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Need to integrate food sciences for the transition towards sustainable local food systems

Summary

Although the scientific and technological advances achieved for human feeding are recognized, the coordination of the sectors regarding the scientific disciplines that facilitate sustainable feeding is needed, an aspect on which awareness is raised in the present short article. Agroecology is justified by promoting multisectoral integration for sustainable food and the need to integrate food sciences as intersectoral innovation is argued, so that local processes and actions (established services and personal attitudes) contribute to sustainable food. Although the transition towards sustainable local food systems puts pressure on the decentralization to the territories of functions of the different sectors and their respective sociotechnical services, among others, it is necessary to understand that the path of sustainability should not be traveled separately, but with coherent integration towards the common goal: achieving that human food is sustainable.

Keywords: sustainable food, integration of disciplines, multisectoral articulation

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Introduction

The construction of sustainable local food systems puts pressure on the integration of disciplines that contribute to making human food sustainable, mainly due to the growing scientific evidence that justifies that the functional interactions between the environment, food production, and the population are sensitive to life, a characteristic that determines the need for multisectoral integration.

It is recognized that the life and survival of human beings depend on the health of the planet, a process that requires interventions that allow progress towards sustainability, through transformations of agri-food systems, energy sources, production and consumption patterns.[1] It is also known that integrated health and ecology approaches have adopted concepts such as "One Health", "Conservation Medicine", "Ecological Resilience", "Ecological Integrity", "Healthy Communities", and a wide variety of other approaches.[2]

The Anthropocene, the era in which humans have become the dominant force in planetary processes, driving innovations can enable adaptation to global change;[3] because, to overcome the challenges facing humanity, systemic socio-ecological transformations are required.[4]

Recently, the consideration of agricultural spaces as structuring systems of the territory has occurred in parallel with the recognition of the agri-food system as a strategic element in economic development, in quality of life, and in the creation of urban-rural links, from the perspective of reterritorialized or locally-based agrifood systems. This opens up multiple possibilities for connection and the creation of intersectoral synergies in the planning of agricultural spaces, also considering their multifunctionality and the overlap of their economic, ecological, and social dimensions.[5]

In this context, Agroecology is reaffirmed as a complex socio-technical, organizational, and contextual/territorial phenomenon, which in particular suggests a broad approach that allows understanding (considering) agricultural action in holistic terms, proposing that the contemporary problem of production has evolved from a merely technical dimension to a more sociotechnical dimension, where social, economic, political, and ecosystem aspects are present and are part of the situation.[6]

In this regard, although the scientific and technological advances achieved for human nutrition are recognized, the coherence in the articulation of the different sectors is not sufficient for nutrition to be sustainable; among other reasons, because the integration of food sciences and their respective fields of action in the territories is limited, an aspect that is highlighted in this short article.

Agroecology as a science that promotes multisectoral integration for sustainable food

The accelerated lifestyle, the population's eating habits, and the increase in diseases typical of the late 20th century and early 21st century create a public health problem in many countries and significant changes in food matters worldwide. In search of a response to these health problems and thanks to important scientific advances and technological development, the current aim is to promote the consumption of foods that, in addition to basic nutrition, provide additional benefits for the health and well-being of the population, taking into account their genetic, environmental, social, and cultural characteristics.[7]

Unfortunately, and in a very short time, modern society went from a relatively organic metabolism to a techno-scientific one based on the mechanistic paradigm, in an apparent separation from the natural world and with the imposition of an individualistic economic model that significantly harms the biosphere (Hamilton and Grinevald 2015). The current social metabolism goes against (or at least in another direction from) the longed-for socio-environmental sustainability. If the Anthropocene is the result of unsustainable human systems, how can they be redesigned with a perspective of sustainability and social justice?[8]

It is known that human feeding has been characterized by acquiring and consuming what is offered to them: from the first populations that hunted animals or gathered fruits within their reach, to today's society, where they purchase products sold in nearby markets. This social myopia of depending on supply has become more sophisticated after World War II, reaching impressive levels in presentation, flavor, and persuasive messages that give them high attractiveness, to the point of leading to addiction.[9]

In fact, diet is closely linked to the evolutionary processes of human beings along the path of civilization and their coexistence with Nature. Food standards have been changing as interactions between human activity and the environment where this activity takes place have increased, reaching the point of disconnection, as aspects of the denaturalization of the environment have increased.[10]

The discrepancy between the evolutionary environment of the Paleolithic era and the current one is as follows: in genetic terms, modern humans live in a nutritional environment that differs from the one for which our genetic constitution was selected. It is a brief span, 10,000 years, in which selective pressures have not acted sufficiently to produce new adaptive changes. The contradiction between the modern diet and the genetic structure that resulted from adaptation to the Paleolithic diet is known as the evolutionary mismatch of the diet.[11]

Therefore, it is necessary to move towards healthy and sustainable eating, a dietary pattern that promotes all dimensions of people's health and well-being, with low environmental pressure and impact, accessible, affordable, safe, equitable, and culturally accepted. Furthermore, it allows for the optimal growth and development of people at all stages of their lives, both for present and future generations, contributing to the prevention of malnutrition in all its forms and to the reduction of the risk of non-communicable diseases.[12]

From this perspective, sustainable food is an emerging strategic objective, due to its importance for the quality of life of current and future generations. Although there are other proposals in this regard, consensus has increased in favor of the transition towards local and sustainable food systems, especially those based on Agroecology, whose social adoption is a challenge for local entities that interact in food governance, due to the coexistence of contrasting approaches regarding production, post-production, and access to fresh foods, which are also determinants in the population's attitude towards food.[13]

In this regard, in Agroecology there is a dynamic of participatory research taking place that influences the reconfiguration of the attributes of food; because, in addition to those related to quality, safety, nutrition, and health, those that consider the production and post-production processes in aspects related to social responsibility, environmental responsibility, equity, and solidarity, among others, are integrated; a trend that redirects the attitude towards food toward the restoration and conservation of natural and social resources.[14]

Precisely, a disruptive proposal that arose from the need for disciplinary integration in local food management is that the scope of action of agroecology during the transition toward local food systems considers the following domains:[9,14] (a) governance (policies, regulations, strategies); (b) the environment, natural resources, and primary production (agricultural and livestock); (c) complementary services (advisory, training, analytical laboratories, innovation, and input management, among others); (d) the different post-production processes (fresh product benefits, processing or transformation, collection, storage, transportation, marketing); and (e) the attitude of families and individuals toward food (education, health, communication).

The benefits of agroecological approaches on food security and nutrition have been reported in a variety of studies. However, the results of the true impact of Agroecology on nutrition and food have not yet been fully understood.[15,17] In particular, the multiple pathways through which agroecological methods can impact nutrition and the food system, both from consumer demand and from aspects of food supply, deserve further research.[18]

According to this approach, recent studies indicate a scientific paradigm shift for addressing the agri-food system, from sectoral theoretical approaches to systemic approaches supported by decision-making processes linked to territorial governance. From a holistic perspective, agroecology considers that the problems of the agrarian system cannot be studied independently of the human communities and social contexts in which they are situated.[19]

Although in local food management functional interactions are encouraged among the participating actors, disarticulation predominates with regard to the integration of the scientific and methodological base needed to facilitate convergent co-action with sustainable food. That is, the approach of locally self-managed food and nutritional security is promoted as a substitute for conventional globalized food; but with low synergies for making food production and supply and the population's attitude toward food sustainable, all of which constitutes a challenge in facilitating the agroecological transition.

Integration of food sciences as intersectoral innovation

Although the compartmentalization of human knowledge and hyperspecialization are nothing more than a product of industrial society; since the second half of the 20th century we have been witnessing the emergence of a multitude of theoretical approaches and methods of a multidisciplinary and transversal nature, in light of the universal assumption that to address the challenges to be faced, a holistic and systemic vision is necessary to understand these phenomena in all their complexity.[20]

In this sense, levels of interdisciplinary relationships are considered: interdisciplinarity, as an elementary level; multidisciplinarity, the level where there are only exchanges of information, but no mutual enrichment; understanding interdisciplinarity as a medium structuring level and transdisciplinarity as the higher level. Integration is a stage of interdisciplinarity; and at the same time, interdisciplinarity requires the integration of disciplines to achieve true effectiveness.[21]

In fact, integration is an inherent property of every system, which involves the action or effect of integrating, that is, uniting separate elements into a coherent whole. From a psychological point of view, integration is a mental process through which different knowledge is united.[22]

However, the importance of modeling ways to face such a complex and hybrid phenomenon as food security demands new ways of thinking, doing, and knowing how to do from social innovation.[23] Since the end of the 19th century, food has also been the object of study by different disciplines belonging to the Social Sciences, such as Health Sociology, Sociology of Consumption, Cultural Anthropology, and Social Anthropology, among others.[24,25]

Food sciences study the composition of foods and the effects that their components cause in the course of the different processes to which they are subject, investigating and discovering the connections that exist between the structure of the different compounds and their organoleptic properties, as well as their capacity for deterioration depending on their chemical composition.[26] In turn, the study of food from a biomedical perspective has a long tradition linked to the origins of the science of Nutrition. Indeed, since the first developments in

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the area came from Chemistry and Physiology and since the Dietitian emerged connected to medical practice and the hospital, these have determined the way to approach human nutrition well into the 20th century.[27,28]

In this regard, on the plot where the plant is cultivated (agroecosystem), it interacts with the soil biota, other uncultivated plants, the animals used for work, and the people who cultivate them, among other elements of biodiversity; whereas, when the agricultural product is harvested, it enters a process until it is marketed in different types of markets, where the rehandling of the fresh product exposes it to possible contaminations. In its route from the agroecosystem to the abdominal ecosystem of people, food can be considered as hybrid vectors: positive, for their nutritional and caloric content, in addition to an associated biota composed of microorganisms with functions in nutrient assimilation, immunity, and brain function, among others; negative, for being prone to carrying physical, chemical, and biological contaminants.[9]

On the other hand, various theoretical and methodological approaches have addressed aspects of food such as cultural identity, religion, family memory, historical processes, class situation, and the availability and access to food (Diez 1994). It is worth noting that over the past three decades, a theoretical body focused on the study of food culture has been developed from Social Anthropology, which has given rise to a specific field: the Anthropology of Food.[24]

For this reason, it is considered that food sovereignty requires more integration of all sciences because it is a phenomenon that must be confronted from a multidisciplinary and multisectoral perspective. Accompanied, as other research suggests, by a "systematic and comprehensive analysis of multilevel processes"[29] as a "multi-actor and governance approach".[30]

Professionals in food science and technology must work together with many others: the food industry and those in regulatory and public policy communities. With scientific and technological solutions available to address specific problems throughout the food system, our ability to feed a growing population sustainably, while safeguarding human and planetary health, seems not only possible but also promising. However, we must remain steadfast and rational in our approach, to help both humanity and nature.[31]

At the territorial level, the transition towards sustainable local food systems is generally promoted, organized, advised, and supervised by local governments, with the initial participation of entities that produce food (agriculture, livestock, environment) and provide different types of support services (laboratories, input suppliers, technical services, others); also those that manage post-production processes (processing, transformation, storage, transportation, markets, food), among others. As these processes advance, entities related to the influence of food on health (quality, nutrition, safety, biosecurity, public health) and the population's attitude towards sustainable food (education, communication) are integrated.

The growing trend towards the reconfiguration of territories as sustainable local food systems constitutes a disruptive transformation, if compared to the conventional food system; in this scenario, the different actors involved show narratives and proactive collaborations towards the integration of agriculture-environment, food-nutrition, food-health, among others. However, these various disciplines do not have sufficient basic documentation to achieve sustainable integration in local public policies and the specialized services they offer; that is, they act vertically according to perceptions ingrained during the conventional systems established from their respective sciences.

This perspective demands co-innovation for the systemic articulation of Food Sciences, considering the respective disciplines that provide services in the territories. Food Sciences should integrate disciplines from agricultural sciences, nutrition, health, education, communication, and social sciences, among others that are related to the processes that contribute to making human food sustainable.

A quick look at local processes and actions related to sustainable food (Figure 1). In fact, these processes involve disciplines that operate in the territories, where established services mix with personal attitudes; these, as a whole, are determinants of sustainable food. Indeed, although most of these actions are located within established disciplines, it is important to understand that the population acts as a hybrid actor: in the social responsibility to establish these services and in the personal attitudes acquired as behavior.

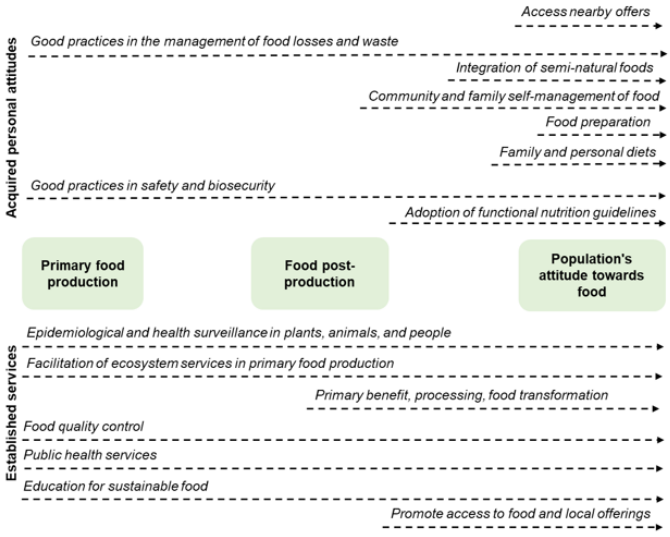

Figure 1 Local processes and actions (established services and personal attitudes) that contribute to sustainable food. Clues for awareness.

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Various works have meant valuable contributions insofar as they have sought a holistic vision, incorporating into the analysis of the complex food phenomenon both its material aspects, food practices in their broadest sense: production, distribution, selection, preparation, consumption, as well as the symbolic aspects, beliefs, representations, knowledge, that motivate and explain the practices.[24]

As has happened with other objects of study of a complex nature, currently no one would question that human nutrition must be approached and understood from an integral and multidisciplinary perspective and, for this, collaboration is required among various disciplines of the Natural and Social Sciences.[32]

Precisely, the Theory of Social Representations constitutes an interesting option for the study of the meanings that people construct around food and its links to health, insofar as it seeks to combine the subjective dimensions and the social dimensions involved in that construction.[33] This is particularly important, because in the population of the territory there are hybrid actors who, in addition to their social responsibilities in the different processes related to food, must demonstrate a proactive attitude towards sustainable eating.

The food-health link is the subject of representation insofar as it generates opinions, beliefs, and meanings that circulate socially and that have an impact on eating practices.[34]

It is evident that environmental, nutritional, and health education, which in many cases is managed separately because they constitute different sectors of society, requires holistic integration. This should be based on a scientific interpretation to educate families about the positive and negative interactions that must be managed along the path that food follows, from the agroecosystem to the abdominal ecosystem of people.[9]

The challenge is that food governance during the facilitation of the agroecological transition towards sustainable food systems is carried out under a Food Science approach, with disciplinary integration and transdisciplinary participation as an inclusive model.

Additional comments

An important and useful point to justify the need to integrate disciplines is to understand that foods are exposed to different processes, which influence their characteristics; that is to say, in their journey from the agroecosystem to the human abdominal ecosystem, foods can be considered as hybrid vectors of biodiversity: positive, due to their nutritional and caloric content, as well as an associated biota composed of microorganisms with functions in nutrient assimilation, immunity, and brain function, among others; negative, because they are susceptible to carrying contaminants (chemical residues, particles, toxins, parasites, and pathogens that cause diseases).[9]

It is known that the human body is populated by myriads of microorganisms on its entire surface and in cavities connected to the exterior. The microbial colonizers of the intestine (microbiota) are a functional and indispensable part of the human organism: they provide genes (microbiome) and additional functions to the resources of our species, and they participate in multiple physiological processes (somatic development, nutrition, immunity, etc.).[35] The intestinal microbiota is fundamental for the development of the brain, mobility, learning, and memory in humans.[36,37]

Recent advances in microbial ecology and genomics show that major disturbances of human microbial populations closely correspond to the major phases of the Anthropocene: a) the emergence of agriculture and livestock farming in the Neolithic; b) the Industrial Revolution, at the end of the 18th century; and c) the 'great acceleration' from the 1950s to the present.[38,39]

In fact, agricultural production has faced the dilemma of food safety for human consumption for a very long time, and this is one of the justifications for the alternative known as "organic agriculture." However, in general, there is a short-sightedness regarding this, because humans certainly require that fresh food be free of toxic residues; but it is also necessary that they carry their natural microbiota so that it interacts with the microbiota of a person's abdominal ecosystem when ingested, mainly due to its importance in food digestion, nutrition, and immunity against certain diseases.[40–43]

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Conflict of interest

Authors declare that there is no conflict of interest.

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