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Editorial

Circular Economy: a sustainable model for the development of the Agricultural Sector

Economía Circular: un modelo sostenible para el desarrollo del Sector Agropecuario

Economia Circular: um modelo sustentável para o desenvolvimento do setor agrícola

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After the processes of world globalization, especially in the last century, the international economic environment has been characterized by an increase in the speed of technological change, which has allowed large increases in the level of production and productivity at the corporate level, which in turn, has generated a culture of "consumption" in which individuals seek to acquire goods constantly, with high rates of technological replacement, discarding and disposing of materials and equipment in the trash.

This phenomenon is centered on the linear production model that develops the cycle of take, produce and dispose (Melendez et al., 2021), in which a heterogeneous mass of waste, biological, technological and other materials is generated, making their separation and subsequent reuse difficult. This is why this model is being replaced by the Circular Economy (CE) perspective that promotes more sustainable processes (Vega Ventosilla et al., 2020) involving economic prosperity, environmental quality and its impact on social equity.

CE is a production model based on ecological principles that aims to restore or regenerate production processes, replacing the philosophy of recycling, reduction and reuse with a concept of sustainable transformation of production, reducing the impacts caused by the linear production model on the environment and giving a major role to waste and residues. At this point, CE is considered as an

opposite to the view that the economy is a "materially linear" system (Allen et al., 2021), since it considers the need of human beings to live in harmony with the ecological system of the planet (Whalen & Whalen, 2020), adopts standardized models of cleaner production at the company level, uses renewable technologies and materials and adopts clear policies of sustainable development for society (Melendez et al., 2021).

Srivastava and Pathak (2020) posit that CE as a tool for waste management focuses on redesign, reduce, reuse, repair, renew, recover and recycle shortened as the basic 7Rs of the circular economy.

From various fields of study, disciplines, governments, business associations and academia, forces have joined to promote the change from the linear economic system to the circular paradigm as a scalable strategy to advance the goals of decarbonization and the Sustainable Development Goals.

Particularly in Latin America and the Caribbean, CE is included in the national policy agenda and is part of business strategies and the recovery of the economy after the crisis caused by Covid-19 (Salazar Xirinachs, 2022). From this area, the interest is to close energy and material flows, in line with the evolution of the concept of sustainability (Prieto Sandoval et al., 2017), to design projects and systems that manage to maintain the usefulness of products, components and raw materials at all times, redefining or, even, suppressing the very idea of waste (Filgueiras Sainz de Rozas et al., 2022). From this point of view, technology, as a structuring element of society and mediator of its interrelation with the environment (Villalba et al., 2022), is considered a central element for the development of the model.

In the case of activities related to food production, they have traditionally developed from a linear model focused on use, transformation and waste. Currently, about one third of all food produced in the world is lost or wasted. These losses encompass both the mass of edible food that is wasted by the supply chain during production, post-harvest, processing, etc., and the waste that occurs at the end of the food chain, at retail and in households where approximately 570 million tons of processed food is wasted, representing 17% of the food produced for human consumption each year. Household food waste per capita is very similar in all countries, regardless of income group, indicating that measures against such waste are equally necessary in high, middle- and low-income countries (United Nations, 2021).

This situation reflects the fact that economic systems are based on linear value chains that depend on a continuous and growing extraction of raw materials. Virtually all of these raw materials -91.4%-

are extracted from the earth, processed, used and discarded without any opportunity for recovery, causing irreparable environmental deterioration.

Therefore, focusing on this reality, specifically on production systems and waste, the need arises to develop circular production management systems to maintain the value of resources (material and immaterial) and products in all links of the production chain, reducing raw material and energy inputs, in order to mitigate negative externalities for the environment and for the economic agents involved in the process.

To achieve the integration of the circular economy approach in the agricultural sector, actions must move from the current linear models to a scheme in which waste is not directly associated with waste, but can be used as raw materials for new processes. In other words, recycle or reuse materials and products for as long as possible.

In this case, the application of this model in the agricultural activity is not only limited to evaluating the technical feasibility of introducing a certain waste to a greater or lesser extent in the links of the production chain, but this reuse must also comply with the principle of economic and environmental sustainability (Castellano et al., 2022).

In this line, the circular economy in the agricultural sector aims to promote:

- The use of renewable energies: since it allows for a change in the use of fossil fuels for renewable energies. In this case, the circular economy raises the problem of what to do with the waste generated by the traditional linear model of production and consumption in order to reduce environmental impact.
- Reduce carbon dioxide emissions by generating less waste: by applying new designs in the production chain to reduce waste and emissions, keeping products and materials in use to conserve energy in their manufacture, regenerating carbon sequestration systems in soil and products.
- Circular economy indicator systems: to measure the degree of circularity of waste, which will highlight the sustainable key of balancing economic, environmental and social aspects.
- Use of residual biomass: using agricultural surpluses as a source of energy in the production of new products. As waste is a problem for the environment due to the pollution it causes, the circular model promotes the recovery of materials considered waste.

- Development of sustainable production chains: developing more sustainable products that reduce the environmental impact of the production chain. One of these strategies is the inhibition of gas emissions in favor of carbon sequestration, an area in which the agricultural sector has great potential.
- The value of products, materials and resources are retained in the economy for as long as possible, while waste generation is reduced, thus multiplying the productivity of natural resources, energy savings and the reduction of greenhouse gas emissions.

Therefore, it is essential that each link in the chain manages its processes in accordance with the principles of the circular economy, and to this end, priority should be given to training and capacity building of actors to align the objectives of each link with these principles.

Base on the aforementioned, it can be stated that the success of the circular economy in the agricultural sector will depend primarily on the willingness of the sector's enterprises to apply this model, the education and training of the actors in the chain, the technological capacity of the sector's enterprises, as well as the processes of social innovation, participation and collaboration of the productive and social sector in which all the links in the production chain are involved.

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