

# Status of the postharvest sector and its contribution to agricultural development and economic growth

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## Abstract

The past 35 years have witnessed an evolution of priorities within the postharvest sector of developing countries—from a primarily technical focus geared towards the reduction of losses, to a more holistic approach designed to link on-farm activities to processing, marketing and distribution. Despite this evolution in trends, fundamental problems and concerns of the sector have remained relatively unchanged, with high postharvest losses, poor marketing systems, weak research and development capacity, and inadequacies in policies, infrastructure and information exchange cited as major constraints within the sector in the five developing regions of the world.

Emerging trends that currently impact upon the development of the sector in developing countries include urbanization, trade liberalization, vertical integration of commodity chains, developments in biotechnology, and food safety and quality concerns of consumers, both in the domestic and in the importing markets. The rapidly increasing pace of urbanization in developing countries will undoubtedly present by far the greatest opportunities for their agricultural development and economic growth.

Value-addition through postharvest processing, handling and storage holds the potential for agricultural development and economic growth and hence increasing incomes and generating off-farm employment at the rural level in developing countries. Associated economic benefits will, however, only be maximized with increased productivity at the farmer level. Improving production–processing linkages through contract farming, for example, and the formation of farmers' associations and cooperatives—designed to foster economies of scale at the production and processing levels—offer opportunities for increasing productivity and competitiveness in value-addition. Strengthening the markets for agro-based value-added products, and updating standard infrastructure (e.g. access to water, power, road facilities, ports etc.) as well as that specific to postharvest requirements (e.g. refrigerated facilities, packaging units, storage facilities etc.) will, however, be critical. Appropriate research and development as well as extension systems geared toward increasing efficiency along the postharvest chain will also be needed in support of strengthening the sector at the rural level. These initiatives can be effective only if supported by enabling policies that stimulate agricultural development and economic growth.

## Introduction

THIRTY-FIVE years ago (in October 1967), a symposium on crop losses, convened by the Food and Agriculture Organization of the United Nations (FAO) in Rome, highlighted the need to increase food availability through the reduction of crop losses. This symposium followed on the significant increases in agricultural productivity being realized then in many parts of the world, due to the introduction of high-

yielding plant varieties (HYV) and the use of fertilizers and irrigation which marked the beginning of the green revolution. Consequences of this increased on-farm productivity were a significant increase in crop yields, and a resultant crisis in the postharvest sector, with high grain losses both at the field (as a result of rodent attack) as well as at the processing, handling and storage levels.

On the basis of the outcome of this symposium, the 1968 session of the FAO Conference recommended that higher priority be accorded to: the development of standard methods for the assessment of crop losses—work designed to prevent both pre- and postharvest

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losses, particularly in the areas of control of rodents and other field pests as well as work on harvesting, drying and storage of farm produce, particularly in tropical climates.

Furthermore, this session of the FAO Conference approved recommendations to restructure FAO's Agriculture Department in order to address critical issues pertinent to: agricultural production, collection and dissemination of improved processing technologies, and improved handling, drying and storage technologies. At the same time, FAO launched a 'war on waste' campaign, designed to encourage and promote efficient use of harvested produce.

FAO's efforts in this endeavor were strengthened when the 1974 World Food Conference drew global attention to the high postharvest losses occurring in most of the developing world notwithstanding the remarkable successes of the on-going green revolution. The United Nations General Assembly in 1975 took up the recommendations of the World Food Conference and passed a resolution to bring about a 50% reduction in postharvest losses by the year 1985. These events led to the establishment of an Action Program for the Prevention of Food Losses (PFL Program) by FAO in 1977.

Early interventions of the PFL Program had an overwhelmingly technical focus on the assessment of storage losses and the transfer of improved on-farm storage technologies, with emphasis on cereals. Poor sustainability of these interventions, which targeted subsistence farmers, and unsatisfactory adoption rates, led to recognition of the fact that this purely technical focus was inadequate to solving problems within the sector. By the mid-1980s to early 1990s, the scope of work covered within the program was broadened to cover roots and tubers, as well as fruits and vegetables. Some efforts were also directed at produce marketing which was at that time monopolized, in most developing countries, by state-controlled marketing boards and parastatals (large, state-owned enterprises). This period also coincided with growing demand in Europe and North America for fresh fruit and vegetable imports from developing countries (Cook 1998). There was also a realization that technical improvements alone were inadequate to solve the problems within the sector. At the same time, there was a significant move towards the liberalization and privatization of staple food marketing systems in many developing and transition economy countries as part of economic structural adjustment programs advocated by key Western donor agencies (Jones 1998).

The mid-1990s saw the development of a 'systems approach' to tackling postharvest issues, spearheaded by a collaborative program between FAO and the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ—German Agency for Technical Coopera-

tion). This approach emphasized linking on-farm activities with other operations within the food and/or commodity chain, while placing the chain within a wider socioeconomic, business and political context. This was followed in the late 1990s by the launching of the Internet-based Information Network on Postharvest Operations (INPhO: <[www.fao.org/inpho/](http://www.fao.org/inpho/)>) by FAO in collaboration with GTZ and the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), in order to better address the information needs of developing countries on postharvest issues.

This paper addresses issues pertinent to the evolution of the sector over the past three-and-a-half decades. It sets out to review the current status of the sector and emerging trends which impact upon it, now and in the future, within the context of its functional activities, operational mechanisms and areas required for improvement. Much of the information presented is based on the outcome of five regional workshops conducted by the former Agro-Industries and Post-Harvest Management Service of FAO, in cooperation with the Global Forum for Agricultural Research (GFAR), during the period September 2001 through March 2002. A total of 197 experts participated in these workshops, representing 67 countries.

## **The postharvest sector: roles and functions**

THE postharvest sector can be viewed within the context of both functional activities and operational mechanisms. Functionally, the sector spans the continuum from the 'field to the plate' and incorporates a series of activities that include harvesting, handling, storage, processing, packaging, transportation and marketing. In order to function efficiently, the sector must, however, operate within a multi-dimensional context (Figure 1) which incorporates considerations for economic, social, technical, infrastructural, environmental, institutional and business considerations, with overall concern for gender issues (FAO 2001). Its primary impact should be geared to meeting consumer requirements and assuring their nutrition, food security and food safety.

Major technical roles of the sector are the reduction of food losses and the enhancement of food safety and quality. Its economic and social importance lies in the major contribution of the sector to economic growth in comparison to primary agricultural production and to food security, social development and nutritional requirements of populations. Economic and efficient functioning of the sector hinges upon appropriate technologies and infrastructure, functioning storage, processing, marketing, transportation, and distribution

systems, and the associated supportive institutional arrangements including those required for successful enterprise development.

## Postharvest capabilities in developing countries

DEVELOPING countries show a gradient in their postharvest capabilities (Figure 2) in that the technological level and scale of postharvest-specific infrastructure varies widely both across and within these countries. While all levels of technology are generally available in any one particular country, the predominance of a particular technology level is generally linked to the economic status of the country concerned.

Traditional postharvest technologies which make use of very simple techniques are predominant in low-income countries. These technologies which are, in general, applied by subsistence farmers are very rudimentary and labor-intensive. They are focused on handling household food requirements and any surplus is sold in local market outlets.

Intermediate-level postharvest technologies are predominant in low and middle-income countries. These are widely applied by small-scale farmers who often have access to limited postharvest-specific infrastructure, such as packing houses, refrigeration and storage facilities. The outputs of these small farmers

are variable in quality, and target both local (including supermarkets) and, increasingly of late, export markets in a number of countries.

High-level postharvest technologies are predominant in middle- and high-income countries, and are generally applied by medium- and large-scale farmers who have access to relatively sophisticated technologies, such as packing-house equipment and cold chains. These farmers are generally able to meet the quality and safety as well as volume and timeliness demands of local (particularly supermarkets) and export markets.

The traditional technology segment of the sector should by no means be ignored since it makes a tremendous contribution to feeding the rural poor. Interventions within this segment of the sector should target upgrading, at the household and/or community level, the handling, processing and storage infrastructure of subsistence farmers, so as to minimize their postharvest losses, improve their food security and alleviate the drudgery of rudimentary technologies employed in their postharvest and processing activities. Promulgation of enabling policies which facilitate local merchants and/or business enterprises set up by farmers’ organizations and cooperatives to purchase any surplus from such farmers should be encouraged. Training and technology transfer must be emphasized within this segment of the sector.

The intermediate technology segment of the sector, on the other hand, shows the greatest opportunity for

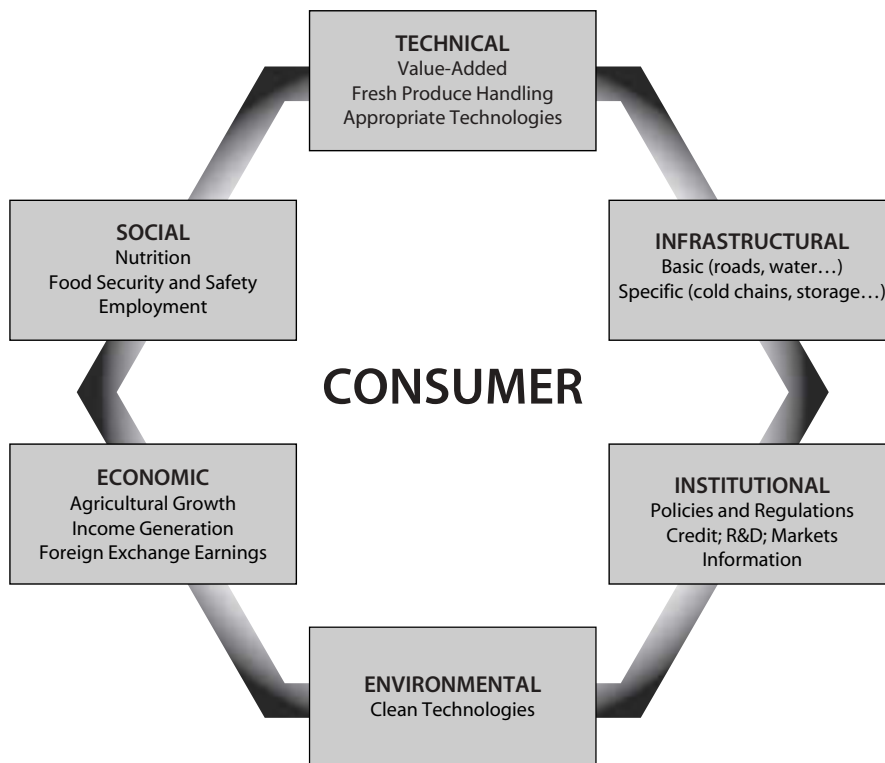


Figure 1. Dimensions of the postharvest sector (FAO 2001).

contributing to economic growth and agricultural development. It must therefore be approached from a perspective which incorporates considerations for each dimension of the sector, in light of a number of emerging global trends. If this segment is to remain competitive, then these trends increasingly dictate the need for greater efficiency and better organization and management within the sector as well as improvements in marketing systems, research and development, infrastructure and information exchange. These improvements can be achieved only if supportive policies are promulgated and appropriate resources are invested in the sector.

### Current trends that impact on the sector

THE intermediate technology segment of the postharvest sector is currently being restructured and reshaped in light of a number of emerging global trends. These trends indeed present windows of opportunity for growth and development within the sector. The challenge will therefore be for this segment of the sector to restructure and reorganize itself in order to take advantage of the opportunities presented.

#### Contraction in the agricultural sector

Production agriculture is increasingly declining both in terms of employment (Figure 3) and relative contribution to the gross domestic product (GDP) in

most countries. It will therefore be necessary to generate alternative sources of income through the generation of off-farm employment, in order to feed both the rural and urban poor.

#### Urbanization

Strong urbanization trends in developing countries (Figure 4) will dictate the need for more food, both fresh and processed, in urban areas (Regmi and Dyck 2001). This will necessitate the improvement of rural–urban linkages through investment in roads, transportation and marketing infrastructure, so as to keep down marketing costs and thus keep food costs affordable to the lower-income groups in these cities. Improving efficiency within the postharvest and marketing systems will be critical to tackling the challenges of feeding the increasing urban population.

#### Globalization

Globalization opens up opportunities for increased agricultural exports while at the same time increasing the vulnerability of internal markets in developing countries to competition from inexpensive (or subsidized) imports of ostensibly higher quality than can be produced in their local markets. Staying well ahead of this competition will necessitate greater consideration for quality assurance throughout the postharvest chain (ITC 2001).

Maintenance of low production costs as well as a trained workforce will also contribute to increasing the competitiveness of the sector.

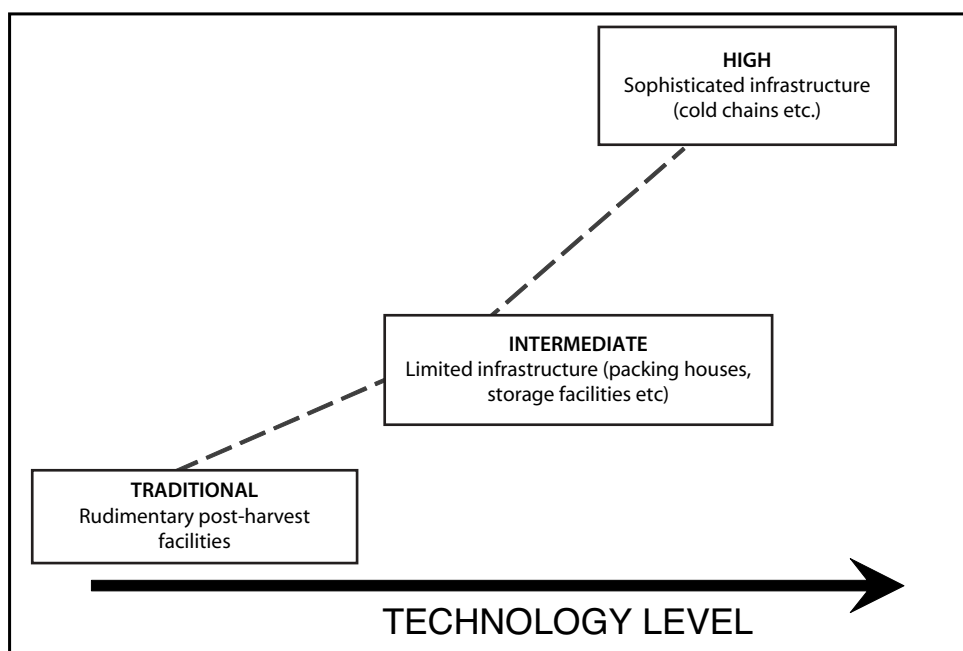
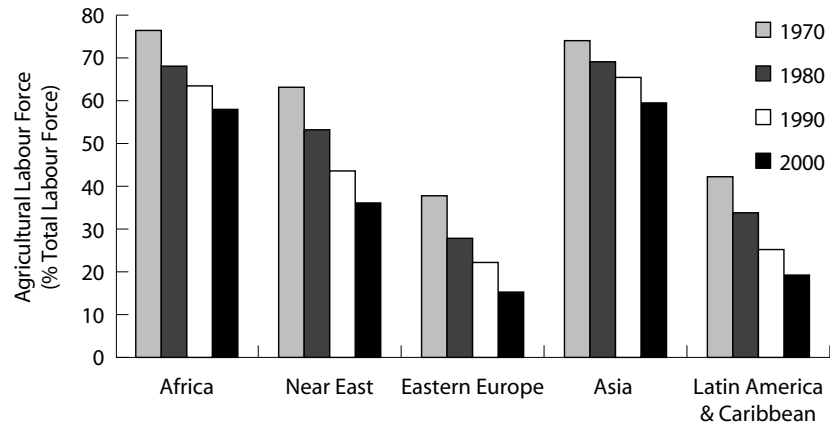
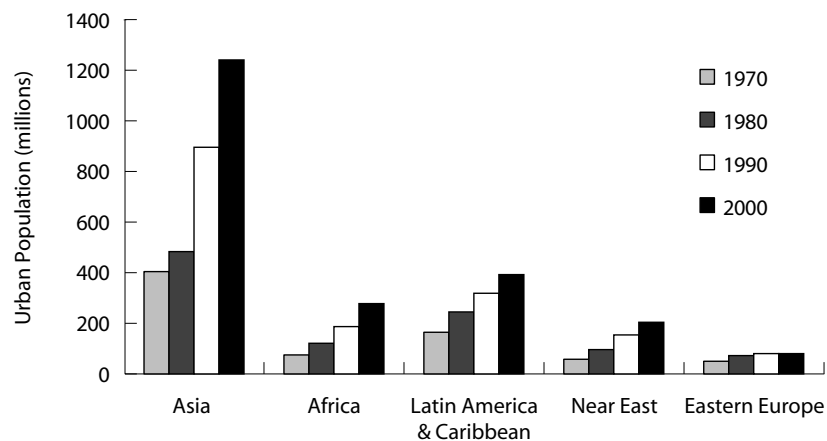


Figure 2. Gradient of postharvest technologies in developing countries.



**Figure 3.** Trends in employment in the agricultural sector of developing regions, 1970–2000. Source: World Development Indicators Database, World Bank, April 2002.



**Figure 4.** Trends in urban population growth in developing regions of the world, 1970–2000. Source: FAOSTAT.

### Food safety and quality issues

The bulk of food exports from developing countries are subject to safety risks and trade barriers owing to sanitary and phytosanitary regulations. This is particularly critical with increasing trade in perishable commodities. Failure to meet basic food hygienic requirements accounts for a large percentage of the rejections of fresh food imports in developed country markets. Table 1 exemplifies the situation for fresh food imports into United States markets.

Food safety concerns (Table 2) have propelled the use of preventive methods such as good agricultural practices (GAPs) before harvest, and good manufacturing practices (GMPs) and hazard analysis and critical control point (HACCP) procedures in order to reduce the risk of microbial, physical and chemical contamination in foods. Associated with food safety concerns is interest in traceability, or the ability to track

food items from production to consumption. Traceability issues increasingly make the case for the vertical integration of commodity chains.

Food quality concerns have emerged as a major issue as a result of growing food safety concerns. International requirements and demand for increasing quality will necessitate greater attention to grades and standards and to GAPs and GMPs for the improvement of quality.

In order to guarantee the safety and quality of their produce and products, it will be necessary for developing countries to develop and upgrade their capacity to assure process control and prevent risks along the food chain.

### Changing consumer demands

With increasing urbanization, and as countries develop, dietary habits change. Rising incomes, more

women in the workplace, and a larger number of urban dwellers, impose demand for foods that can be easily and quickly prepared, and that are attractively packaged. It is, however, important to recognize that the limited purchasing power of consumers in a large number of developing country markets necessitates that food be made available to them at low cost, so as to ensure their food security.

### New players within the marketplace

Wholesale and retail markets for food are rapidly changing, and the strong tendency toward concentration and consolidation at both the buyer and supplier levels is increasingly leading to procurement methods that manage supply chains. Furthermore, supermarkets are becoming predominant players in many developing countries, with increasing demand for consistent volumes of high-quality products. These trends are particularly significant in Asia and in the Latin American region (Reardon and Berdegue 2002) and spell significant change for farmers and processors. It will therefore be necessary to: integrate postharvest activities, from harvesting through to distribution; and establish appropriate postharvest infrastructure and develop logistical arrangements that allow for economies of scale in both production and processing.

### Biotechnology

The application of biotechnology in food production and processing has been received with mixed reactions in both developed and developing countries. While on one hand it is viewed as a possible solution to

world hunger, there is also the school of thought that argues that risks associated with biotechnology may far outweigh the benefits associated with its application. It will, however, be important to stay abreast of biotechnology developments, so as not to miss out on any potential opportunities that they present for the sector.

**Table 2.** Food safety concerns and trends in developing countries.

<b>Food safety concerns (WHO 2001)</b>	
•	Inappropriate use of agricultural chemicals
•	Use of untreated or partially treated wastewater
•	Excreta or manure supplies for crop irrigation
•	Absence of food inspection
•	Lack of infrastructure, including potable water or a functional cold chain
•	Poor personal hygiene
•	Lack of basic food safety legislation, poor analytical facilities and ineffective food inspection
<b>Trends in food safety</b>	
•	Consumer demands
•	Traceability
•	Documentation and certification
•	Increasing focus on hazard analysis and critical control point (HACCP) procedures

### Niche market opportunities

Urbanization in developing and developed countries has provided opportunities for market segmentation and differentiation, thus creating opportunities for niche markets, especially for developing countries. Low-volume, high-value products, such as spices, ornamentals and mushrooms, and specialized products,

**Table 1.** Number of contraventions cited for United States Food and Drug Administration import detentions for the period July 1996 to June 1997.

Origin/reason for contravention	Africa	Latin America and the Caribbean	Europe	Asia	Total
Food additives	2 (0.7%)	57 (1.5%)	69 (5.8%)	426 (7.4%)	554 (5.0%)
Pesticide residues	0 (0.0)	821 (21.1%)	20 (1.7%)	23 (0.4%)	864 (7.7%)
Heavy metals	1 (0.3%)	426 (10.9%)	26 (2.2%)	84 (1.5%)	537 (4.8%)
Mould	19 (6.3%)	475 (12.2%)	27 (2.3%)	49 (0.8%)	570 (5.1%)
Microbiological contamination	125 (41.3%)	246 (6.3%)	159 (13.4%)	895 (15.5%)	1425 (12.8%)
Decomposition	9 (3.0%)	206 (5.3%)	7 (0.6%)	668 (11.5%)	890 (8.0%)
Filth	54 (17.8%)	1253 (32.2%)	175 (14.8%)	2037 (35.2%)	3519 (31.5%)
Low acid canned food	4 (1.3%)	142 (3.6%)	425 (35.9%)	829 (14.3%)	1400 (12.5%)
Labeling	38 (12.5%)	201 (5.2%)	237 (20.0%)	622 (10.8%)	1098 (9.8%)
Other	51 (16.8%)	68 (1.7%)	39 (3.3%)	151 (2.6%)	309 (2.8%)
Totals	303 (100%)	3895 (100%)	1184 (100%)	5784 (100%)	11166 (100%)

Source: FAO 1999.

such as organic products, are increasingly entering the international trade. Increasing trade in these products raises issues pertinent to safety, processing and infrastructure and, in the case of organically grown produce, certification requirements. These issues must therefore be considered and addressed in order to exploit these opportunities.

**Information technologies**

Developments in information technology have considerably increased efficiency in accessing and exchanging information on markets, technologies, standards and regulations. Internet use (Figure 5) also provides opportunities for the development of business contacts. Developing countries will need to exploit these developments in order to boost performance within the sector.

**The sector as a catalyst for agricultural growth and economic development**

ALL of the trends described above should be viewed as windows of opportunity for the intermediate-technology segment of the postharvest sector, and thus the small farmer. A major challenge, however, lies in appropriately equipping and managing logistics within that segment of the sector so as to derive the benefits for rural poverty alleviation, foreign exchange earnings and foreign investment opportunities in the agricultural sector of developing countries. Issues such as improving productivity within the sector, value-addition, strengthening the markets for both fresh produce and processed products, and maintaining competitiveness through the application of proper standards,

testing and quality systems will be central to realizing these opportunities. The development of appropriate postharvest infrastructure (both institutions and physical) as well as policies which stimulate growth will also be critical to success.

**Improving quality**

Quality, supply chain management, logistical arrangements and the need for infrastructure (both physical and institutional) have all emerged in the foregoing discussion as critical areas requiring attention in the intermediate technology segment of the sector. Contract farming and the development of cooperative associations in particular can help to overcome these problems, and increase productivity and efficiency in postharvest operations. Cooperative associations must, however, be equipped with access to proper guidance, marketing intelligence systems, assured supplies of inputs (credit, extension services etc.), appropriate infrastructure, and be aware of quality controls and standardization of farm products (including supporting institutions for quality certification) in order to be able to function effectively and be competitive.

**Value-addition**

Value-addition is one strategic area the offers an opportunity for shifting from subsistence agriculture to economic development in that it makes intensive use of both human resources and the local raw agricultural base with linkages to both agriculture and industries. Furthermore, value-addition provides the linkage between the rural and urban sectors while generating off-farm employment at the rural level. Apart from the requirement for technical inputs and training in value-added technologies, stronger rural–urban linkages must be fostered through the development of basic

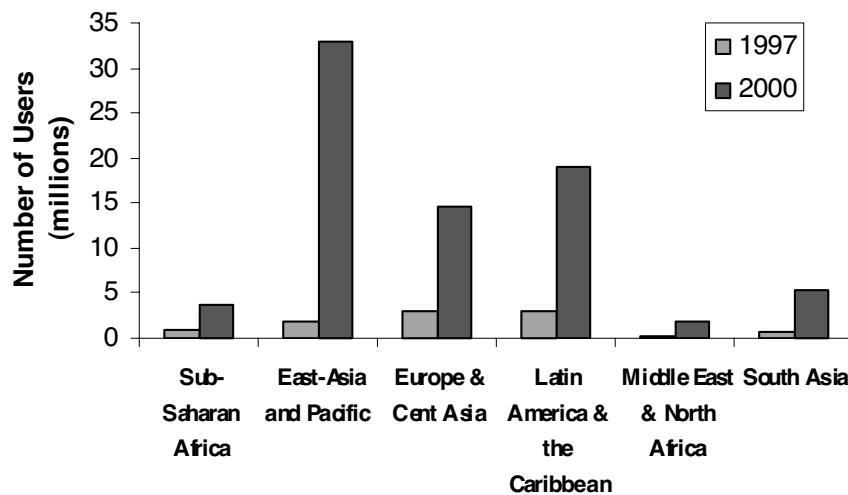


Figure 5. Trends in Internet use, 1997–2000. Source: World Development Indicators Database, World Bank, April 2002.

supporting infrastructure such as roads, transportation and marketing infrastructure and, if the sector is to be competitive, provide low-income consumers access to food and generate economic benefits.

Value-added activities developed and implemented must be environmentally sound and incorporate considerations for alleviating the drudgery of traditional processing operations.

### Strengthening markets

The integration of harvesting, handling, storage, processing, packaging, and land, air and sea transportation will become increasingly important if the intermediate technology segment of the sector is to respond to current market trends. Logistical arrangements that facilitate and support this integration and which foster economies of scale will therefore be required. Knowledge of consumer preferences, market access conditions, marketing channels, techniques and import requirements in importing countries will also be important for realization of economic benefits from export trade. The development of appropriate marketing strategies for both domestic and export markets are therefore critical.

## Conclusions

Current trends in the global economy are indeed restructuring and reshaping the role and functioning of the intermediate technology segment of the sector. Within this segment, the technology push of 35 years ago has given way to the demand-driven trends that currently drive the sector. Closer integration among producers, input suppliers, processors, distribution systems and markets is becoming increasingly important in order to ensure economies of scale, competitiveness, efficiency and sustainability of this segment of the sector. Within this context, the intermediate technology segment must harness the opportunities created by these trends to meet the food security and nutritional requirements of the populations, alleviate rural poverty and make a positive contribution to agricultural development and economic growth.

At the same time, importance must be given and attention paid to assisting the rural poor in upgrading the traditional segment of the sector. Interventions

within that segment of the sector must focus on training and upgrading technical capacity in order to reduce losses, increase efficiency and reduce the drudgery associated with the rudimentary technologies employed.

These initiatives can be effective only if supported by enabling and supporting policies.

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