Vegetable production: an economic and nutritional asset for developing countries

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ABSTRACT
Vegetables offer less developed countries (LDC) considerable agricultural diversification potential, both in terms of their food value and high demand on regional (close to production centres) and world markets (where there is increased demand for healthy natural food commodities). Indeed, vegetables should become an increasingly important economic asset for LDC, provided that real sector-based dynamics are developed, that production is directed towards meeting consumers' needs, and that support is provided through efficient research projects.

Les productions maraîchères : un enjeu économique et nutritionnel pour les pays en voie de développement.

RÉSUMÉ
Les légumes représentent un potentiel élevé de diversification de l'agriculture dans les PVD, du fait de leur intérêt nutritionnel et de la forte demande des marchés régionaux (à proximité des centres de production) et internationaux, où le consommateur des pays riches recherche de plus en plus une alimentation saine et naturelle ; à la condition de développer une véritable dynamique des filières, d'adapter la production aux aspirations du consommateur et de s'appuyer sur des actions de recherche performantes, les légumes devraient occuper une place croissante dans l'économie des PVD.

Las producciones hortícolas: una importancia económica y nutricional para los países en vías de desarrollo.

RESUMEN
Las legumbres representan un potencial elevado de diversificación de la agricultura en los PVD por su interés nutricional y la fuerte demanda de los mercados regionales (a proximidad de los centros de producción) e internacionales donde el consumidor de los países ricos busca cada día más una alimentación sana y natural ; a la condición de desarrollar una verdadera dinámica de los sectores, de adaptar la producción a las aspiraciones del consumidor y de apoyarse sobre acciones de investigación performantes, las legumbres deberían ocupar una importancia creciente en la economía de los PVD.

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KEYWORDS
Developing countries, vegetable growing, production location, economic analysis, economic situation, economic trends, world markets.

MOTS CLÉS
Pays en développement, culture maraîchère, localisation des productions, analyse économique, situation économique, tendance économique, marché mondial.

PALABRAS CLAVES
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from Babylon to Rotterdam

In the days of the splendour of Babylon (12th century BC), Nebuchadnezzar built the "7th Wonder of the World" – the suspended gardens, an incredible technical achievement that brought together all horticultural products (decorative flowers, ornamental shrubs, along with fruit trees and various vegetable species).

The Roman *Hortus* also included a walled orchard and vegetable garden (PELT, 1994 a and b).

During the Hispano-Moresque era, Andalusian gardens were a patchwork of fruit, vegetables and flowers. In France, King Louis XIV's interest in horticulture was shown by the vegetable garden, greenhouses and Orangerie that were set up at Versailles (MEILLER and VANNIER, 1991).

Horticulture, contrary to the past situation when activities were grouped together at one location, is now divided into several distinct disciplines as a result of scientific and technical specialization and the development of field cropping: orchard fruit, vegetable crops, ornamental, aromatic and medicinal plants. The CIRAD-FLHOR Horticultural Products programme, for instance, focuses on all of these crops, apart from fruit (table I).

Economic analysis of the impact of these crops is quite complicated because of the wide range of species and varieties involved: 1 500 vegetable species, belonging to 19 different plant families, are currently cultivated (TRONICKOVA, 1990). In addition, there is a serious shortage of available statistical data, especially concerning ornamental, aromatic and medicinal plant production.

In less developed countries (LDC), such analyses are still at the basic stage, but are an essential decision-making tool for public and private operators involved in this sector.

The overall importance can be roughly evaluated. On a world scale, production volumes are much higher for vegetables (450 Mt in 1992) as compared to fruit crops (374 Mt). When tubers (potatoes and sweet potatoes) and dry legumes (peas, lentils, etc) are also considered, overall vegetable production soars to 900 Mt, which represents 50% of total cereal production (table II).

In terms of world trade, vegetables *lato sensu* (with melon and watermelon, tubers and dry legumes) represented nearly US$7 billion in exports in 1992. In contrast, fruit exports represented only US$14 million, or barely 4% of world agricultural produce exports.

World trade figures are the only other global figures available to enable market assessments for

Table I
Crops covered in the CIRAD-FLHOR horticultural products research programme*, relative to all crops considered in a wider definition of this term (world estimates for 1992).

Crops considered in a wider definition of horticultural products	*Production (billions t)*	*Exports (billions US$)*
Fruit	374	14.0
*Vegetables (excluding tubers)	456	6.3
*Ornamental plants Nursery plants Potted and bedding plants Cut flowers and foliage		4.9
*Aromatic plants Edible Nonedible		1.5
*Medicinal plants		
Total	830	26.7

other horticultural products. They indicate an export value of more than US$5 billion for ornamental plants and US$1.5 billion for aromatic plants. Hence, these represent micromarkets as compared to commodities.

From the Mediterranean Basin, the hub of horticultural commerce and production has therefore shifted northwards over the ages, with Rotterdam being the modern-day successor of Babylon.

This paper provides an introductory analysis of the situation concerning vegetable cropping in LDC. The specialists are left the difficult task of detailing the situation and challenges with respect to other horticultural products (ornamental, aromatic and medicinal plants).

legume production in developing countries

Legumes, like most other cultivated plants, originate from tropical and subtropical regions (table III).

Chronologically, vegetable crops, which throughout prehistoric and ancient times involved products that were considered as complements to gathered foods, as well as fruit crops appeared after cereals. Historians mention the appearance of cucumber, beans, lentils and peas in Egyptian agriculture 5 000 years ago. Okra has been cropped for more than 4 000 years.

Overall vegetable production in LDC reached 658 Mt in 1992 (table IV), or 61% of world production, while cereals represented only 54%. The increase in vegetable production through the 1980s was more rapid in LDC (+42% between 1980 and 1992) than in industrialized countries (+27% during the same period) (table II). However, the *per capita* production increase was very moderate in southern countries because of the high population growth rate, ie 130 kg/year in LDC as compared to 280 kg/year in northern countries in 1992.

The area under vegetable crops is relatively small because vegetables are often grown intensively on smallholder's plots: in 1992, 25 Mha for vegetables *stricto sensu* in LDC, and 15 Mha for tuber crops.

Table II
World fruit and vegetable production (Mt). (Source: FAO, 1993).

	1992	*Increase from 1980 to 1992 (%)*
Vegetables (with melons, excluding tubers)		
World	456	27.2
LDC	309	41.7
LDC/world	67.6%	
Fruit (with nuts)		
World	374	24.5
LDC	244	45.4
LDC/world	65.3%	
Fruit and vegetables		
World	830	26.0
LDC	553	43.3
LDC/world	66.6%	
Cereals		
World	1 952	23.8
LDC	1 063	37.0
LDC/world	54.4%	
Population (M inhab)		
World	5 480	23.2
LDC	4 210	28.5
LDC/world	76.8%	

Table III
Main origins of some vegetables.

Origins	*Vegetable species*
China (central, west and Nepal)	Some cabbage and bean species
Southeast Asia (India, Burma, Thailand, Cambodia, Vietnam, Malaysia and Indonesia)	Cucumber and eggplant
Central Asia (North Himalaya, Afghanistan, Uzbekistan, Tadzhikistan)	Pea, garlic, onion, broad bean, radish and spinach
Asia Minor (Transcaucasia, Iran, Irak)	Lettuce and black radish
Mediterranean Basin	Horse bean, beet, parsley, artichoke, thyme, asparagus, endive, scorzonera and some cabbage species
Central America	Pepper, squash, maize
Andean South America	Potato, tomato, bean
Tropical Africa	Melon, watermelon and calabash

The most cultivated vegetable species is, by far, sweet potato, with 9 Mha and 126 Mt (table IV), followed by potato (84 Mt), tomato (37 Mt), watermelon (19 Mt), cabbage (18 Mt) and onion (17 Mt). Production of other crops is less than 10 Mt (cucumber, melon, pepper). Vegetable yields in LDC are generally close to the world average, indicating comparable land productivity,

Table IV
Vegetable production in less developed countries (LDC) in 1992 (Source: FAO, 1993).

	Production (billions t)	*Area (billions ha)*	*Yield (t/ha)*	*Production variation between 1980 and 1992 (%)*
Sweet potato	126.036	9.151	13.8	− 4.7
Potato	83.651	6.623	12.6	+ 38.1
Tomato	36.753	1.918	19.2	+ 70.6
Watermelon	19.234	1.151	16.7	+ 22.5
Cabbage	18.160	0.922	19.7	+ 26.6
Dry onion	17.256	1.370	12.6	+ 42.5
Cucumber	8.957	0.609	14.7	+ 55.9
Melon	8.822	0.545	16.2	+ 53.0
Pepper	6.973	0.978	7.1	+ 56.3
Squash	5.888	0.502	11.7	+ 37.2
Carrot	4.773	0.250	19.1	+ 65.5
Eggplant	4.656	0.372	12.5	+ 38.2
Garlic	2.675	0.396	6.8	+ 48.4
Cauliflower	2.362	0.220	10.7	+ 27.8
Green bean	1.639	0.259	6.3	+ 30.5
Green pea	1.053	0.290	3.6	+ 23.6
Artichoke	0.195	0.015	13.0	+ 6.6
Total	349.083	25.571	216.0	+ 20.8
Total for vegetables (including tubers)	658.000			

ranging from 10 to 20 t/ha. However, labour productivity is not comparable because of the difference in farming systems.

The incredible diversity of tropical crops should be mentioned. In addition to the above-mentioned species that are now popular worldwide, there are other original food crops of considerable nutritional interest. For instance, tropical spinach species such as vine spinach (*Basella rubra* L), amaranth (*Amaranthus* spp), *Celosia argentea*, Guinea black nightshade (*Solanum nigrum* var *guineense*), Para cress of Réunion and Madagascar (*Spilanthus oleracea*) and *Xanthosoma brasiliense* are all leafy vegetables with a high-protein dry extract. The latter is also true for yams (*Disoscorea* spp), ancient mythical plants that include about ten different species and hundreds of varieties cropped throughout the intertropical zone (MESSIAEN, 1975).

Asia is the largest vegetable growing zone *stricto sensu*, producing about 60% of the world output. China, which has increased its vegetable production by 50% over the last 12 years, now produces 120 Mt; this growth rate matches that of South Africa, Mexico and Turkey, but is much lower than that of Morocco (+111%). Other important producers are India (59 Mt), Turkey (19 Mt) and, much further behind, Egypt (9 Mt), South Africa and Mexico (5.7 Mt) and Brazil (5.4 Mt). Nigeria, Argentina, Morocco and Chile produce more than 2 Mt. Vegetable production in LDC is concentrated in about a dozen countries, accounting for three-fourths of the overall supply (table V).

Table V
Important vegetable-producing countries (including melon, excluding tubers).
(Source: FAO, 1992).

	Production (1 000 t)		*Market share*	*Production increase from*
	1979 to 1981	*1992*	*1992 (%)*	*1980 to 1992 (%)*
Africa	23 441	31 926	7.0	36.2
Egypt	7 345	9 358	2.1	27.4
South Africa	3 860	5 738	1.3	48.7
Nigeria	2 906	3 975	0.9	36.8
Morocco	1 320	2 785	0.6	111.0
North and Central America	32 915	40 370	8.8	22.6
Mexico	3 860	5 738	1.3	48.7
Cuba	466	585	0.1	25.5
Guatemala	277	403	0.1	45.5
South America	11 591	14 558	3.2	25.6
Brazil	4 089	5 487	1.2	34.2
Argentina	2 279	2 834	0.6	24.4
Chile	1 760	2 093	0.5	18.9
Asia	194 444	270 406	59.3	39.1
China	79 707	119 786	26.3	50.3
India	42 616	59 194	13.0	38.9
Turkey	13 338	19 054	4.2	42.9
Europe	63 507	66 796	14.6	5.2
South Sea Islands	1 759	3 961	0.9	125.2
Papua New Guinea	286	370	0.1	29.4
Ex-USSR	30 909	29 572	6.5	– 4.3
Developing countries	217 850	308 595	67.6	41.7
Developed countries	140 714	147 575	32.4	4.9
World	358 564	456 170	100.0	27.2

Vegetables, including those produced by developed countries, are not very important on world markets. Proportions of exports relative to production volumes of some vegetable species in 1992 are given in table VI. The percentage for major cereals and oil-seed crops is around 15%, whereas it ranges from 2 to 10% for vegetables.

In 1992, exports of potatoes, fresh tomatoes, onions and dry legumes represented US$6.3 billion (table VII). Export figures for LDC represented only 28% of the world figures, even though vegetable production volumes represent more than 60% of world volumes. These markets are limited by the fact that much of the produce is highly perishable, and export subsectors are very difficult to organize, especially in LDC.

Because of these constraints, the international globalization of fresh fruit and vegetable markets is still only hypothetical. The trend is generally towards increased regionalization of these markets, as determined by the relative proximity (ie, distances weighted by costs and transportation times) of production zones and consumer markets. This does not mean that there is lower competition; the global market remains open, and international merchanise flows are determined by price gaps between regional blocks. Government authorities therefore have to try to maintain the balance between intra- and inter-regional competition which is essential for boosting business comptetitivity, and protecting budding subsectors during the transition phase to an internationalized economy (OMAN, 1994).

The fluctuating nature of prices, and long-term trends, which are declining for most agricultural products, should also be noted. Indeed, for LDC, the mean export price for fresh tomatoes dropped by 37% from 1990 to 1992.

Vegetables, and horticultural products in general, represent a high agricultural diversification potential in LDC, for two main reasons:
– domestic markets and the nutritional value of these products (at a time when there are many food shortages) are important;
– there is considerable world market demand from rich countries, where consumers aim at balancing their food intake throughout the year.

These two points, along with their effects on LDC vegetable subsectors, will now be analysed.

domestic vegetable markets in LDC: an economic and nutritional asset

There are unfortunately no reliable statistics available on vegetable consumption patterns in southern countries. Contrary to cereals (especially wheat), there is very little international flow from the northern hemisphere towards LDC. This indicates that local vegetables are consumed within producing the country, or in neighbouring countries (region). The *per capita* production is thus a relatively reliable indicator of mean consumption per person. Table VIII shows that although there are gaps between the north and the south (about 1 to 1.6 for vegetables, 1 to 2 for fruit and 1 to 3 for tubers), they are much less marked than for cereals (1 to 5). This situation is the result of close productivity rates and the "subsistence" reputation of horticultural products in southern countries.

Nevertheless, vegetables (like fruit) are of considerable nutritional interest, because of their vitamins and fibre contents. Their dietary status should thus be strengthened in LDC, on the basis of the interesting Mediterranean consumption model (RASTOIN, 1993).

Annual *per capita* vegetable consumption, for example, is estimated at 65 kg in Vietnam, 35 kg in Cambodia and 20 kg in Laos, while actual needs are around 100 kg in these countries (GANRY, 1994).

In the south, there is a high degree of subsistence consumption of vegetable produce in rural areas, along with rapid urban market development (40% of the total population in LDC, and more than 70% in Latin America), and "green belts" close to towns, because of the highly perishable produce, and "neighbouring country" import channels (eg, from Burkina to Ivory Coast). The recent devaluation of the CFA franc has strengthened this regional vegetable trade in West Africa (LOSCH, 1994).

In LDC vegetable subsectors, there are many sectoral operators due to the atomization of vegetable producers and the high number of middlemen with very narrow specializations – based on the quality and volume of the marketed

Table VI
Proportion of exports of some types of vegetables as compared to quantities produced in 1992 (Source: FAO, 1993).

Vegetable	*World (%)*	*LDC (%)*
Potato	2.6*	1.6
Fresh tomato	3.4	1.9
Onion	8.6	6.4
Dry legumes	10.9	6.5

*SCOTT, 1994, estimated 4% of world export production.

Table VII
International trade of some types of vegetables: export patterns between 1990 and 1992 and corresponding unit prices (Source: *FAO Trade Yearbook*, 1993).

	1992 Exports (billions US$)	*Export variations from 1990 to 1992 (%)*	*Unit price (US$/t) 1990*	*1992*
Potato				
World	1 468	– 7.8	226	208
LDC	288	+ 20.5	268	213
LDC/world	19.6%			
Dry legumes				
World	2 230	– 16.4	407	358
LDC	910	– 16.3	453	366
LDC/world	40.8%			
Fresh tomato				
World	1 910	– 8.4	858	800
LDC	277	– 50.4	623	391
LDC/world	14.5%			
Onion				
World	675	+ 7.5	278	278
LDC	283	+ 21.5	239	257
LDC/world	41.9%			
Total				
World	6 284	– 9.9		
LDC	1 759	– 17.0		
LDC/world	28.0%			

Table VIII
Per capita fruit and vegetable production in 1992 (Source: FAO, 1993).

	Less developed countries (LDC) (kg/person)	*Developed countries (DC) (kg/person)*	*World (kg/person)*	*Difference (DC/LDC)*
Vegetables	73	116	83	1.58
Tubers	50	147	72	2.95
Legumes	9	15	10	1.66
Fruit	58	102	68	1.77
Total	190	380	233	2.00

vegetable batches (MOUSTIER, 1994). Subsector logistics are quite rudimentary, because of the poor communication routes and insufficient packing equipment and techniques. Transactions are done in a rather opaque manner because of the lack of formal locations for merchandise trade and the absence of public information systems. Regulations for products (standardization, pest and disease control, taxation) are generally quite basic or not respected. Trade is often conducted "off-market" in economic theory terms. The system is well adapted for efficient marketing of merchandise delivered to urban zones, thus buyers are found for all products, even those of poor quality (TEMPLE, 1993). With this system, no "signals", ie, concerning prices and quality, are sent back to the producers. Finally, the system is quite fragile and inadapted to high population growth.

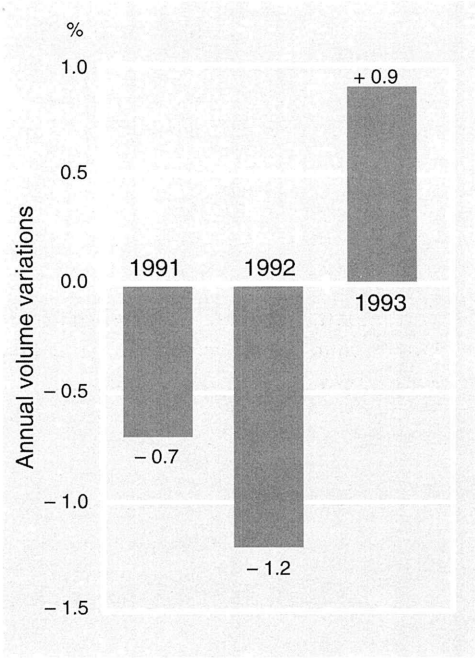

Figure 1
French fruit and vegetable consumption patterns from 1991 to 1993 (Source: SECODIP/Interfel, 1994).

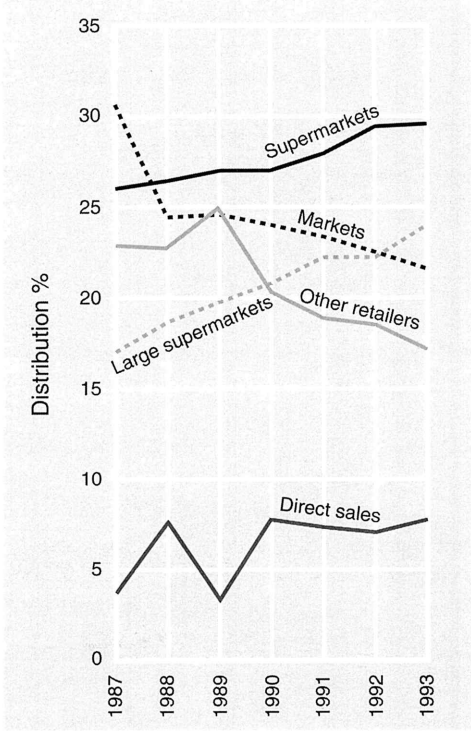

Figure 2
Variations in fruit and vegetable points of purchase in France from 1987 to 1993 (Source: SECODIP/Interfel, 1994).

The challenge to "feed the towns" should be addressed through substantial research and development efforts. Despite recent progress, vegetable (and fruit) crops are not profiting much from national and international intangible investment, contrary to the important traditional tropical agriculture products (rice, maize, coffee, cocoa, etc). The priorities thus concern varietal improvement, within new environment-friendly production systems that are not a threat to human health, increasing productivity and subsector/market organization and management. A crucial research related problem affecting LDC concerns the expensiveness and inefficiency of agricultural extension systems in most situations.

These deficiencies also penalize many developing countries on highly competitive markets in the OECD (Organisation for Economic Cooperation and Development) zone (AUBE, 1994).

vegetable consumption trends in northern countries: western Europe

In 1991 and 1992, food consumption volumes decreased for the first time in France (fig 1) and several other European countries. This phenomenon is an upshot of the economic crisis, signalling new consumer behaviours. In recent years, food markets have been dichotomizing: these markets are segmenting into standard staple products,

with price as the major purchasing factor, and high quality products related to festive occasions, events and traditional customs, and the price of this produce is not a critical concern in the purchasing process. This segmentation also affects fruit and vegetables, especially "exotic" tropical products that are usually available in the off-season and have a holiday image in consumers' minds — these often belong to the second category.

As noted earlier, European consumption of fresh fruit and vegetables is high (about 200 kg/person), but there are marked between-country differences: almost 350 kg in Greece, 300 kg in Italy and less than 100 kg in Denmark (table IX). The growth margins are therefore quite high for northern countries in this zone.

What are the trends in this area?

Increasingly, consumers are looking for healthy natural foods, and the importance of fruit and vegetables should thus be rising. Health-related concerns are noted at two levels:
– the first involves production conditions: lower levels of pesticide residues in the produce and nitrates in the soil, and recyclable packaging;
– the second is related to balancing food intake: increase in soluble carbohydrates, reduction in fats, vitamin supplements, ie, the aim is to develop a Mediterranean-type diet (Italy, Greece).

This quest for natural foods can be classified in three categories, as follows:
– taste quality and gastronomic value;
– visual quality, but this is no longer a distinguishing factor, as the EU "common quality standards" are now generally respected by fruit and vegetable suppliers, especially on very demanding markets, eg, the German market;
– the need to identify the origin of produce: the great tourist migrations along with the audiovisual communications boom have considerably developed consumers' experienced outlook towards food products; indeed, consumers now want to know the origin of food products, as they are increasingly wary of "artificial-industrial" agricultural production methods.

There is a promising future for names specifying and guaranteeing the origin of high quality agricultural products.

The last important feature for exporters from developing countries targeting European and North American markets involves the configuration of marketing networks, expecially distribution to consumers. Food products from these countries are now generally distributed to supermarkets: in 1993, almost 55% of fruit and vegetables from LDC were sold in medium- and large-scale supermarkets, ie, in retail stores with a surface area of more than 400 m^2, whereas traditional retailers marketed less than 17% of this produce (as compared to 25% in 1989) (fig 2). Supermarkets are now controlled by powerful groups whose turnover is comparable to that of large multinational industrial corporations. These groups implement three types of strategic tools: trade name differentiation, merchandizing and logistics (MONTIGAUD *et al*, 1994). Hereafter, distribution companies will have to master logistics in order to remain competitive. This

Table IX
Fresh fruit and vegetable consumption (kg/person) in some European countries (Sources: Germany, France, Italy, UK, according to *Fruchthandel*, June 1994, given by Europanel/GFK; other countries, according to Eurostat/OECD/FAO).

	Fruit	*Vegetables*	*Total*
Greece	159	186	345
Italy	129	167	296
France	80	124	204
Germany	116	84	200
Spain	106	66	172
Netherlands	73	62	135
United Kingdom	64	70	134
Portugal	61	60	121
Denmark	44	37	81
Mean	92	95	188

involves creating real-time information networks, and multimodal warehousing and shipping platforms. After quality, the second discriminating factor for agrifood products is their degree of conformity to modern logistics requirements.

conclusion: subsectors, consumers and economic analysis

Three different features discussed in this exploratory study on tropical and Mediterranean vegetable products should be developed: subsector dynamics, consumer requirements (which will also partially govern the first feature) and the role of research.

The future of production subsectors is clearly dependent upon producers. In LDC, efficient government activities are required to:
– create essential infrastructures (communications channels, open and licit physical and financial markets, transparent information systems);
– draw up market regulations and enforce them;
– create and develop competitive enterprises at various subsector levels (production, processing, distribution, logistics);
– encourage institutional subsector structuring to develop synergies concerning innovation (research/development) and communications (product promotion);
– shift production activities to the private sector.

In competitive markets, under identical agroclimatic conditions, the performance of an enterprise is closely linked with the dynamics that are created under a favourable economic, infrastructural and administrative environment (PORTER, 1991).

Economists should focus on three research areas:
– the first involves improving empirical bases for the analysis of food product subsectors (eg, vegetables and some fruits) in LDC; in this area, studies on consumption patterns and household purchasing behaviour require the most improvement, then come quantitative and managerial studies on the fabric of enterprises; this chiefly falls within the microeconomy and management sciences field;
– the second area concerns market regulation; this is a mesoeconomy issue, with emphasis on the theory of between-agent agreements, which should lead to considerable progress in the understanding of subsector dynamics;
– in the third area, the thrust will be to fully apprehend public policies for consolidating or inducing subsector development using macroeconomic and sociological tools.

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