Agroecology and its role within ISHS

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Horticultural Science Focus

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As a concept, agroecology was proposed over a century ago as a framework for more sustainable farming systems. Agroecology seeks to reduce our dependency on fossil fuel (petrol, gas), to reduce pollution of the environment and to mitigate the effects of climate change. It is based on principles that collectively aim to increase the autonomy and the resilience of the agroecosystem: recycling biomass, enhancing soil biotic activity through better management of organic matter, minimizing nutrient losses from the agroecosystem, increasing energy efficiency, increasing species and within-species diversity, and enhancing beneficial interactions and synergisms within agroecosystems (Altieri, 2015).

Although initially inspired by the science of ecology, agroecology is comprised of at least three dimensions: a science; a set of practices; and according to agroecological principles, a social movement that is more or less significant depending on the region in the world where it is developed (Wezel et al., 2020). It thus encompasses not only biotechnical issues that are classically investigated in horticulture (plant breeding, land management, product transformation, and the food supply chain, among others) but also the place human beings have in horticultural research from field to fork, and at a more general level, human health, and environmental safety.

Agroecology is a scientific discipline that involves the holistic study of agroecosystems and food systems: a set of principles and practices that improves the resilience and sustainability of food and agricultural systems, while preserving social integrity, and a socio-political movement that promotes the practical application of agroecology, pursues new ways of considering agriculture, food processing, distribution and consumption, and its relationships with society and nature (Wezel et al., 2009; CIDSE, 2018). It is a profound and continuous transformation that leads us to completely rethink our relationship to each other and to the earth that sustains us.

Agriculture is a significant contributor to climate change due to the amount of greenhouse gas (GHG) emissions generated on farm and in the processing, distribution, and consumption of food products. Global emissions from agriculture and related land use currently account for about one-fifth to one-quarter of total emissions from all economic activities (IPCC, 2019). However, the climate change impact of the entire food system is much greater when pre- and post-production activities along the supply chain, retail, consumption, and waste disposal are included. When all food system activities are considered, food system emissions can account for between 20 and 40% of total anthropogenic emissions (EAT-Lancet Commission, 2019; Tubiello et al., 2021).

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2019) global assessment warned that biodiversity is declining faster than at any time in human history. Food systems are responsible for around 60% of global terrestrial biodiversity loss. At the same time, around one-third of all food goes to waste between the points of production and consumption, while around 11% of the world's population are undernourished and 39% are either overweight or obese (FAO, IFAD, UNICEF, WFP and WHO, 2019). There is a close link between human health, plant, soil, animal, and ecological health.

The ETC Group (2017) calculates that smallholder farmers make up 80% of the total number of farmers and, using agroecological methods, produce 70% of the food available for human consumption (measured in calories and weight). Smallholder farmers use less than 25% of the world's agricultural land, only 10% of the fossil fuel and no more than 20% of the world's freshwater. In contrast, global agribusiness uses more than 75% of the world's agricultural land, provides food for only 30% of the world's population, and is responsible for the consumption of almost 90% of the fossil fuels used in agriculture (and consequently the corresponding emissions of GHG), and at least 80% of the fresh water.

Agriculture for the future must consider oil-independent agricultural models; agroecosystems with a low environmental impact that are resilient to climate change; multifunctional agriculture that provides economic, social, and environmental services; and local food systems, among other aspects. The new paradigm to feed the world requires an agroecological approach based on the right to food for all people and an acknowledgement of the social function of land. The conversion of specialized agricultural systems to an agroecological system follows three principles: diversification (by including different species of crops, trees and animals); integration (by the dynamic exchange and recycling

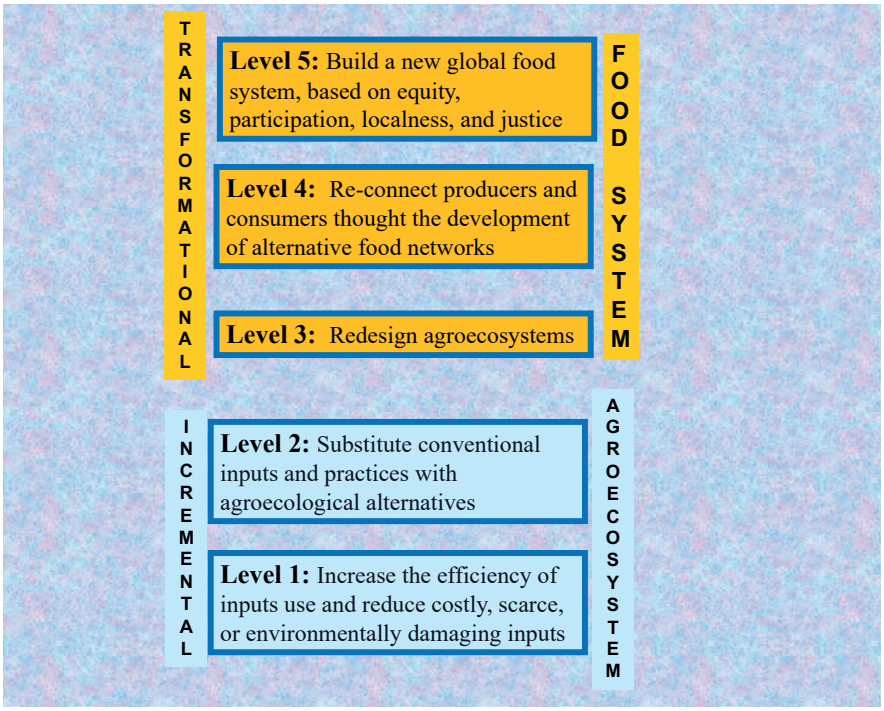

Figure 1. Transformational process from conventional form of agriculture towards agroecological food systems (adapted from Gliessman (2016) and Wezel et al. (2020)).

of energy and nutrients between the components of the system); and the achievement of food self-sufficiency.

In its second international symposium on agroecology "Scaling up Agroecology to Achieve the Sustainable Development Goals" (SDGs), the Food and Agriculture Organization of the United Nations (FAO, 2018) reinforced the opportunities for agroecology: to enhance smallholder and family farmers' adaptation and resilience to the impact of climate change; to improve food security and nutrition through healthy food and diversified diets; to protect and enhance agro-biodiversity to support ecosystem services such as pollination, soil health and the recovery of degraded lands and forests; to improve livelihoods in rural areas; and to achieve a transformative change in agricultural practices towards sustainable development. These statements were reinforced by the High-Level Panel of Experts (HLPE) on food security and nutrition that produced a report on "Agroecological approaches and other innovations for sustainable agriculture and food systems that enhance food security and nutrition" (HPLE, 2019).

Many of the recommendations made by FAO (2018) and the HLPE (2019) already align with the attitudes and values of most ISHS members. The "one-size-fits-all" paradigm that was the main element of standardized mono cropping in the mid 20th century has been replaced by the need to adapt our horticultural systems to specific contexts. Another aspect is the need to reconfigure the relationship between formal scientific research and the local knowledge and experience of farmers, rural and urban communities, and other actors along food value chains. Not only is ISHS interdisciplinary, but also transdisciplinary, for the Society aims to involve all the actors in food value chains (farmers, technicians, scientists, industry, government). This accentuates the importance of thinking both holistically and systemically about our agri-food system. Problems cannot be addressed in isolation, as they are interconnected and interdependent, and when problems become more acute, the effects spread throughout the entire system, potentiating other problems.

Thousands of agroecological initiatives around the world are revitalizing traditional farming systems that have stood the test of time to enhance food sovereignty, while contributing to the conservation of biodiversity. Increased plant species diversity and genetic diversity increase the overall resilience of food systems to new environmental threats and climate fluctuations. Agroecological farmers opt for intercropping and/or silvo-pastoral systems, agroforestry practices, as well as other diversified agricultural approaches that incorporate genetic diversity within their cropping regimes. This choice not only improves the biodiversity of their land, but also revitalizes the health of the soils and strengthens the resilience of their farming systems to extreme weather events.

Agroecology is a holistic model of global change. Its principles are a set of general guidelines that constitute the fundamental pillars of agroecology, its practice and implementation. Within the model, there are four dimensions: an environmental dimension, a social and cultural dimension, an economic dimension, and a political dimension (CIDSE, 2018). According to Gliessman (2016), the transformational process from conventional production systems towards agroecological-based systems involves five levels. Level 1 seeks to increase the efficiency of industrial and conventional farming practices to reduce the use and consumption of costly, scarce, and environmentally damaging inputs. Level 2 requires farmers to substitute conventional inputs and practices with agroecological alternatives. Level 3 requires a redesign of the farming system so that it functions based on a new set of ecological processes. Level 4 seeks to reconnect producers with consumers through the development of alternative food networks. Level 5 ultimately seeks to construct a new global food system, based on equity, participation, democracy, and justice. Whereas Levels 1 and 2 are incremental, Levels 3 to 5 are transformational (Figure 1).

Horticulture faces complex challenges that require problems to be addressed and resolved through an interdisciplinary and transdisciplinary approach to systematically develop, deliver, and apply sustainable farming techniques and methods to reconstruct our agrifood model (Dussi, 2019; Tüzel and Bertschinger, 2020). This integrated approach considers consumer related values like health, nutrition and well-being. In this way, horticulture can play a leading role since fruit and vegetables are food crops of utmost importance in the diet and are a valuable source of income for farmers (Dussi and Simon, 2022).

With its inherent ability to share knowledge and a broad range of Divisions and Commissions encompassing the diversity of tropical and temperate tree fruits, nuts, vegetables and ornamentals, protected cropping, urban food systems and responsible governance and interconnected functions of its members, ISHS is undoubtedly a relevant organization to facilitate the development of agroecology on a world scale.

ISHS promotes and encourages research and education worldwide for horticultural science. Our Society contributes to the achievement of the UN Sustainable Development Goals and in this sense, agroecology plays a strategic role in facilitating a more biodiverse, productive and resilient food system, capable of locally and regionally producing a sufficient quantity of healthy and accessible food for all humanity.

Agroecology is now an integral part of ISHS, with its own events and chairpersons to promote it, and has a bright future in collectively building a transformative process to develop new global food systems based on democracy, equity, knowledge sharing, and participation.

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