4 Sustainability of Food Sector Development in Tropical Areas

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Abstract

Debates over the last few years concerning the future of the planet have seen the question of food sufficiency reappear. Developing countries in the tropics and subtropics, primarily agricultural, are currently having to adapt to unprecedented socio-economic changes (urbanization, demographic growth, globalization of trade, widening disparities) and to cope with serious problems of food security, public health, and environmental damage. How can the food sector help meet these new challenges? Can the food sector development model initiated by the countries of the North be durably applied on a global scale? Which research and development priorities face these challenges? The objective of this chapter is to try to answer such questions. The first section focuses on the possible contribution of food sector development in meeting new challenges. The second, third, and fourth sections present, respectively, an outline of the history of food research over the past 40 years, main achievements and limits of research past lines, and the concept of sustainability in food processing. This appraisal serves as a background against which to examine the new directions that need to be explored for a sustainable development of the food sector, which is the subject of the last section.

4.1 INTRODUCTION

The developing countries in the tropics and subtropics, usually primarily agricultural, are currently having to adapt to extremely rapid socio-economic change (urbanization, demographic growth, globalization of trade) and to cope with serious problems of food security, public health, poverty and environmental damage. Debates over the last few years concerning the future of the planet have seen the question of food sufficiency reappear. With the world's population growing at an ever-increasing rate and an extra 1.7 million mouths to feed each week, the Malthusian fears of a widening gap between people's needs and food production are once more coming to the fore.1,2 The threat of medium- or long-term hardship is directing public attention to the need for a new international effort to increase food availability.

Faced with such issues, the development of these countries is generally handicapped not only by economic and political obstacles, but also by the inadequacy of their scientific and technical resources in many fields.3,4 This is particularly true for the food sector. In fact, for over half a century, most of the efforts directed to the agri-food sector have been focused on agriculture (perfecting and popularizing improved varieties and more intensive cropping and livestock systems), whereas only a very small part of the research resources has been targeted toward the food sector (processing and trading of agricultural raw materials). It must be emphasized, however, that the situation varies considerably, from the rapidly developing countries of Asia or Latin America to the most impoverished ones.

In the North, the terms of the problem are different. The countries of the North, richly endowed with major scientific organizations and facilities, are faced not only with growing social disparities and the exclusion of some categories of their popu-
How can the food sector contribute to meet the new challenges triggered by demographic growth and urbanization, globalization of trade, environmental damages, and widening disparities? Can the food sector development model initiated by the countries of the North be durably applied on a global scale? Which new research and development priorities face these challenges? How should scientists change or adapt their methods in the present context of unprecedented changes?

The objective of this contribution is to answer such questions. The first section focuses on the possible contribution of the food sector development in meeting new challenges. The second, third, and fourth sections present, respectively, an outline of the history of food research over the past 40 years, main achievements and limits of research past lines, and the concept of sustainability in food processing. This appraisal serves as a background against which to examine the new directions that need to be explored for a sustainable development of the food sector, which is the subject of the last section.

4.2 CHALLENGES FACING THE FUTURE OF THE WORLD’S FOOD SUPPLY

4.2.1 Demographic Growth

The first challenge is demographic growth. The world’s population should reach between 7.5 and 8.5 billion by the year 2020, almost four-fifths of whom will live in tropical countries. The total demand for cereals for human and animal consumption will need to have doubled by this date to about 1.7 billion tons. This challenge basically concerns agriculture. However, the food sector can help to increase the food supplies available by reducing post-harvest losses and improving the yields obtained from converting agricultural raw materials into finished foodstuffs. It is very difficult to evaluate these losses overall. They vary considerably from one country to another but are greater in hot, wet zones and are aggravated in developing countries by a lack of adequate storage and transport infrastructures. Losses also vary considerably according to the perishability of the commodities concerned. Post-harvest losses of 15–20% are often quoted for cereals in tropical areas. These may exceed 50%, and even approach 100%, for more perishable commodities like roots and tubers, fruit, or fish. Appreciable reductions in such losses appear possible not only by improving storage, conservation, and pest control techniques and processing yields but also by improving transport and marketing infrastructures and organization.

4.2.2 Urbanization

The second challenge is urbanization. The increase in the rate of urbanization is particularly rapid in tropical regions and exceeds that of demographic growth. It reinforces fears of a widening gap between people’s needs and long-term food production. Urbanization alters dietary behavior. Town dwellers eat more meat and more processed products that have a built-in service factor (convenience foods)—in other words, calories that cost more to obtain; this is accentuated by the rising level of income. North Americans thus consume the equivalent of 800 kg of grain per annum, Italians 400 kg, and Indians 200 kg.1 The newly industrialized and urbanized countries are moving toward an agro-nutritional model in which it appears impossible to provide a sustainable basis for the entire world, from an energetic point of view.

4.2.3 Globalization of Trade

The third challenge is the globalization of trade, which raises the question of the competitiveness of tropical foodstuffs on internal and international markets. We have seen certain foodstuffs invade the urban and then the rural markets of Africa, Latin America, and Asia. The distribution of bread, rice, chicken, dried milk, beer, hamburgers, and Coca-Cola® has led some authors to fear that local produce will disappear and that food will become completely standardized. However, whereas analysis of the products consumed gives the impression of convergence toward a single or dominant pattern of consumption, analysis of dietary practices reveals a considerable capacity for appropriating and reinterpretating external references through cookery and styles of consumption. The celebrated “thiebou dîne” of Dakar, a rice and fish recipe that has become Senegal’s national dish, is prepared using Thai rice, local fish, mainly imported vegetable oil, and vegetables introduced by the Portuguese and French. But it is far from being recognized as “international cuisine” and has become one of the symbols of African cuisine.

As a whole, as far as dietary change is concerned, the main overall trend appears to be diversification—in particular, in urban environments. Consumers enjoy a more varied diet and obtain their supplies from a wider range of sources.

In the face of this overall movement, which is very noticeable in certain countries of the South, the tropical produce and culinary preparations specific to each culture will be able to resist the globalization of trade only if their diversity is exploited and they are put to varied uses. Benin is a particularly interesting case in point: maize is processed there into about 40 different products, and this, in large part, explains the limited penetration of imported rice and wheat. The identification of products with their country of origin is becoming an important consideration in food sector development.

The competitiveness of local produce in urban markets is, nevertheless, limited by three main factors: it is often not available widely enough or over a long enough period of the year, it is sometimes expensive compared with competing imported products, and its quality does not always meet the new requirements of urban consumers.

As far as the international market is concerned, the competitiveness of tropical foodstuffs is not determined by price alone. Promotion of functional qualities is also an important factor. It is the distinctive qualities of such products as coffee, cocoa, tropical fruit flavors, herbs and spices, and acacia gum that have made them successful. Promotion of the distinctive nature of these properties is what enables such...
products to conquer new markets (e.g., specification of cocoa or coffee quality by geographical origin). Also, a loss of distinctiveness can make them lose markets! Coconut oil sales initially dropped on the world market as a result of the problem of aflatoxins produced by inappropriate drying processes and the cost of the refining procedures needed to remove them. Vanilla and cane sugar are likewise faced with strong competition, the former from synthetic vanillin and the latter from artificial sweeteners.

4.2.4 Widening Disparities

The fourth challenge is widening disparities. Overall, the world currently produces enough food to meet its food requirements. Over 800 million people, however (i.e., one-seventh of the world’s population) do not get enough food to lead a healthy, active life. At the same time, almost 400 million people are suffering from illnesses caused by dietary excess (e.g., obesity, diseases of the cardiovascular system). The first situation is the result of political instability, war, and poverty. Loss of identity and confusion of social and cultural reference points that previously helped maintain behavioral equilibrium are suggested as reasons for the second. In neither case does malnutrition appear as a simple question of the quantities of food available. Food security should include the notions of distribution and of sustainable access to foodstuffs for all, along with those of social and political stability, equilibrium, and consistency. Overabundance of supply may be accompanied by a demand devoid of financial resources, as is the case in Latin America: if the gap between the two widens, food security becomes a major political problem in terms of a more equitable distribution of available resources. Witness the pillaging of supermarkets in the vicinity of the shanty towns.

What has this to do with the food sector? First, it can help improve the transportation and storage of the available food resources. Second, it offers opportunities for economic activity, employment, and income in both rural and urban environments. Food sector activities today represent a major source of employment and income, particularly for women, in countries obtaining most of their resources from agriculture (most tropical countries, for instance). International comparisons show that an increasing percentage of the value added by the combined agricultural and food sectors in terms of GDP/person is attributable to the food sector and is about 10% in the poorest countries and 50% in the richest. It is, thus, of quite strategic importance in tropical countries. And third, it can play a part in reducing the cost of food production (lower losses, higher yields in terms of both materials and energy, more efficient marketing channels).

4.3 Outline History of Food Research in Tropical Areas

The evolution of the history of research in tropical areas can be schematically divided into four main periods, which are described below.

4.3.1 Processing of Export Crops for the International Markets

The initial focus was on industries producing export commodities for the international market (e.g., coffee, cocoa, palm oil, coconut, groundnut, sugar cane, tinned fish, etc.) and was consistent with agricultural research in these areas. The development of tropical agriculture was essentially regarded as a matter of increasing capacity for the production of cash crops in a context where trade was becoming international (product marketing was largely done locally, however; for instance, in the vegetable oil and sugar industries).

4.3.2 Processing of Imported Products to Feed Local Populations

In the second period, research was aimed at developing the food sector to feed the local population by establishing local industries to process imported products (wheat, flour mills, breweries, and soft-drink industries, powdered milk reconstitution plants, etc.) to meet a growing food demand triggered by demographic growth.

4.3.3 Creating Tropical Versions of Imported Foodstuffs

Only recently has food sector research become interested in developing food crops for local markets, mainly aimed at feeding the urban population. This research first consisted of attempts to create tropical versions of imported products. They involved, for instance, the inclusion of millet, sorghum, or maize in traditionally wheat-based foodstuffs (bread, dough, etc.). Over three-fourths of the food sector research into millet and sorghum processing has been devoted to such “compound flour” programs. Research into maize and sorghum processing has also been aimed at developing products shaped like rice grains, called “maize rice” and “sorghum rice.”

4.3.4 Industrializing the Processing of Traditional Produce

The much more recent approach to develop food crops for feeding the urban population has been to industrialize the manufacture of traditional products. This approach involves mechanizing the processing procedures and, often, marketing ready-to-cook foods that are packaged more hygienically (like industrial products) and that have a more standard quality, advantages supposedly sought after by the urban consumer. The strategy has been primarily pursued by private food-processing groups in Latin America and Asia; for example, farina and bread-making quality cassava starch in Brazil, panela (brown sugar from sugar cane) and patacones (plantain crisps) in Colombia, cornmeal (obtained after alkali treatment) in Mexico, charqui (dried meat) in Brazil, tofu and tempeh (fermented soybean curd or cake) in Indonesia, and nuoc mam (fish sauce) or cau noodles in Vietnam. Similar experiments have been tried in Africa: cassava-based products like gari (grated and roasted cassava) in Togo; attieke (a cassava product in granulated form) in the Ivory Coast; chikwangue (fermented paste) in the Congo; yam flakes in the Ivory Coast.
and Nigeria; millet-, sorghum-, and maize-based flour, grits, and granulated products in Senegal and Benin; baby food in Benin, Rwanda, Zaire, and Burkina Faso; fruit juice and fruit nectar and locally picked produce like mango, tamarind, guava and bissap in Senegal, Burkina Faso, Togo, Burundi, etc.

4.4 ACHIEVEMENTS AND LIMITS OF TROPICAL RESEARCH PAST LINES

Previous research priorities were certainly consistent with the development strategies adopted in tropical countries, and the targeted objectives were often achieved thanks to the results of this research. In particular, the coffee, cocoa, palm oil, and coconut subsectors could not have been so well developed if procedures had not been established to maximize the value of such products.

Also, industrialization of local produce or substitutes to imported foodstuffs have certainly contributed, to a certain extent, to filling the gap between the growing food demand and food availability in tropical countries. However, we have today a different and clearer appreciation of what is at stake in developing the food production system, and this makes it possible to analyze the limits of research past lines with respect to new challenges facing food sector development.

First, the initial focus on local industrialization of imported raw materials, although it has helped to fill the gap between urban demand and local agricultural supply in some countries, in particular Africa, has had a secondary detrimental effect of restricting outlets for local commodities.

Technology research initially focused on industrial-scale activities, either for cash crops for the international market or crops for local markets. Businesses on this scale appear more capable of rapidly supplying a suitable amount of produce of an appropriate quality to meet export market requirements or urban demand than do small-scale processing activities. In some cases, industrial technology and processing have been able to learn from other subsectors where a processing industry had been developed (for instance, industrial wheat-milling processes have been transferred or adapted to millet, maize, and sorghum mills). However, this type of business could operate at a profit over an extended period of time only under particular conditions, and satisfactory control of the supply networks was needed, which was frequently difficult to achieve because of inadequate regulation of production and marketing, especially for food crops. In addition, external technical assistance was necessary to bridge the gap between the technology employed and local technical resources.

As a whole, attempts at industrialization have, in the final analysis, had little effect on feeding the most impoverished members of society who make up most of the urban and rural population in Africa and who remain a very important part of it in Latin America and Asia. In most cases, these products have found a market, although a more limited one than expected. Only a small and largely well-to-do section of the population was prepared to pay extra for the quality advantages over domestically or traditionally produced products. Very few ersatz products have met with commercial success in Africa or Latin America for a variety of technical and economic reasons, but primarily because the products had a weak market position. Consumers were generally unwilling to buy products they considered to be of lower quality than the reference products, particularly when presented as direct substitutes.

Various observers have criticized not only the lack of success but also the ethnocentric nature of research past lines. For instance, when talking about research to develop tropical cereals, they stress that “the emphasis placed on compound flour has undeniably marginalized research into improving traditional procedures and the development of new products.” Research has made only very few efforts to exploit a large number of local food crops: cereals (e.g., millet, sorghum, maize, fonio, quinoa, teff, amaranth), tropical roots and tubers (cassava, yam, taro, sweet potato, cana, aracacha, etc.), pulses (cowpea, pigeon pea, néré, etc.), vegetable oils (karité, balanites, etc.) and fruit (cupuaçu, acerola, mango, safou, etc.) plus their role in the agricultural economy or as foodstuffs was geographically restricted.

And yet, commercial processing of such commodities has now developed with the opening up of the urban markets. As a result of past research priorities, scientists are not well equipped to meet the needs of new companies wanting to obtain information on processing procedures, improve product quality, or diversify product use. Such knowledge is rarely committed to paper, and its dissemination remains limited except in the case of a few major products. In addition, very little information on experiences and results is exchanged between Africa, Latin America, and Asia, even when they are dealing with the same subjects.

4.5 ABOUT SUSTAINABILITY OF FOOD PROCESSING

In the current renewal of the debate on global food security, there is a great danger of oversimplifying the problem by thinking that it is a question of quantity in the South and of quality in the North. Development of the industrial food sector appears essential in a context of rapid urbanization, of increased competitiveness between supply chains on a worldwide scale, and of attempts to find new forms of added value in still essentially agricultural economies.

The faith in technological progress and industrialization that typified the 1960s, 1970s, and 1980s has distracted the attention of scientists from the questions of sustainability, i.e., social control, ethics, and long-term management of changes to the food production system.

This is true in southern countries as well as in northern countries. The effects of industrialization on man’s relationship to his food, on energy consumption, on the environment, and on health risks were neglected. Such concerns were too remote from the short-term requirements of business and of policy makers and often had ideological overtones. They have still not entered into fields of scientific research except to a marginal extent. Some of these concerns are given below.

4.5.1 Man’s Relationship to His Food

As a whole, the history of the world’s food can be seen as a process of increasing remoteness in man’s relationship to his food: remoteness in space because of the
internationalization of trade in agricultural products and because of urbanization; remoteness in time due to a growing offer of stabilized and out-of-season products; and remoteness resulting from the growing length and complexity of the supply chain, with the development of an intermediation sector in the food industry (storage, transportation, marketing, processing, distribution). This sector is becoming increasingly independent of agricultural production and consumption.²

For the consumer, the increasing remoteness in relationship to food is reflected in a certain loss and confusion of points of reference in terms of both identity and diet, contributing to certain nutritional imbalances and to loss of confidence in the industrial food sector and its lack of openness.³

However, a further analysis of the long history of these changes shows that man’s relationship to food and to nature in general is in fact an ambivalent and simultaneous move toward greater remoteness and greater proximity.

The move toward greater proximity in the consumer relation to his food is shown by the development of farm produce, organically grown produce, local specialties, direct selling by the producer, home-grown garden produce, and, now, suspicion about transgenic food. This is very noticeable in the countries of the South, but it is also apparent in industrialized countries, mainly in Europe.

4.5.2 Food Sector Development Models

The increased offer of ever more highly processed foodstuffs, particularly in the industrialized countries but now also in towns throughout the world, raises the question of the overall energy efficiency of the food-processing system. To supply individuals with enough food, more and more energy needs to be injected into the transformation system, given the increased sophistication of the technology and services involved (packaging, portioning, precooking, etc.).

An awareness of the two tendencies described above (move toward remoteness and proximity), in both the North and the South, opens the way to the elaboration of new or complementary models for food sector development. Rural, small-scale, decentralized processing is no longer regarded as the survival of archaic, outmoded activities that ought logically to make way for more "rational" industrial processing. It is only recently that the strategic importance of more decentralized enterprises, rural agro-industries, and small-scale urban workshops in the food sector has come to be appreciated.⁴ As public authorities were often not officially notified of the existence of such activities, their contribution to the supply of processed food products was not usually taken into account. The view of a large number of policy makers and scientists that the food sector was an archaic symbol of underdevelopment and technological backwardness did not help its importance to be recognized, either.

It is now recognized that the consumer can maintain or re-establish reference points in his relationships with others, with himself, and with nature. In addition, long-term respect for the environment is becoming a consumer preoccupation, particularly with foods: interest in foodstuffs grown by less environmentally polluting agricultural methods and in biodegradable packaging mistrust, or even refusal of irradiated or transgenic foodstuffs, etc.² Over and above this, the individual as consumer is becoming a user with citizenship responsibilities.

4.5.3 Management of Risks and Traceability

The process of increasing remoteness, already well under way in the industrialized countries, is now at work in the countries of the South as a result of their rapid urbanization and their growing involvement in international trade. This increasing remoteness means greater long-term risks for food security and the environment. Management of these risks raises the question of the sustainability of food sector development.

The greater length and complexity of the supply chains makes it more difficult to monitor the origin and the quality of foodstuffs or to react rapidly to large-scale outbreaks of food poisoning. These risks are all the greater with the growth of mass production and distribution and have to be further controlled, which is difficult in the context of developing countries.

4.6 Defining New Research Priorities for a Sustainable Development of Food Processing in Tropical Areas

The imbalance between the developed countries (richly endowed with scientific organizations and facilities) and the developing countries manifests itself in cooperation-oriented scientific exchanges in the following way: funding and practices remain largely dominated by the idea of the transfer of knowledge, methods, and technologies from the North to the South and are at times solely concerned with cheaply exploiting local resources. The scientific contributions of the South, potentially rich in representations of the world different from those of traditional sciences, have not been integrated as a real part of the cooperation model, unless they reveal themselves to be a possible object for economic exploitation.⁵

The objective of this section is to illustrate how new fields of research can be opened, taking into account ethical and long-term issues in food sector development, to meet the challenges facing the food sector development.

4.6.1 To Contribute to Employment and Reduction of Disparities

To meet the challenge of widening economic disparities, research must become involved in job creation in both rural and urban environments. Expanding food-processing activities can help to increase income levels, particularly for women, and make food more readily available to the most impoverished members of society. Research and development work already carried out in urban agriculture,⁶ small-scale food production in Africa, rural agro-industries in Latin America,⁷ and street food in Asia⁸ show the way for investigations of this type. In addition to its major
contribution to the supply of local foodstuffs to the towns, it is worth recalling its importance in terms of job and income creation and its capacity for innovation.

Compared to what has so far been accomplished in the agricultural sphere (smallholder organizations, training and advice for farmers, decentralized credit facilities), efforts to give the food sector a more professional approach have been neglected. This is a new field of research for economics, the social sciences, and business studies: whose interest in this sector has up to now focused on the operation and policies of big business concerns. The diversity and complementarity of the different types of enterprise; the conditions under which they come into being and under which they operate; trade organizations; and technical, financial, and management training requirements will all need to become serious topics for research to back up their development.

4.6.2 To Make Local Products and Technologies Competitive on National and International Markets

The extremely limited interest that scientists have shown in this type of activity has led them to neglect the traditional processes used and the knowledge and skills they presuppose. A major field of research still in need of development involves identifying and characterizing the wide range of food technology know-how existing in the world. This wealth of expertise is put to good use in the North but is still relatively neglected in the South. Over and above the economic problem of providing outlets for local produce, the challenge is to exploit the diversity of man's heritage that such resources represent.

With a small number of exceptions, few countries in the South are presently familiar with their own technical resources, i.e., their areas of expertise and their own special products, while market operators are busy developing initiatives to exploit them.

Such initiatives concern the local and the international sectors. The people of Colombia and Brazil, for instance, know how to make a cassava product, so-called "sour" starch, using a combination of fermentation and sun drying. The remarkable property of sour starch is that it can be used like wheat flour to produce leavened bread (i.e., with an alveolar structure) despite an absence of gluten.

This is not the case with other starches obtained from cereals, roots, or tubers, which in the current state of technology can only be used to produce flat loaves. The development of this traditional know-how has resulted in cassava being more competitive on the local markets for starch products in these two countries. Bread rolls made with sour starch are now sold in fast-food outlets in the big cities of Brazil, whereas, until recently, cassava had the image of being a poor man's food. It is still not known why this form of processing makes cassava starch suitable for bread making. Scientists are currently trying to discover how to adapt the process for use with other starch products in other countries, with the twin objectives of giving added value to cereals, roots, and tubers in the countries of the South and of manufacturing gluten-free foods essential to certain diets (baby food, food for people who are allergic to gluten).

Other examples are tropical roots and tubers (cassava, yam, sweet potato, cana, aracacha, etc.), which up to now have essentially been regarded simply as sources of starch. Better development of their distinctive properties would immediately open new markets for these products. Some of these foods have properties that are in great demand on the international market as a result of recent regulations restricting the use of modified starch. Little research has so far been carried out on properties such as the resistance of starch to heat treatment (for use in frozen foods or baby foods); the precise rheological behavior required to produce analogues of fat; its rising quality in cookery; shear strength; etc.

4.6.3 To Design Environment-Friendly Processes

Up to the present, when questions of technical aid are considered, little attention has been paid to the energy yield of the food production system or to the environmental impact of its development. There is a shortage not only of data but also of suitable methods for carrying out such assessments and providing answers to the various questions that arise. What proportion of the total energy injected into the agricultural or other sectors is used in processing, distributing, and marketing the agricultural raw materials? What are the energy requirements of the different industries according to product stability (e.g., fresh, refrigerated, frozen, dried, or sterilized products)? What is the environmental impact of these processing activities (e.g., water and wood requirements, pollutant effluents, by-products) in terms of the different processes used? Recent efforts in the industrialized countries to develop methods based on economic, ecological, and energy balance sheets may well be a path worth exploring, even though these methods still have flaws.

4.6.4 To Rethink Man's Relationship to Food and Social Control of Food Technologies

Another field of research concerns the conditions required to give better social control of evolving food technologies. How can users, i.e., ordinary citizens, participate in the research and development process? Current research into the social control of technology represents an interesting approach.

It raises questions about long-term changes in technical systems and about man's relationship to food and to nature in general. From this point of view, further attention should be given to methods and tools to assess food risks and hazards as perceived by consumers.

It also raises questions about the role of research in the development process. Such an approach means that the issues examined and the objectives become inseparable from the way in which the research is carried out and from ethical concerns. As far as science in general is concerned, the new challenges and limits of past research results have revealed the reductive and compartmentalized representation of the world used in the traditional scientific approach. Also, as far as scientific cooperation is concerned, former practices have been brought into question: in particular, the linear view of development based on industrialization and the "transferability" and "transportability" of technology. This is particularly true for food-
sector research and cooperation, as recently analyzed in detail in another paper. Over the last few years, new approaches have emerged, calling for a major reform of the practices employed by researchers, development officers, extension agents, and politicians. This new wave of thinking has four main aims: to break down the barriers between the different disciplines, to focus research procedures on the users, to adopt more flexible and interactive methods of research project management, and to develop a new-science-sharing approach that goes well beyond simple knowledge transfer.

4.7 CONCLUSION

After a century of major technological progress, one of the age-old questions facing mankind is still with us: will there be enough food for everyone tomorrow? Half a century of agronomic research has shown that the problem cannot be defined simply in terms of chasing after a constantly rising demographic curve and proposing more productive crop varieties. New priorities have emerged, and key issues in today’s debate are urbanization, globalization, disparity and poverty, health risks, long-term planning, social control of technology, sustainability, and ethics.

As a consequence, food-sector development can no longer be thought of in terms of “headlong pursuit,” producing local and global imbalances and uncontrolled or disruptive effects. This is not just a wish. This is a profound and explicit social demand that has expressed itself, for instance, through the rejection of scientific and technological advances such as irradiated or transgenic food in many countries, but more generally through the move toward proximity that has marked recent changes in man’s relationship to food and nature. This leads to the assertion that scientists are responsible not only to society in general in their own country, but also to society in general throughout the world, as stated in the recent World Declaration on Science and the Use of Scientific Knowledge:

Nowadays ethical implications of the use of scientific knowledge have become so profound and so much of concern to individuals and society at large, that any research or application of its results have to comply with ethical standards and principles. In this context, scientists themselves start to play an active role in defining and taking on their responsibilities.

This opens the way to further thinking and rethinking of scientific priorities, methods, and responsibilities in food research and development, both in Northern and Southern countries.

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