HETEROGENEITY POVERTY SCENARIOS AS A FACTOR OF TECHNOLOGY DEMAND IN LATIN AMERICA AND THE CARIBBEAN

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Abstract

New basic factors are affecting the orientation of the research strategies of the CGIAR Centers and national research and transfer of technology institutions in the region (NARI´s). Global macroeconomy changes imply a new set of rules that are followed by the economies of the region and a redefinition of the terms to face the problems of access to income and ways of overcoming food insecurity and poverty in the rural and peri-urban areas. The agriculture sectorial context contemplates critical aspects for the design of strategies to alleviate poverty: the phenomena of dual-modality of agrarian structures (co-existence of a peasant and entrepreneurial agriculture with the logical differences in the management of their resources); the important differences of the peasant sector itself and the growth of non agricultural rural employment at rates far superior that those of agriculture, which are decreasing in various countries. The wide scope of the heterogeneity of poverty demands that there be more ways to have access to employment or other forms of income. This supposedly implies the elaboration of typologies for the design of differentiated policies based on these forms, in particular, the different combinations of small land employment and rural agricultural and non agricultural employment with urban or peri-urban employment. Highly diversified technological demand to supply agro/silvicultural/pasture eco-regional scenarios, together with crops and cropping alternatives for intensive rural and peri-urban production of quality and innocuous products, requires institutional changes implying resources and technologies at the micro-entrepreneurial level. The development of a growing urban or peri-urban agriculture, demands appropriate sustainable technologies which should be considered in these strategies. These conditions imply a strong challenge for research at the CGIAR and NARI´s level, which should identify and characterize said demand and replace it in the short term with adequate technological solutions.

*Keywords:*appropriate technology; rural and peri-urban agriculture; poverty; non agricultural rural employment

Abbreviated title: poverty demand on technology in Latin America

Introduction

Rural poverty in Latin America has persistently affected more than 55 percent of the population with one third of the latter being below the extreme poverty line which means an income below a basic food basket. Furthermore in six out of eleven countries for which there was information for several years, extreme poverty showed relative increases between the beginning of the eighties and the mid nineties.

This establishes the magnitude of the problem to which research in agricultural production has to find a way to contribute to its alleviation.

The political mood in the developing world has changed dramatically in the last decade. An almost universal shift has taken place away from centrally planned economies and toward market-driven economies. As a result of the structural adjustment policies applied with greater or less intensity in all the countries, the "rules of the game" that governed the economies of the Region during several decades to which economic agents were used to, are now being redefined. These are: 1) surrender of protectionists practices and increased liberalization of the external market; 2) reduction of the public sectors´relative importance and the privatization of State enterprises; 3) subordination of agricultural sector policies for the sector to macro economic balances; and 4) the bias to exportable products and others. The effects in the economic growth, distributive equity and long-term sustainability are still unpredictable.

As a result, technical assistance to the developing world has to shift way from government and toward the private entrepreneur. A radical rethinking of the entire technical-assistance process will be required if we are to effectively contribute to private enterprise development. Future initiatives will have to be direct to fostering new alliances to serve private entrepreneurs with programs that support economic development and provide the information, expertise and contacts that result in profitable and sustainable enterprises.

The bi-modal agrarian context

In the agriculture and livestock sector and at least in the short run, the new conditions have mainly benefited medium and large modernized enterprises particularly those producing for export, with access to credit, technology and information on the conditions of internal and external markets. In various countries this meant a significant export growth, especially in non-traditional products. However, even recognizing the positive elements of this dynamic, it also contains the potential risk of emphasizing the trend of exclusion and concentration which has been a distinguishing characteristic of the agrarian modernization process in the last decades, where the benefits went basically to specific products, to certain regions and, to the hands of medium and large-scale producers. Changes in the international

context and in the internal governance rules have made the sustainable increase of competitivy and its corollary, the ample dissemination of technical progress, a necessary pre requisite for growth and viability of the producers and this challenge has to be viewed in terms of the particular agrarian structures that characterize the Region and of the functioning of rural markets.

Two structural features are the clues to the functioning of the agriculture and livestock sector of most of the countries in the Region: the highly heterogeneous nature of the production units and the non existence or the failures of the markets for credit, insurance, appropriate technology, information, labor etc. Within this context, the co-existence of differences in the allocation of resources between the entrepreneurial segment and the peasant agriculture are due fundamentally to the fact that a family unit is at the same time a unit for production, consumption and reproduction, in which domestic activity is inseparable from production activity and in which the latter is carried out mainly with the use of family labor.

The existence of these kind of bimodal agriculture raises complex problems for a broad dissemination of technological progress. In fact, an appropriate technological option (i.e., an option in keeping with the relative resource endowments of the economy with the corresponding set of relative prices) in homogeneous structures, is valid for the great majority of the producers. In the other hand, in bi-modal structures an option valid for a large modem agricultural enterprise is unlikely to be so for the small family farm. A contrast between the two types of "managerial logic is schematically represented in Table 1 emplying differences related mainly to the character of labor force and to the way that risk and uncertainty are assumed by each type of producer. It is pointed out that, in peasant agriculture child labor, woman and other members of the family with unpaid labor and "free" time of the head of household is able to create value within the family unit while by contrast, the farm enterprise depends on a paid labour force recruited in the market (Shejtman, 1982).

Considerations regarding risk are also internalized in a different way in the management criteria; while for an entrepreneur it is reasonable to assume a higher risk if it is compensated by a greater profit, the small farmer would tend to avoid a higher risk alternative, in spite of the expected high income of a positive result, if his family and productive sustainability would be threatened with an adverse outcome.

The first conclusion of the above mentioned contrast is that although for the large and modern agricultural entrepreneurs an enabling macro economic context might be sufficient to establish a basic framework of incentives; for the small farmers sector there is a need for a specific set of policies that should take into account, not only what we have called its "managerial logic", but also the high degree of heterogeneity that characterizes the peasantry in Latin America. This means that there is a need to design differentiated policies for the different types of peasants units covering the range that goes from those with land enough to depend exclusively on the agricultural production to those whose income comes mainly from rural non farm employment. The differences in access to land and other assets or, stated in another terms, the differences in the productive potentiality of family units
must be taken into account for the design of efficient and well focused poverty alleviation policies, through the construction of some kind of producer typologies that can be illustrated to the mexican case (Fig.1).

As any policy oriented typology, both the number of categories and the definition of them has strictly instrumental value and has to be determined by the type of policy that is going to be implemented and by the capacity of those in charge of the design and implementation; nevertheless, a distinction must be made at least between those where the increase in agriculture productivity is the main road out of poverty from those where it is other kind of income generation activity the one that has to be privileged .

Rural poverty alleviation policies must also take into account the fact that rural non farm employment has been growing, in the last decades, at a faster rate not only of agriculture employment but in some cases even than urban employment. For instance Klein (1992) indicates that in Latin America non-agricultural employment grew, in the eighties, at 3.4% while agricultural employment grew at only 0.8% (Fig.2), the same trends are indicated for the nineties by Da Silva (1998) for Brazil, Escobal (1996) for Peru; De Janvry, Gordillo and Sadoulet (1997) for Mexico, the World Bank (1997) for El Salvador; Lanjouw (1998) for Ecuador.

Agricultural activities in general and particularly those of small farmers are performed in an environment where markets are far from the model that postulates first that they exist and second that the equilibrium prices determined in those markets are applicable to all producers. By contrast, what one finds is that for peasant households, at least either they do not exist at all (i.e. like insurance, information), they are to shallow (giving place to large variations in prices) or access to them imply high transaction costs as in the case of formal credit, marketing and technology and specialized inputs . As a

consequence peasant households engage in various non market institutional arrangements with diverse agents to have access to insurance, credit, inputs and credit markets, technical assistance, labor and land.

Although decentralized poverty alleviation policies might offer the possibility of greater precision in terms of focusing on the specific nature of the deficiencies affecting local poor families, there is no formula for how the process should be implemented and there are more than a few examples where a particular combination of centralization and decentralization policies have been very effective (Tendler 1999). Both, the kind of research and the diffusion of technology to improve productivity among the poor peasants will have to take into account the different needs of the different type of producers and the particular nature of the transactions in which peasants engage to have access to their production requisites.

Geographical and socioeconomic scenarios for technological research demand

Highly diversified technological demand to supply agro/silvicultural/pasture eco-regional scenarios, together with crops and cropping alternatives for intensive rural and peri-urban production of quality and innocuous products, requires institutional changes implying resources and technologies at the micro-entrepreneurial level**. F**our different scenarios constitute very particular media for development in Latin America:

- the Andean Communities with several under utilized traditional crops,
- the High Sloped lands (hillside areas "laderas") in Central and South America,
- the Amazon Basin and its high biodiversity,
- the Periurban Areas around the biggest cities of each country.

All these areas have several points in common, the very low educational level, the very high migration rate, the high levels of malnutrition, the very few working opportunities and the high participation of the women in the family activities even when not in the family income. Even when these areas have those factors in common, they represent very clear examples of the great heterogeneity that can be found in Latin America, specially in rural areas and in the most underdeveloped countries. Poverty is very

heterogeneous in Latin America, and so are the solutions. The four mentioned areas have very particular set of problems and require special approach and focus to solve them:

- Andean communities in countries of Bolivia, Chile, Peru, Ecuador and Venezuela, represent a very especial type of culture that is depository of an ancient agriculture with several very important crops that could constitute inputs to high nutritious food. Among the Andean food crops genetic resources, arracacha *(Arracacia xanthorrhiza)*, achira (*Canna edulis*), yacon (*Polymnia sonchifolia*), mashua (*Tropaeolum tuberosum*), oca (*Oxalis tuberosa*), ulluco (*Ullucus tuberosus*), quinoa (*Chenopodium quinoa*), amaranto o kiwicha (*Amaranthus caudatus*), popping beans -"nuñas" (*Phaseolus vulgaris*), tarwi (*Lupinus mutabilis*), goldenberry-"capuli" (*Physalis peruviana*), cherimoya (*Annona cherimola*) and passion -fruit (*Passiflora sp*.), are highly under-utilized (Izquierdo and Roca, 1998). In the meantime, population of Andes suffer severely the effects of food insecurity, malnutrition and the health problems derived from it. The necessity and the impact of agronomic research in this area is out of question, but the point is where that research has to be focused. Andean cultures have to be maintained, so the technology has to be introduced in a participatory way, according to the needs that have been identified by the communities themselves, that will be the only way that the technology is adopted and accepted (FAO, 1990).

The principal needs in Andean Areas are related to the use of water, the preservation of soil and soil fertility, and, the better management of Andean crops, genetically improved and with better crop management. The Andean Countries of Latin America (LAC) face the need to strengthen the use of modern plant biotechnology for the conservation and sustainable agricultural use of genetic resources of under-utilized crops (Izquierdo and Roca, 1998). However, none of that will give any positive result if education level is not improved, and also the improving capacity, that means the capacity to adapt to changes. This is especially difficult when the migration to other areas of each country and even to a neighbor country is a very important factor of the population dynamics in these countries. Migration to the coastal areas in Ecuador, to the valleys of Cochabamba y Santa Cruz in Bolivia, to the Amazon areas in Peru and to the central valley in Chile are examples of this phenomena. Despite of these difficulties, adaptation and transfer of improved agricultural technology, improved genetic material of introduced (wheat) or autoctonous crops as well as better uses and processing of the different crops have been

carried out in the area by R&D institutions. These activities, however, have not been enough to create sustainability in the region (FAO, 1992).

- The high slope lands or hillsides in Central and South America have some problems similar to the Andean Areas, but they do not have the particular tradition in high valued crops and difficulties to maintain the nutritional level of population is grater. Traditional practices in land management is causing severe damage to the soil and the implementation of sustainable systems for soil and soil fertility preservation is a must in this area. At the same time, specially in Central America, the climatological disasters does not help to the preservation of the soil and harvested crops, and post harvest and processing technology have to be implemented to assure the food security in the area.

Great efforts have been dedicated to define the way to solve the management of the production system where animal husbandry, horticulture and forestry have to coexist. This means that tradition and technology, once again, have to be complementary. The main subject in this area is soil protection, so, all the efforts have to be focalized to implement productive solutions to community organization in order to establish a high productive type of agriculture conducted to lower the malnutrition problem and severe health problems derived of a very low consumption of micro nutrients. These overused soils need a new management system to produce the amount and quality of food that the population need to improve their life standards, but this solutions necessarily pass, like in Andean communities, by an improvement in education level that prepare people to receive and adopt the new technology.

- The Amazon Basin, is one of the richest areas in the world. The high vegetal and animal biodiversity gives this area a real possibility to become sustainable in terms of food security, nutrition, and economic development. However, Amazon area in all the countries where this very especial tropical humid forest exist, has social security restrains, food insecurity and bad-nutrition problems, as well as an increasing poverty, specially in areas near the biggest cities of Amazonia (TCA-FAO, 1997).

The biggest problem in Amazonia has been the colonization. Several countries in Amazon Area have the same situation, with a very intense migration dynamics from areas that do not have similar characteristics and with completely different culture. Amazonia has been penetrated with culture systems, especially

animal production, that have caused severe impact in this very weak bio-system. The management of Amazon soils, their poor structure, low fertility and acidity, is one of the most important subject to be studied and this is the principal dedication of several R&D institutions in Amazon Countries. However, this is not the only subject to focalize the research in Amazonia. There are several other items that have to be included in the production system to sustainable transform the on -going "extractivism" to an agri-forestry technicaly and environmentally productive, where all the agronomic productivity as well the socio-economic factors are considered. Fruits, vegetables, medicinal plants, animal husbandry, soil conservation and fertility improvement are just few of the basic subjects that are today a mandate and have to be kept in focus and reinforced.

From all the above scenarios, Amazonia is probably the only that has an educational level suited for further social and economic development. In Amazonia, there are some important cities, research university centers, private investment pools under the general support of the Amazon Cooperation Treaty, the agreement of the eight Amazon countries.

- the periurban areas of Latin America, recently included in the global analysis of urban agriculture (UNDP, 1996), represents the most socio-economic complex situation. The increasing of periurban and urban population and the decreasing of rural population represent the new and specially difficult scenario in the very near future for Latin America. The Region presents a critical case of "mega-urbanization", associated with food insecurity, health problems and malnutrition that are increasing proportionally.

This new scenario presents new and undiscovered needs. Productive animal and plants systems in confined structure, using sustainable technology are required to interact with the city complex infraestructure and environment. People that do not have agriculture experience, typical city people, are and will be working with plants and small animals inserted in a dynamic community, moving around the big cities and implementing activities that could help them to obtain income and secure food, and also to create a commercial activity that could help them to improve the family development (UNDP, 1996). Urban home, school, community and commercial gardening contributes an important percentage of total non-grain urban food supply in many developing countries, adding significantly to urban food self-sufficiency (Marsh, 1998). The more intensive urban and peri-urban gardens also create jobs. Risks from urban horticulture include environmental contamination of the water supply from agrochemicals

and animal manures, and contamination of foods from air pollution. At the same time urban gardening offers potential positive opportunities for recycling city garbage for productive purposes (e.g. fertilizer, land fill).

Urban horticulture varies from a few household plants in the poorest homes to large agribusinesses. It is found around houses (front, back and side yards, rooftops, balconies, patios, walls and fences) and wherever temporarily unoccupied land is available: in community spaces, on abandoned public and private lands, along roads and railways, at airports and on otherwise uninhabitable floodplains, wetlands and steep slopes. Vegetables play an ever more important role in the diet and well-being of the population. Given their content in essential vitamins, minerals, micro-nutrients, fibers and plant proteins, the daily consumption of vegetables contributes to a balanced diet and an improved global health status. Furthermore, from a socio-economic view point, vegetable growing is of critical importance to small-scale farmers, considering that vegetables can produce high yields on small plots and in a short period. Vegetables are also referred to as the preferred crops for women, thanks to the income they can provide on a short-cycle and year-round basis. Urban gardeners are often forced on to very marginal land because of land speculation and antagonistic city planners and governments that discourage agriculture as an urban land use. Where governments have been more tolerant and even supportive of urban agriculture, it has tended to thrive. These communities needs a clean technology to go on with their plans. This is one of the principal focus of further technical demand for agriculture research in Latin America. The changes in population are occurring faster than the answers from the scientific world and this has to be solved.

These four particular areas in Latin America have served here to illustrate the great heterogeneity of scenarios that exists. In solving the problem of poverty, this heterogeneity has to be considered to adjust special treatments, but without no doubt, agriculture research and transfer of technology will always have a positive impact in solving poverty problems.

Can the benefits of agricultural research reach poorer farmers?

Over the past decade and still on-going there has been some advocacy of a need for a pro-poor bias in the development and transfer of modern technology. However, whether any benefits of current agriculture technology research will actually reach poorer farmers at specific scenarios without major further public sector intervention is an open question. The vast majority of the region's farmers are known to have a limited level of access to external inputs or other productive resources. Resource poor farmers, by definition, are unlikely to have easy financial access to agricultural inputs such as pesticides, fertilizers or irrigation. Moreover, it is now thought that an increasing majority of the resource poor farmers are women. For instance, over 70% of the people in developing countries living below the poverty line are women, the majority of whom live in rural areas and this apply for Latin America too (UNDP,1998).

While such resource-poor farmers practice approximately 60% of global agriculture, they produce 15-20% of the world's food (Francis, 1986). However, when looked at another way the small-scale resource poor farming sector is responsible for 80% of agricultural production in developing countries and is key to future food security (Daw,1989). The low productivity of resource poor farmers tends to perpetuate rural poverty and 76 million people living in rural areas are below the poverty line in Latin America (Jazairy et al,1992).

Science alone is unlikely to provide a "technical fix" for alleviating such poverty. There are many processes, factors and socio-economic structures underlying rural peoples poverty such as; lack of access to land and other productive resources, low purchasing power, political powerlessness, fragile environments, peripherally from markets, etc. In this milieu, agricultural research (or indeed for example plant biotechnology) is but one factor which could have differential impacts on rural poverty. Indeed, the potential contribution of biotechnology to developing country agriculture or to poverty alleviation is considered to have been overstated, in the short term at least. Yet over the longer term there is little doubt that some biotechnological approaches to crop improvement could generate social, economic and environmental benefits if specifically targeted at specific needs, especially those of poorer groups. Such needs might for instance include the reduction in pesticide use via insect/disease resistant crops, improved nutritional composition of crops, elimination of toxic substances or allergens, developing early maturing varieties, reducing post-harvest storage losses, abiotic stress tolerant crops or reducing labour demands at appropriate times during the cropping cycle. The many resource poor farmers in developing countries who depend on an income of less than a $1 per day are not likely to be a near term target

market for most of the agricultural companies. If agriculture research is to be better targeted to addressing the needs of poorer farmers, it will be necessary for relevant public sector institutions to more transparently identify which farmers needs are of concern to their research of funding (FAO 1999b).

For the private sector, poorer farmers and consumers are by definition not a lucrative market and are unlikely to exert any effective "demand pull" on the private sector research agenda. In theory, the responsibility would therefore fall on the public sector to fund and perform any research required to meet the differential needs of poorer farmers or consumers. Yet, in most public sector institutions or funding bodies there are currently few priority setting or needs assessment mechanisms (analogues to the functions of private sector marketing department) in place to help guide the direction of publicly funded plant biotechnology or crop improvement research towards meeting the immediate needs of poorer farmers.

As an example, plant biotechnology may represent one of a number of competing technological approaches to addressing a particular agronomic problem but however, a particular pest problem might equally be addressed through conventional plant breeding, through a transgenic approach, or through an integrated pest management (IPM) approach or any combination of these (FAO, 1999). Within the broader agricultural research community there is often a lack of priority setting mechanisms and relative cost-benefit analyses to determine which available technological approaches may be the most suitable within particular timeframes for addressing prioritized agronomic needs of the needs of particular groups of farmers.

How are the products of agricultural research to reach poorer farmers?

Farmers interface with the products of technology or agricultural research through a range of intermediary service providers, usually through public extension or private marketing agents. Agricultural extension is the public sector equivalent of agricultural sales of marketing or sales agents in the private sector. The distribution channels by which products reach farmers fields are now undergoing major structural changes. There are now a wide range of public, private and NGO organizations with differing objectives attempting to deliver appropriate products to different groups of farmers. This has

significant implications regarding the nature of the technology disseminating organizations that researchers interact with in identifying what priority technologies are needed, what farmers are the resultant client group and what types of farmers and consumers will ultimately reap the benefits of technology research and development.

Within the Region, agricultural extension is now in a process of reform and transition. Pressures towards cost-recovery and privatization have led to rapid slimming and of public sector extension services in Latin America. In many countries, governments are withdrawing NARs from extension services and now expects other institutions (private or NGO e.g. farmers organizations) to provide and/or finance such activities. Financial pressure have led to the search for ways of reducing public sector costs by e.g. privatizing parts of the extension service, having farmers pay government for some services, and cost-sharing arrangements between government and NGOs or farmers' organizations. The most efficient public sector extension services of the future are likely to focus on spheres (geographical; thematic, social) inadequately serviced by the private commercial sector. As a result novel extension approaches are emerging which are approaches which are participatory, institutionally pluralistic and geared towards cost-sharing

Appropriate technology for small scale economic activities to satisfy basic needs.

There are seventy six million people in Latin America and the Caribbean living in extreme poverty and suffering from major shortcomings in terms of food, water, health services, housing, energy and jobs. With so many basic needs unsatisfied, there must be a way to translate human creativity into tools (innovations and appropriate technology) for the betterment of human living conditions both rural and peri-urban. There is a urgent need to advocate a systems approach to technology development which, while focused on the grass roots level, incorporates all stockholders in the development strategy from the local to international level. For FAO purposes, ‘technology’ comprises know-how and skills, goods and services, equipment (hardware) to organizational and managerial procedures, institutions and (social) support structures. To be truly *appropriate*, a technology must be compatible with available natural, human and financial resources and correspond to the cultural practices of users. The objective of a

technology strategy for for small scale economic activities to satisfy basic needs must be the development and adoption of technologies which:

1. Improve the productivity of a communities assets;
2. Enhance capabilities and provide for new livelihood opportunities for the poor;
3. Are sustainable in an environmental and socio-economic sense i.e.: technology that promotes equality in society.
4. Empower communities especially vulnerable groups within this sector.
5. Link communities in similar circumstances and relevant stockholders through networks.

The proposed approach requires technology development and transfer to emphasize the importance of establishing links between indigenous knowledge and outside scientific knowledge. There is two reason for this: firstly to ensure that local problem identification and focus remain the starting point for participatory further work, and secondly to accelerate innovation by systematic and focused efforts that build on indigenous scientific methods as well as examples from outside the community or country. This process involves building and using modern information communication technologies (databases, distance learning) to facilitate the exchange of knowledge and best practices.

The first step is generally to approach host local governments with a view to taking full advantage of what it has to offer in terms of support for investment in infrastructure (roads, canals, credits, market, clearing of bunds, watershed management, tree planting etc.) and social services. The main focus is introducing changes that can help the community to use, initiate and support the transfer of modern technology and eventually to participate in the innovation of technologies that can enhance the utilization of natural, human, physical and social resources that are available locally. This could for instance involve better use of by- products from production systems (for example rice husks, manure, grass cuttings, non-wood products, etc. are often perceived as being "waste" items), new varieties or under-utilized germplams (ideally found locally), selection and breeding for adaptation to local agri-ecological conditions(stable yield under low imputs, stress tolerance), and sustainable (environmentally sound) practices (integrated crop management). There are important strategic considerations to increase the impact of this approach:

(1) Technology will be based on the needs of the specific social, environmental

and climatological conditions of local communities.

(2) Technology will blend local with international technologies which will help to make the best use of the available know-how and capital base of the communities under consideration. Advanced research and development globally can be drawn upon, through the use of information exchange for example.

(3) Technology will be refined through a participatory process, since in a appropriate technology for small scale economic activities to satisfy basic needs program, local solutions, assets and ideas are central to the development of the program.

(4) Technology will be integrated and networked to create a connection between regional, national and international science and technology stockholders and the poor;

(5) Technology will be flexible in response to changes in the socio-economic and environmental conditions;

(6) Technology will be empowering to communities especially so for the vulnerable groups within the community.

Within the above context, the impact of CGIAR´centres, Development Banks, NARS´s and UNO´Agencies as FAO (R&D Institutions) in assisting developing countries in the generation and transfer of science based technology, with the aim of supporting small-scale farmers and entrepreneurs in rural communities, depends on its applicability to differing social, economic, cultural and climatological scenarios. The success of any appropriate technology for small scale economic activities to satisfy basic needs program, be it for business or for community development, must be focused on the men and women who produce most of the food in developing countries (IDRC-UNCTAD, 1998).

This work in research and technology development, conducted in close co-operation with researchers and research institutions in developing and developed countries, has to consider a wide range of objectives:

- to increase, intensify and diversify food production:
- to improve consumption and nutrition;
- to raise the value added of agricultural produce
- to improve income-earning capacity; and
- to create opportunities for employment in the production, processing and marketing of agricultural goods.

To pursue this goal, the functional focus has traditionally been on activities that address the most basic needs of people and would, in addition, have a positive economic effect. Small-scale economic activities are a major source of rural and coastal livelihoods in developing countries. Much of this employment and income may be of a semisubsistence nature and poorly remunerative, but some enterprises are profitable and, occasionally, grow to a significant size. Even the semisubsistence enterprises are important because they reduce open unemployment and are accessible to the disadvantaged segments of society, such as women and the landless. Although the basis focus on the poor in developing countries has remained the same over years, general approaches to assisting the poor have been modified to take advantage of experiences gained and to accommodate changes in the recipient environment.

R&D Institutions operate with a very wide range a technology-transfer activities to address the basic needs of low-income populations in food production and processing. The rage of commodity coverage spans virtually all the known edible animal, aquatic, and plant products. The scope of technical activities employed to assist in the execution of small-scale economic activities is equally vast and includes basic production and all postharvest activities, including storage, transformation, and analytical technologies. In some cases, that technologies are used to stabilize perishable goods so that they may be marketed over and extended period, but in other cases, technologies are used to transform basic commodities into more marketable forms. The technologies used in this process may include traditional and modern technologies to reduce natural toxicity and specific antinutritional factors in certain foods.

For example, the unit of FAO dealing with the processing of plant products covers close to 100 different commodities, which are convertible to items in more than 300 product groups (for example, juices, flours, baked or fermented products, and infant foods). More than 50 types of technology (for example, milling extraction, extrusion and dehydration), from rudimentary-cottage scale to small-industrial scale, are used. When additional sectors, such as meat, fish and other aquatic resources, and nonwood forest resources, are considered, the range of technologies employed is enormous. In the case of crop production, the scenario range interacts with the complexity of soil-climate eco-regions, genetic resources availability and biodiversity, technology, socio-economics as well as culture and historic background.

Key issues in sustainable crop production

R&D Institutions promote technologies for the sustainable production of cereals and food legumes, roots, tubers, vegetables, and fruits, which constitute staple-food crops for the majority of people in developing countries. In recent years, FAO has addressed an integrated plant-nutrition system and an integrated pest-management approach that are considered environmentally sound and socially and economically feasible have emerged. The focus of attention is the cropping system, rather than an individual crop.

Within the above context and focus, several type of activities have been conducted or are on-going. Field trials with farmers to demonstrate options for improved production and information on increased access to marginal growing areas for different crops, appropriate agronomic practices, and identification and field introduction of improved varieties are commonly organized . Special emphasis is given to testing locally available and low-cost inputs, tailoring input applications to specific localities, and training national research and extension staff. For some perishable crops, such as roots and tubers, or protein and oil crops, such as tropical soybeans, increased production should be linked to increased capacity for postharvest processing and handling at the village level to generate more value added in the processing of such crops and to integrate processing with improved production techniques. Plant propagation, focusing appropriated biotechnologies as micropropagation, is available for transfer to small pilot enterprises (Izquierdo and de la Riva, 1998). Home gardening and fruit-tree development, linked with

nutrition education, both at rural and peri-urban areas are being transferred through differing institutions which has prepared technical material for specific country conditions.

One of the keys of sustainable development in resource-poor areas is better management of farm production systems to minimize risks and enable the farm household to withstand shocks and stress. For small farms, special emphasis on efficient, sustainable operation that uses available material and labour resources, raises farm output, and increases farm and farm-family income must be the final focus. On this issue, FAO has supported studies on integrated crop and livestock farming systems in circumstances of shifting cultivation and plantation cropping. Through the introduction and support of a wide range of engineering technologies, FAO seeks to improve production, reduce the risk of failure, and alleviate drudgery for farm families, especially for women in developing countries. National agricultural research institutions, extension agencies, and end-users are encouraged to select technologies appropriate to the relevant farming systems (IDRC-UNCTAD, 1998).

Adding value to the food chain

Too much of the world's food harvest is lost to spoilage and infestations on its journey to the consumer. Losses occur in all operations, from harvesting through to handling, storage, processing and marketing. Proper evaluation of postharvest technologies should consider the entire postharvest chain, using loss assessment as a tool for understanding when, where, and why losses occur. Such an evaluation should include technical, economic and social components and involve beneficiary participation throughout. Small-scale agroindustries sector ensures that any comparative agricultural advantage that a country may have is sustained through the preservation and shelf-life extension of these materials in the most convenient and construction materials depends on a country's agro-industrial base.

The technical-assistance community is clearly giving more attention to small-scale food and agricultural enterprises. This is under-standable because the agro-industries sector contributes significantly to the economies of developing countries. Agro-industries, regardless of scale, are generally defined as those industries engaged in a full range of economic activities involving raw materials derived from natural resources. Because the economies of most developing countries are agriculturally based, agro-industries

generally contribute more than 50% of the overall manufacturing sector's added value. Agro-industries also have an extraordinary ability to generate employment opportunities. In many developing countries, small-scale agro-industry is often the largest employer in the manufacturing sector.

Application of simple techniques for harvesting, postharvest treatment, grading, sorting, and presentation of many fruits and vegetables, at village and community levels, has proven profitable for small-scale growers in numerous countries. The introduction of controlled-atmosphere techniques (where feasible) has provided access to more local and export markets.

The role of agro-industries in economic development is often underestimated. These industries aim to improve the quality and increase the value of primary agricultural products. Appropriate technologies are particularly needed for processing food in rural areas of developing countries. Traditional technologies can sometimes be upgraded to enhance the shelf life and consumer acceptance of indigenous or "orphan" foods, as well as developing value added for products with export potential.

The technical support for the establishment of small and medium scale food-processing industries to facilitate food preservation in rural and semiurban areas, on small-scale labour intensive industries with low-cost available materials, and on import substitution, must be integrated within the R&D "arena".

Agricultural products other than food should also be processed to increase value, secure markets, and raise returns for the primary producers. Small-scale agro-industries provide for basic food, shelter and energy needs and are centrally involved in health through medicinal plants. Until 150 years ago, crude plants were central to all medicine, and herbs are humankind's most ancient therapeutic aid. Their central role in medicine throughout the ages eventually led to these plants becoming part of folkloric tradition. Because developing countries, particularly those in tropical or semitropical regions, have a comparative advantage in the production of medicinal plants, a number of FAO technical units and other institutions are providing assistance to this area.

Future focus

It is unclear how agricultural research could better interface with such scenarios and the demands generated from then, especially in relation to NGO or farmer-led approaches to agricultural research and extension. It cannot be assumed that even useful agricultural technologies which are wholly in the public domain will actually reach the fields of poorer farmers in the short term through existing state extension channels. There is a need to explore pilot project on "appropriate technologies" which might better meet the needs of small-scale farmers in developing countries. A key feature of such approaches have been farmer participatory needs assessments to determine research priorities prior to initiation of research and development. However, most agricultural technology research is still conducted far "upstream" of such "downstream" structural changes in the agricultural extension and marketing sectors. There has been a lack of technology research which would enable key agricultural "processes" at the on farm level which could improve farmers livelihoods.

The further focus of technical assistance may have to be reconsidered because of the general move toward private-sector development. In the past, research and development (R&D) capacity has been geared toward helping national institutions, which, in turn, were to transfer R&D capability to local people. This approach has achieved very limited success on the ground. In future, it may be more worthwhile to concentrate less on research capacity per se and focus more on mechanisms to transfer this capacity to the sectors that can turn it into practical economy-building activities.

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