

Consultative Group on International Agricultural Research  
Science Forum  
CGIAR Priorities: Science for the Poor

**INCREASING INCOME THROUGH FRUIT AND VEGETABLE  
PRODUCTION OPPORTUNITIES AND CHALLENGES**

**Thomas A Lumpkin<sup>1</sup>**

**Katinka Weinberger**

**Shanna Moore**

December 6, 2005  
Marrakech, Morocco

---

Diversification into horticultural crops is becoming attractive for many poor farmers around the world. Worldwide production of fruit and vegetable crops has grown faster than that of cereal crops, albeit from a much lower base. Between 1960 and 2000, the area under horticultural crops worldwide has more than doubled. China is the most dramatic example of this trend with the area under horticulture increasing more than five fold to about 20% of the arable land area over the last 25 years. Increases in fruit and vegetables traded worldwide have also been dramatic (Table 1)<sup>2</sup> and the total value of horticultural crops traded at present is more than double that of cereal crops, reaching nearly 21% of total value exported from developing countries<sup>3</sup>.

Recently, the FAO and WHO<sup>4</sup>, GFAR<sup>5</sup> and the CGIAR<sup>6</sup> have expressed keen interest in horticulture for reducing health inequality and improving poverty alleviation, and research on high value crops and products has been identified as a system priority by the

---

<sup>1</sup> Director General AVRDC – the World Vegetable Center, P.O. 42 Shanhua, Tainan, 741 TAIWAN, website: [www.avrdc.org](http://www.avrdc.org). tel: 886-6-583-7801 ext. 100, cell: 886-963-11-7076, email: [lumpkin@avrdc.org](mailto:lumpkin@avrdc.org)

<sup>2</sup> Source: FAO (Food and Agriculture Organization of the United Nations) 2004. FAOSTAT data accessed November 2004, <<http://www.fao.org>>

<sup>3</sup> Weinberger, K., and T. A. Lumpkin. 2005. Horticulture for Poverty Alleviation: The Unfunded Revolution. Working Paper No. 15. Shanhua: AVRDC - The World Vegetable Center.

<sup>4</sup> [http://www.who.int/hpr/NPH/fruit\\_and\\_vegetables/fruit\\_vegetables\\_fs.pdf](http://www.who.int/hpr/NPH/fruit_and_vegetables/fruit_vegetables_fs.pdf)

<sup>5</sup> <http://www.egfar.org/knowledge/spotlights/spotlight-38.shtml>

<sup>6</sup> <http://www.sciencecouncil.cgiar.org/publications/pdf/screpmay05.pdf>

CGIAR Science Council<sup>7</sup>. Still, investment into horticultural research and development remains woefully inadequate<sup>8</sup>. Some international agricultural research centers do address horticultural research, such as AVRDC – The World Vegetable Center, CIAT, CIP, ICARDA, ICRAF, ICRISAT, IITA, IFPRI and IPGRI, however their funding for this activity is quite small.

There are several reasons for the global increase in production and trade of fruit and vegetable crops. Horticultural production is profitable. Farmers involved in horticultural production usually earn much higher farm incomes as compared to cereal producers, and per capita farm income (Table 2) has been reported to be up to five times higher<sup>9</sup>. Cultivation of fruits and vegetables allows for productive employment where the labor/ land ratio is high, since horticultural production is usually labor intensive (Table 3). Depending on the crop, production of horticulture crops requires at least twice the labor, and up to five times the labor days per ha as compared to cereal crops<sup>10</sup>. Increasing horticultural production contributes to commercialization of the rural economy and creates many off-farm jobs.

Although the production of fruits and vegetables has increased continuously on a global scale, much of this growth has been concentrated in Latin America and China. Area expansion has been largest in China, but farmers in other regions of the world have also found it profitable to expand production of horticultural produce at the expense of the cereal area. However, in general, for fruits and vegetables the expansion of area has been larger than yield increases, in contrast to cereals, where growth in yields has usually been larger than area expansion<sup>11</sup>. This increase in produce area is due both to increasing domestic and international demand. However, the miniscule or negative response in yields of horticultural produce indicates a need for research investment.

Horticulture crops, in general, are more knowledge and capital intensive than staple crops. Expanding the scale of horticultural production is often complicated by substantial problems. These can include lack of market access, market information, and many biological factors; specifically yield limits, losses to abiotic stress and lack of quality-post-harvest processing and storage. These issues along with impact on poverty and human nutrition must become priorities for funding and basic research on an international level.

---

<sup>7</sup> CGIAR (Consultative Group on International Agricultural Research). 2003. 2003 CGIAR annual report. Washington D.C.: CGIAR.

<sup>8</sup> Weinberger, K., and T. A. Lumpkin, op.cit.

<sup>9</sup> Ibidem.

<sup>10</sup> Ibid.

<sup>11</sup> Ibid.

**Table 1. Share of horticulture in all agricultural export value**

	Developed countries (%)	Developing countries (%)
1970	12.8	12.2
1980	10.9	13.0
1990	13.8	20.5
2000	14.6	20.7

Source: FAO, 2004

**Table 2. Difference in net farm income: Horticultural vs. non-horticultural smallholder farms**

Country	Difference in farm income (%)
Kenya	497
Bangladesh	29
Cambodia	117
Lao PDR	380
South Vietnam	189
North Vietnam	20

Source: Weinberger and Lumpkin, 2005

**Table 3. Average number of labor days per ha for production of cereals and vegetables in Asia**

	Cereals	Vegetables
Cambodia	81	437
Laos	101	227
South Vietnam	111	297
North Vietnam	216	468
Philippines	93	185
Bangladesh	133	338
India	80	124

Source: Weinberger and Lumpkin, 2005



In Bangladesh, this landless farming family has begun purchasing land from income derived from vegetable production.

The current status of the major topics hindering the increased production and distribution of fruit and vegetable crops has been elucidated by a USAID funded Global Horticulture Assessment (GHA)<sup>12</sup> conducted by University of California – Davis and AVRDC – The World Vegetable Center with assistance of Michigan State University, Purdue University, and University of Hawaii<sup>13</sup>. This assessment identified eight significant categories/issues that constrain horticultural development or represent major social considerations. These eight are described below, occasionally with text directly from the report.

### **1. Market systems**

Demand for horticultural produce is rising, both in domestic and international markets. This market is changing rapidly, partially fueled by the spread of supermarkets<sup>14</sup>. In

<sup>12</sup> GHA (Global Horticulture Assessment). 2005. International Programs Office, University of California, Davis, CA, USA.

<sup>13</sup> <http://caes.ucdavis.edu/IntProg/GHAPublication2005Web.pdf>

<sup>14</sup> Reardon, T., and C. B. Barrett. 2000. "Agroindustrialization, globalization, and international development: An overview of issues, patterns, and determinants". *Agricultural Economics* 23: 195-205.

developed countries, a desire for year-round availability and increased diversity of foods, as well as a growing awareness of the relationship between diet and health, all contribute to the increased consumption of these commodities. Many consumers today purchase a broad range of relatively expensive commodities such as off-season produce, exotic fruits and vegetables, and organic produce. Increasing participation of women in the labor market of developed economies has created demand for processed, ready-to-eat convenience products. Developing countries are taking advantage of this trend, and over the past decade the increase of their processed food exports has exceeded that from the developed regions (Table 4). Many work tasks, such as chopping, washing, labeling, and bar coding, are being transferred to developing countries and are generating new jobs, especially for women.

**Table 4. Growth rates of processed food exports**

	<b>1975-1985 (%)</b>	<b>1985-1995 (%)</b>
Developed countries	6.6	9.6
Developing countries	2.8	9.9
Global	5.3	9.4

Source: Rae and Josling, 2003



Women in an Egyptian processing company packaging snow peas for export to Western Europe

But negative consequences of increasing trade have also been reported. Supermarkets increasingly influence the structure of the agri-food system and dictate the conditions for small farms and firms to sell agri-food products<sup>15</sup>. Quality and reliability demands of supermarkets often act as barriers to participation in the trade chain by small-scale producers and exporters. The participation of small-scale producers in global fruit and vegetable trade is also affected by the increasing attention that food quality and safety are receiving in food trade, coupled with an expansion in the number of non-tariff measures that developed countries apply to agricultural products. To ensure that small-scale and resource-poor farmers stand a chance to participate in these expanding markets, policy makers and researchers must place greater attention toward the needs of poor small landholders and tenant farmers.

Small producers frequently lack the resources and the skills to access and interpret market information, and adequate financial, human or social capital to develop the linkages to succeed in the market. To assist poor producers to gain access to local, regional and export markets, the GHA has proposed to help: poor producers to appreciate and access market information, phytosanitary regulations and quality standards; facilitate exchange of information between all elements of the value chain; create and/or support producer organizations; support investment in market infrastructure including modern designs for traditional markets, cold storage and traffic access.

## **2. Postharvest systems and food safety**

Horticultural production, particularly in hot-wet tropical environments is severely constrained by post-harvest losses, reducing profits to farmers and processors. Horticultural crops are often highly perishable, restricting the ability of producers to store them to cope with price fluctuations. Postharvest losses of vegetables vary greatly among commodities, production areas and seasons, however it is estimated that between 20 to 50% of crops are lost in the varied steps from farmer to consumer<sup>16</sup>. A study in Brazil found that an average of 200g/capita/day were lost in fruit and vegetables between harvest and consumption<sup>17</sup>. Reducing post-harvest losses would make diversification into vegetable production less risky and more attractive for small-scale farmers.

Minimizing post-harvest losses requires the coordination of multiple factors, with each factor encompassing complicated and often costly options. Areas such as handling, packing, storage and transport can require costly equipment and extensive research into areas like controlled atmosphere storage and quality assessment<sup>18</sup>. Additional fac-

---

<sup>15</sup> Reardon, T., C. P. Timmer, C. B. Barrett, and J. Berdegue. 2003 "The rise of supermarkets in Africa, Asia, and Latin America". *American Journal of Agricultural Economics* 85 (5): 1140-1146.

<sup>16</sup> Kader, A. 2003 A Perspective on Postharvest Horticulture (1978–2003). *HortScience* 38 (5): 1004-1008.

<sup>17</sup> Fehr, M., and D. C. Romao. 2001. Measurement of Fruit and Vegetable Losses in Brazil: A Case Study. *Environment, Development and Sustainability* 3 (3): 253-263.

<sup>18</sup> Flores, R.A. and K.L.B. Gast. 1997. Postharvest management of commercial horticulture crops: storage options –fruits and vegetables. Kansas State University Agricultural Experiment Station and Cooperative Extension Service MF1030: 1-6.

Bachman J. and R. Earles. 2000. Postharvest handling of fruits and vegetables. Appropriate Technology Transfer for Rural Areas. Horticulture Technical Note. United States Department of Agriculture 1-12.

tors affecting post-harvest losses include the physiology, biochemistry and genetics of ripening and senescence, breeding for post harvest vigor and pest resistance, the effects of pesticide residues and the presence of mycotoxins.

For any product, domestic markets often have different post-harvest selection and processing needs compared to export markets. Diverse standards and traceability requirements create obstacles for small farmers and businesses to expand into regional and global markets. Smaller producers and firms often lack access to critical postharvest knowledge, technology and infrastructure. Therefore, development efforts in the post-harvest sector which will favor the poor must include appropriate pre- and post-harvest processing technologies, as well as developing and improving market information systems that include information on prices, seasonality, handling constraints, and emerging technologies that are relevant to their capacity. Small-scale farmers and marketers need to be trained, organized and supported to meet the challenges of supplying both domestic and international markets.



A vegetable consolidator in Lao PDR transporting vegetables by tuk-tuk from remote farmers to the central market in Vientiane.

### ***3. Genetic resources conservation and development***

A major limitation to fruit and vegetable production in many developing countries is the lack of access to good quality open-pollinated or hybrid seeds of exotic and indigenous varieties. The public sector in developing countries frequently has shrinking, deficient or no capacity to supply adequate quantities of good quality seed. Farmers themselves often produce seeds of locally preferred or indigenous varieties, as individual markets are too small to attract the interest of large commercial companies. Without proper seed production, processing technology, quality assurance, and management supervision, seeds are often contaminated by seed-transmitted pests and diseases, low yielding and genetically diverse. The lack of proper storage facilities often leads to low or uncertain seed viability and vigor. Moreover, low capital resources and poor market information discourage development of seed-related agribusiness. Development of traditional (or indigenous) fruits and vegetables has only been marginally supported by policy makers and researchers, yet many developing countries have rich endemic horticultural diversity for possible economic exploitation. Production of indigenous horticultural crops often takes place under low-input conditions and yet contribute substantially to household food and livelihood security, particularly for

resource-poor farmers<sup>19</sup>. Exploitation of this rich diversity requires investment in collection, characterization, and conservation of both the varieties and the knowledge for their production and use.

Knowledge on constraints in the horticultural seed production and distribution chain remains limited in many countries, making it difficult to enter into target-oriented promotion of the vegetable and fruit seed and seedling sector. A solid understanding of the issues within the fruit and vegetable seed sector, both private and public are necessary in order to identify constraints that this sector faces and to formulate a strategy for its sustainable development.

#### **4. Sustainable production systems and natural resources management**

Commercial production of horticultural crops often is associated with large applications of agricultural chemicals and water, sometimes resulting in severe environmental impacts. Poor farmers usually lack access to inputs or knowledge for their safe use. Fruits and vegetables together account for the major share of the global pesticide market, and commercial farmers have been reported to apply pesticides every few days, often just before harvesting, and many of the pesticides are unapproved for these crops<sup>20</sup>. Safe and locally adapted sustainable production systems targeted for poor farmers must be developed and extended to farmers, including information on how to produce and supply products for both regional and international markets that meet price, quality and safety standards. Other topics needing support related to this issue include: drip irrigation, protected production systems, fertility management, IPM and components of organic systems.

#### **5. Capacity building**

As stated in the GHA *“Horticulture is perhaps the most knowledge intensive and dynamic agricultural system. Short-term growth and long-term viability are critically dependent on access to technical knowledge, the ability to adapt that knowledge to local conditions and the flexibility to develop new production systems as market conditions change.”* Yet, in the face of this need, public institutions for capacity building in horticultural sciences and even donor support for capacity building, in general, are shrinking in both developing and developed countries. Weak support and demand driven market conditions in the current era dictate the need for strong Public-Private Partnerships and renewed donor support to

---

<sup>19</sup> Cavendish, W. 2000. Empirical regularities in the poverty-environment relationship of poor households: Evidence from Zimbabwe. *World Development* 28:1979–2003.

Naylor, R.L., W.P. Falcon, R.M. Goodman, M.M. Jahn, T. Sengooba, H. Tefera, and R.J. Nelson. 2004. Biotechnology in the developing world: a case for increased investments in orphan crops. *Food Policy* 29: 15-44.

Weinberger, K. and J. Msuya. 2004. Indigenous vegetables in Tanzania: significance and prospects. Technical Bulletin No. 31. Shanhua: AVRDC. – The World Vegetable Center.

<sup>20</sup> Alam, S. N., M. A. Rashid, F. M. A. Rouf, R. C. Jhala, J. R. Patel, S. Satpathy, T. M. Shivalingaswamy, S. Rai, I. Wahundeniya, A. Cork, C. Ammanaram, and N. Talekar. 2003. Development of an Integrated Pest Management Strategy for Eggplant Fruit and Shoot Borer in South Asia. Technical Bulletin No. 28. Shanhua: AVRDC.

Dinham, B. 2003. Growing vegetables in developing countries for local urban populations and export markets: Problems confronting small-scale producers. *Pest Management Science* 59 (5): 575 - 582.

address capacity building needs for the requirements of regional and global markets<sup>21</sup>. Modern communication and information technologies such as internet, voice over internet, teleconferencing and cell phone text messaging can bring global access for capacity building, linking organizations such as the International Society of Horticulture Science and advanced research institutes with developing country extension systems, NGOs and benevolent commercial enterprise projects such as the Tanzanian Vegetable Seed Program. *“Enhancement of capacity at all levels and along all stages in the value chain, from production to postharvest and marketing, is critical to the creation of a dynamic and sustainable horticultural industry.”* (GHA)

## **6. Enabling environment**

Capital and risk constraints are additional key factors that limit the adoption of high-value crops by small farmers because these crops generally are much more costly to produce per hectare than traditional crops, and most growers require credit to finance their production. Horticultural crops tend to be riskier than staple crops, since the higher production costs, market volatility and perishability impose a greater income risk. Enabling environments, defined as the set of interrelated economic, social and political elements, reduces the risk associated with production of horticultural crops. For example, improving market information systems for horticultural crops, secure land tenure and credit markets are essential components of a strategy that seeks to develop horticultural systems. But horticulture also requires sound legislative and policy frameworks. Examples of important policy considerations include regulatory systems for horticultural standards, and postharvest and food safety protocols. *“Significant research will be required to determine the effects of intellectual property rights on production choices; the consequences of trade liberalization and market aggregation for small producers and households; credit markets; and operation of up-to-date phytosanitary monitoring systems.”* (GHA)

## **7. Gender equity**

Often poor and landless women have been able to capitalize on new labor market opportunities associated with production or processing of high value horticultural products<sup>22</sup>. Working women are often the major beneficiaries of the convenience associated with processed horticultural products. In Africa and Latin America, high-value crop exports are female intensive industries, with women dominating most aspects of production and processing. In Chile, Ecuador, Guatemala, Kenya, Mexico, South Africa, and Zimbabwe, evidence suggests that women occupy at least 50% or more of the employment in these industries<sup>23</sup>. Similarly, in nearly all developing countries, women dominate the marketing of horticultural crops and products in traditional markets. To capitalize on the unique opportunities to bring financial and nutritional benefits of horticulture to women, gender-based donor support should help women access educa-

---

<sup>21</sup> <http://www.ifpri.org/events/conferences/2005/ppp/ppptopics.asp>

<sup>22</sup> McCulloch, N. and M. Ota. 2002. Export horticulture and poverty in Kenya.” IDS Working Paper 174. Brighton, Sussex: Institute of Development Studies.

<sup>23</sup> Dolan, C.S. and K. Sorby. 2003. Gender and employment in high-value agriculture industries. Agriculture and Rural Development Working Paper No. 7. Washington D.C.: World Bank.



tional opportunities and technical information and should “*consider women’s roles and needs in culturally-specific food systems, emphasize research on women’s participation in small-scale production for export; include comparative research on gendered dimensions of horticultural production across regions and market levels; and document women’s particular constraints and opportunities in the horticultural sector*” (GHA)



Women dominate sales of vegetables in most traditional markets in the developing world.

## **8. Nutrition and human health**

All people in the world should have access to a nutritionally balanced and diverse diet, enjoying an equal opportunity for a long and healthy life. WHO/FAO recommends an intake of at least 400g per day but consumption ranges from less than 100g/day in less developed countries to about 450g/day in European developed countries. Low levels of fruit and vegetable consumption in some parts of the world have devastating health effects. It is estimated that insufficient fruit and vegetable intake, and the micronutrient deficiencies that often result from such shortages, cause some 2.7 million deaths each year, making it one of the top ten risk factors contributing to mortality<sup>24</sup>.

Iron and pro-vitamin A deficiencies are two of the top three micronutrient deficiencies noted worldwide, responsible for serious health problems (e.g. anemia, night blindness). WHO estimates that 52% of pregnant women and 39% of pre-school aged children are iron deficient<sup>25</sup>. Additionally 4.4 million pre-school aged children worldwide have visible eye damage due to insufficient Vitamin A, with over 250,000 going blind every year and two-thirds dying within months of losing their sight.

The diverse array of micronutrients offered by horticultural products is an answer to these deficiencies. For example, indigenous vegetables constitute an important source of micronutrients, contributing between 30% and 50% of iron and vitamin A consumed, respectively, in poor households<sup>26</sup>, <sup>27</sup>. Thus, more research is needed to analyze functional properties of fruits and vegetables, particularly those already available in high-

---

<sup>24</sup> Ezzati, M., A. D. Lopez, A. Rodgers, S. V. Hoorn, and C. J. L. Murray. 2002. Selected major risk factors and global and regional burden of disease. *Lancet* 360 (9343): 1347-1360.

<sup>25</sup> WHO (World Health Organization). 2003. Diet, nutrition and the prevention of chronic diseases. Report of a joint FAO/WHO expert consultation. WHO Technical Report Series 916. Geneva: WHO.

<sup>26</sup> Gockowski, J., J. Mbazoo'o, G. Mbah, and T. Moulende. 2003. African traditional leafy vegetables and the urban and peri-urban poor. *Food Policy* 28:221–235.

<sup>27</sup> Weinberger, K. and J. Msuya, op.cit.

risk areas, and to develop new varieties that add value for poor, malnourished populations. Analysis of the nutritional properties of select indigenous and traditional crops and varieties is especially important for delivering benefit to the poor. The bioavailability of specific nutrients from mineral rich foods can help to determine which crops should be promoted and marketed for their health benefits in zones of known micronutrient deficiencies.

## **Conclusions**

Horticultural produce and processed products are enjoying increasing domestic and international demand. The expansion of markets and the liberalization of trade policies are providing new opportunities for rural people to escape poverty through production and exchange of non-staple crops. However, much more focused effort needs to be undertaken to bring resource-poor farmers and landless labors into this development.

Today, 1.1 billion people continue to live in extreme poverty on less than US\$1 a day. Another 1.6 billion live on between US\$1–2 per day. Opportunities in horticulture and food industries must increase, especially for women, to enable their escape from poverty and live long, healthy lives. However, growth in the horticulture sector does not always favor the poor. Most growth and development in the horticultural sector which presents opportunities for small farmers and rural economies occurs in local and regional markets. The rapidly changing dynamics and criteria of global horticultural markets often act as barriers to their participation in the global value chain.

The research agenda for agriculture must be broadened and more emphasis must be put on the growing importance of the fruit and vegetable sector and how these crops can contribute to poverty alleviation, economic development and human health. Such investments will allow a significant portion of the world's poor nations, farmers and landless laborers to gain from horticulture and propel societies toward healthier and more diverse diets. Part of this investment should be directed toward a coordinating program, such as the suggested Global Horticulture Initiative. This initiative can bring focused efficiency and synergy to horticultural research and development, especially toward **collective action** in areas such as molecular genetics/genomics, biodiversity, safe production practices, value chains, enabling environment and targeted nutrition programs.