Chapter 13
A Step Towards Food Security

Nadine Zakhia-Rozis, Éric Scopel, and Dominique Pallet

Feeding the 9–10 billion people that the UN foresees will inhabit the planet in 2050 will be a truly major global issue. Agricultural research and agri-chains will have to rise to the challenge of providing these billions with food that is healthy in a sustainable and equitable manner. To do so, they will have to, first, take into account global changes (climate, environmental, nutritional, and policy) and, second, construct a real transversality and interdisciplinarity.

In order to contribute to global food security according to the four pillars defined by the FAO in 1996, transformative action will be required at the level of agri-chains. This will mean ensuring:

- food availability (related to production capacity);
- access to food (related to poverty and social inequalities);
- stability of prices (related to market variability and various hazards);
- food utilization (related to food and nutritional transitions in the North and the South).

The governance and public policy dimension is inseparable from these four pillars to achieve the goals of providing healthy food in a sustainable and equitable manner.

This chapter focuses on one of the pillars: food availability.

N. Zakhia-Rozis (✉)
CIRAD – Department Persyst, Montpellier, France
e-mail: nadine.zakhia-rozis@cirad.fr

É. Scopel
CIRAD – UPR Aida, Montpellier, France
e-mail: eric.scopel@cirad.fr

D. Pallet
CIRAD – UMR Qualisud, Montpellier, France
e-mail: dominique.pallet@cirad.fr

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13.1 Several Approaches to Consider

Different approaches can improve food availability at the global scale but none of them is exclusive. Indeed, capacity to improve food availability and meet the needs and demands of the Earth's populations will likely be the result of implementing a combination of these approaches.

The first and obvious approach is to extend the area of agricultural and cultivated land. But this approach brings with it risks of deterioration of soil quality, damage to natural ecosystems, and land tensions, especially because of competition between food and energy uses of agricultural production and between urban development and agricultural development.

A second approach aims to increase agricultural yields, either through the use of various inputs, such as more productive varieties, fertilizers, or pesticides, or by improving the efficiency of use of available resources. Despite considerable advances in this field, it is clear that a gap still exists between the theoretical or potential yields and actual yields obtained. Furthermore, negative environmental impacts are also to be considered when the intensification practices adopted are not ecological.

A third way is to reduce post-harvest losses (products lost after leaving the field and during transport or storage) and wastage of food (products lost by the consumer after processing and distribution). This issue, which was a priority in the international research agenda and in those of donor agencies in the 1970s and 1980s, is now occupying centre stage once again given the high percentage of current post-harvest losses, especially in tropical regions. This approach of reducing losses amounts to optimizing the different links of the agri-chain (production, processing, distribution, consumption), while taking into account the technical, social, economic, organizational, and political aspects of the value chain's context. In other words, this third way comes down to working on the interactions between agricultural practices, the efficiency and sustainability of food processes, and the organization of actors and value chains in order to reduce losses and wastage of food. This is a complex topic of research involving multiple stakeholders and disciplines.

13.2 An Agenda for Research

When seen through this prism, the contribution of agri-chains to food security can be divided into three themes, each of which, in turn, can be broken down into research issues that involve agricultural research in its disciplinary diversity and which form the research agenda presented here.

13.2.1 Theme 1: Increasing the Quantity and Improving the Quality of Food Products Through Upstream Developments (Fields, Livestock)

- Understanding the influence of agroecological practices on the increase in quantity and the improvement in quality of upstream production, through efficient use of resources and/or the reduction of potentially contaminating products.
- Developing relevant quality indicators that are shared by all the actors (from producers to consumers) in order to ensure better communication and ease of trade all through the agri-chain. These quality indicators should incorporate the health, nutritional, and organoleptic determinants of food quality.
- Better consideration and management of the variability and diversity of agricultural raw materials produced.
- Studying the impact of standards (health, nutritional, economic, social, security) on the organization of agri-chains and actors.
- Understanding the mechanisms by which the needs and expectations of consumers and civil society orient practices of food production and processing.
- Managing trade-offs between product quantity and quality (pesticide reduction versus lowered yields) or between environmental impacts of production and product quality (use of agricultural effluents versus health quality of harvested products, for example) in order to optimize the supply chain's functioning. To be able to make these trade-offs in an informed manner requires multicriteria modelling and assessment tools, which then lead to the development of decision-making tools for use by actors and policymakers.

13.2.2 Theme 2: Tighter Integration Between Production, Processing, and Consumption

- Analyzing actor networks and their functioning in order to identify possible room for manoeuvre to promote efficient and sustainable agriculture and food systems.
- Studying the concepts of proximity and integration, which can be geographical (for example, undertaking the first processing on the production site itself, with the aim of a quick stabilization of the product and value addition) or concern intra-agri-chain levels (between different stages, in different locations, or by different actors).
- Making more efficient and sustainable food processing systems by supporting the creation of mobile processing units (which can be positioned close to production sites) that are flexible (which can adapt to the variability and diversity of agricultural raw materials) or by sharing processing equipment (like the cooperative use of agricultural equipment), in pursuit of an improved

distribution of wealth, responsibilities, and tasks between the agri-chain's actors. These changes require an integrated approach and new skills (in logistics, design, infrastructure, or biomass exploitation).
- Modelling the functioning of agricultural and food systems at the scale of demarcated territories to find balances in the use of natural resources (soil, climate, water) and human resources (actors, governance). Indeed, the concept of the territory emerges as a relevant unit of sufficiently large operational size for an integrative approach aiming to optimize the functioning of and interactions between agri-chains in pursuit of food security.

13.2.3 Theme 3: Limiting or Reducing Post-Harvest Losses and Recycling, Reusing, and Extracting Value from Co-products

- Using a systemic approach to research and identifying the factors underlying pre-harvest and post-harvest losses to establish the hierarchy and interactions of causes.
- Identifying possible room for manoeuvre in terms of agronomic and technological itineraries to limit these losses. Different scenarios can coexist, such as: prevention (designing itineraries that produce less waste), reduction (identifying new commercial outlets for waste products of agri-chains currently considered as losses, such as the agri-chains of 'ugly' fruits and vegetables, rejected by traditional distribution networks because of their heterogeneous appearance but sold via different commercial routes), and recycling (for example, cascade reuse of agricultural co-products and by-products).

Limiting losses requires managing trade-offs between, for example: recycling of agricultural effluents and managing problems of quality of health of products; cascading use of various co-products and by-products such as the use of agricultural residues for soil fertilization and amendment versus for livestock farming versus for processing into biofuels; or the use of additional energy (refrigeration, for example) to reduce food perishability.

In conclusion, it is a matter of combining options for improving production (quantity and quality) through agroecology, optimizing proximities and integrations within agri-chains, and minimizing post-harvest losses while promoting recycling. The challenges facing agricultural research in its efforts to contribute to sustainable development, food security, and global changes require an unprecedented scientific openness and a truly interdisciplinary participation. If one had to define a single clear priority, it would have to be the need to design, at the territorial scale and with the involvement of the agri-chains' actors, efficient and innovative agricultural and food systems capable of producing sufficient quantities in a sustainable manner.