

## Protected agriculture in Colombia: A diverse and strategic sector

### Agricultura protegida en Colombia: Un sector diverso y estratégico

Human societies demand not only a greater quantity but also an increased variety of agricultural goods. In response to this situation, agricultural researchers have explored various alternatives to meet these demands in the context of constant population growth and environmental deterioration caused in part by agriculture itself. In the most traditional view, the challenge is raised to agricultural communities to produce enough food that would be distributed equitably throughout a population expected to reach 9.8 billion by 2050. It is necessary to emphasize that, according to demographic predictions, global population growth will slow down from that decade on, and in 2100 the human population will be around 10.4 billion. However, this demand is not limited to the production of nutritious, safe, and affordable food. Additionally, more crops are required to provide energy sources (biofuels), raw materials for the pharmaceutical and cosmetic industries, natural fibers, biopolymers, decorative (ornamental) elements, and even inputs for the sports and recreation activities, just to name a few. In Colombia, the agricultural sector also confronts the local and global trade of illicit plant products.

Human creativity has responded to these challenges from different perspectives, implementing various agricultural production systems, most of which share the same bases as for the search for sustainability, although depending on the socioeconomic context and the biophysical conditions of each region. An agricultural production system is understood as a form of organization and administration of resources that enables the generation of agricultural goods. Thus, we can infer that production systems depend on features such as environmental conditions, market characteristics, available resources, and the emphasis placed on sustainability's significance. This creates a wide diversity of agricultural production systems, ranging from traditional open-field crops to those cultivated in protected environments which permit at least partial control of environmental factors.

Protected environments appear to be among of the most important innovations in modern agriculture. A distinctive feature of these systems is the use of structures that protect cultivated plants against biotic and abiotic factors that limit their productivity. These structures are designed to generate favorable microclimatic conditions that, together with the efficient use of water, mineral nutrients, and energy, allow for increased yield. For the latter, we work together with other trends in modern agriculture, such as process automation.

In protected crop systems, the most common structure is a greenhouse, which in the Colombian context is employed to produce ornamental plants, especially cut flowers, such as roses, hydrangeas, carnations, chrysanthemums, and alstroemerias. Greenhouses are also used to produce vegetables (lettuce and tomatoes), potted plants (poinsettias and bromeliads), and other species. In addition, the structures locally called semi-covers provide partial protection against adverse weather conditions during the cultivation of fruit crops, such as passion fruits. Smaller structures, such as macro tunnels, are used to cultivate blueberries, and photoselective nets are employed to provide shading in the propagation areas of woody species. This heterogeneity of structures responds to the inherent variations in the country's geography, as well as to the markets for which the products are intended and the resources available to growers with each system.

Except for the cut flower industry, in other agricultural sectors of Colombia, it is difficult to quantify the use of protective covers. An estimate based on the land area by the Center for Innovation in Colombian Floriculture (Ceniflores) and the Ministry of Agriculture and Rural Development (MADR) indicates that greenhouse-grown plants occupy between 15,000 and 18,000 ha. At first glance, this area seems to be marginal compared with other crops such as coffee ( $\approx 850,000$  ha), oil palm ( $\approx 600,000$  ha),

rice (between 400,000 and 500,000 ha), and sugarcane ( $\approx 250,000$  ha). However, plants cultivated under protected conditions represent considerable economic value, as the cut flower sector alone is expected to generate export revenues of more than US \$ 2 billion by 2023. This illustrates the intensive nature of cultivation in protected environments, in terms of resource use and the need for knowledge generation when creating diverse agricultural products.

Although it is risky to predict the trend of agricultural production in protected environments in Colombia, it is very likely that the cultivation areas will increase in the coming years because of the new species moving

from open-field conditions to protected systems. In more consolidated sectors, such as cut flowers, there is already evidence of a technological transition to a more efficient use of resources considering water as a priority, together with the automation of labors such as fertigation. It is important for the academic community to endorse this process. This implies the training of professionals capable of crop production in protected environments as well as the active participation of Agricultural faculties in strategic studies, including a greater use of biological tools and further development of extension programs. These efforts will contribute to increasing efficiency, sustainability, and profitability for growers.

RODRIGO GIL CASTAÑEDA, PhD

Associate Professor

Universidad Nacional de Colombia, Facultad de Ciencias Agrarias,

Departamento de Agronomía, Bogotá (Colombia)

Email: [rgilc@unal.edu.co](mailto:rgilc@unal.edu.co)