replacing those resources based on fossil fuels so that more sustainable products are achieved and by-products and waste in the chain are minimized [52][53].

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