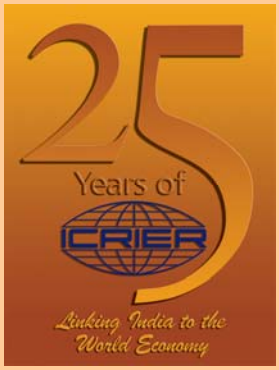

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CAN HORTICULTURE BE A SUCCESS STORY FOR INDIA?

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INDIAN COUNCIL FOR RESEARCH ON INTERNATIONAL ECONOMIC RELATIONS

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Abbreviations and Acronyms

APEDA	Agricultural and Processed Food Products Export Development Authority
APMC	Agricultural Produce Marketing Committee Act
AEZ	Agricultural Economic Zones
CA	Controlled Atmosphere
CACP	Commission for Agricultural Costs and Prices
CBR	Cost-Benefit Ratio
CIF	Cost, Insurance and Freight
CMIE	Centre for Monitoring Indian Economy
EU	European Union
EUREPGAP	European Retailers Parties Good Agricultural Practices
FAO	Food and Agriculture Organization
FOB	Free on Board
FPEAK	Fresh Produce Exporters Association of Kenya
GAP	Good Agricultural Practice
GDP	Gross Domestic Product
Ha	Hectare
HOPCOMS	Horticultural Produce Cooperative Marketing Societies
HS	Harmonized System
ICM	Integrated Crop Management
IFPRI	International Food Policy Research Institute
IPM	Integrated Pest Management
IT	Information Technology
ITC	Indian Tobacco Company
KARI	Kenya Agricultural Research Institute
KVIC	Khadi and Village Industries Commission
NDDB	National Dairy Development Board
NGO	Non-Governmental Organization
NHB	National Horticulture Board
NPC	Nominal Protection Coefficient
NSS	National Sample Survey
NSSO	National Sample Survey Organization
PC TAS	Personal Computer Trade Analysis System
QMS	Quality Management System
Qtl	Quintal
R&D	Research & Development
RCA	Revealed Comparative Advantage
T	Tonne
UAE	United Arab Emirates
UK	United Kingdom
UNSD	United Nations Statistics Division
USA	United States of America
USDA	United States Department of Agriculture
Veg.	Vegetables
WTO	World Trade Organization

Foreword

The ongoing liberalization and the emergence of an integrated global market have opened new vistas for the Indian horticulture. In fact, the country's main policy focus until recently was only on grains and cereals, but it has changed in recent times with the launch of the National Horticulture Mission, 2005-06. This will enable India to exploit its true potential.

However, several factors like low crop productivity, limited irrigation facilities and underdeveloped infrastructure facilities like cold storages, markets, roads and transportation, are stumbling blocks which prevent the horticulture potential from being fully exploited.

This paper advocates for improving the facilities in the horticulture sector so that the impact could be felt after its true potential is exploited and the new practices of distribution and management needs are introduced. The supply chain management needs to be strengthened in collaboration with various stakeholders. These measures will be successful only if necessary reforms are implemented to integrate the domestic market both vertically and horizontally and provide farmers with the freedom to sell their produce wherever it's more profitable for them. I am sure the paper, which breaks new ground in the horticulture sector, will be of interest to a wider audience.

Rajiv Kumar
Director and Chief Executive

August 6, 2007

Abstract

India is the second largest producer of fruits and vegetables in the world after China. Since the 1980s, the international trade in fruits and vegetables has expanded rapidly. The number of commodities as well as the number of varieties produced and traded have increased manifold during the past 25 years. There is an overall increase in the demand for fruits and vegetables for consumption both in the fresh and the processed form. Also there is a wide diversification in production pattern globally. Income in this sector is increasing which is indeed driving the supply. In spite of being one of the largest producers of fruits and vegetables in the world, the export competitiveness among the Indian producers remains low. But with new marketing initiatives, the post-harvest losses and the wastage due to poor infrastructure facilities, such as storage and transportation, have been reduced to a considerable extent. Yet a lot needs to be done in this sector. In an effort to overcome some of the problems associated with this sector, the case study of the successful SAFAL Market is presented in the paper.

The study has observed a shift in cropping pattern in favour of horticulture in India in the past one-and-a-half decades. Analysis of the economic feasibility of this shift away from cereals to fruits and vegetable shows that it's economically viable and beneficial to shift towards horticulture production, but this diversification needs to be planned in a systematic manner. Certain strategies and policies are also suggested in this regards. The study confirms the changing consumption patterns and diversification, along with the outlook for the next 15-20 years in the light of shortage of supply to increased domestic demand. The major exports from India are mango, grapes, orange, apple, banana, mosambi, onion, potato, tomato and pumpkins. The major share of India's exports of fresh fruits and vegetables go to Bangladesh, Nepal, UAE, UK and Malaysia.

The supply constraints, yield gaps and huge logistic costs affect our competitive and comparative advantage in world trade market. In this study the nominal protection coefficient and revealed comparative advantage are computed to check on the existing status. Study also identifies the potential states for the fruits and vegetables, for which India is globally competitive and has comparative advantage in production. These states should be targeted for enhancing the export potential of the country. The potential competing countries are also identified. Lessons from other developing countries focus on the growth of the horticulture sector through increased participation of small and marginal farmers in an organized manner and farmers being trained with entrepreneurial skills.

Key words: *Horticulture, Cost Benefit Ratio, Competitiveness, Comparative Advantage, SAFAL Market*

JEL Classification: *Q13, Q17*

1 Introduction[1]

Since independence, India has made tremendous progress with respect to food and the overall livelihood security. India has emerged as one of the leading producers of rice, wheat, pulses, fruits, vegetables, milk and other commodities. The country's population has almost tripled in the last five decades and its foodgrain production has more than quadrupled, significantly enhancing the per capita foodgrain availability. On the other hand, the share of agriculture in GDP has declined substantially from 55 per cent in the early 1950s to about 42 per cent in the 1980s and further to 19 per cent in 2006 (Economic Survey, 2006-07). However, there is only a marginal decline in the number of people resident in rural area, but not all of them are engaged in agriculture on a full-time basis.

Recognizing that the Indian economy is agriculture-oriented, some perceptible changes during last three-and-a-half decades have impacted the agricultural growth and the overall development patterns of the economy. The size of operational holdings in India has declined from 2.28 ha (hectares) in 1971 to 1.57 ha in 1991 to 1.41 ha in 1995-96 and some estimates say it has further declined to 1.22 ha in recent years, which has an impact on crop productivity. Future increase in agricultural growth has to be essentially achieved through increase in yields. Cereal yields have gone down and at the same time consumer preferences have shifted away from cereals and moved towards high-value agricultural produce. Higher incomes and urbanization in India, changing lifestyles, international market integration and trade liberalization are expected to increase the demand for horticultural products even further. On the production side, if cereal pricing is left to market forces, land will be released from rice and wheat cultivation to meet the growing demand for non-cereal crops such as oilseeds, fruits and vegetables in accordance with the diversification in consumption pattern (Mittal, 2006). Thus, in a holistic way, horticulture can be promoted as a means of agro-diversification for the second Green Revolution, providing the much needed impetus to the growth of agricultural sector, through increase in trade, income and employment. Indian agriculture is diversifying into the production of high value commodities, also providing an increasing role to small holding farmers. Indian rural economy had been facing the challenge of inability to manage the problems involved with transition of agriculture from a supply-driven value chain to a demand-led market-oriented supply chain (Viswanadham, 2006).

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1.1 Background to Horticultural Development in India

Horticultural development had not been a priority in India until recent years. In the period 1948-80, the main focus of the country was on cereals. Much planned efforts had not been made for horticultural development, except for some technical support and development efforts for specific commodities like spices, coconut and potato. During 1980-92 there was consolidation of institutional support and a planned process for the development of horticulture. It was in the post-1993 period that a focused attention was given to horticulture development through an enhancement of plan allocation and knowledge-based technology. Despite of this decade being called a "golden revolution" in horticultural production, the productivity of horticultural crops has increased only marginally from 7.5 tonnes per hectare in 1991-92 to 8.4 tonnes per hectare in 2004-05 (NHB, 2005). Then the National Horticulture Mission was launched in 2005-06 by the Government of India with a mandate to promote integrated development in horticulture, to help in coordinating, stimulating and sustaining the production and processing of fruits and vegetables and to establish a sound infrastructure in the field of production, processing and marketing with a focus on post-harvest management to reduce losses.

In 2005 the total area under fruits and vegetables was 11.72 million hectares and the aggregate production stood at 150.73 million tonnes (NHB, 2005). As a result of this huge spurt in horticulture produce, India has become the second largest producer of fruits and vegetables in the world, next only to China. The annual area and production growth under fruits and vegetables in the period 1991-2005 in India was 2.6 per cent and 3.6 per cent respectively. This growth is quite significant compared to the decline in area under cereals and cereal production which is growing at the rate of 1.4 per cent per annum only in the last one-and-a-half decades. The share of fruits and vegetables in the total value of agricultural exports has increased over the years from 9.5 per cent in 1980-81 to 16.5 per cent in 2002-03. But India is still lagging behind in actual exports of these produce. For example, India produces 65 per cent and 11 per cent of world's mango and banana, respectively, ranking first in the production of both the crops. Yet India's exports of the two crops are nearly negligible of the total agricultural exports from India.

The Indian horticulture sector is facing severe constrains such as low crop productivity, limited irrigation facilities and underdeveloped infrastructure support like cold storages, markets, roads, transportation facilities, etc. There are heavy post-harvest and handling losses, resulting in low productivity per unit area and high cost of production. However, on the other hand, India's long growing-season, diverse soil and climatic conditions comprising several agro-ecological regions provide ample opportunity to grow a variety of horticulture crops. Thus, efforts are needed in the direction to capitalize on our strengths and remove constrains to meet the goal of moving towards a formidable horticultural growth in India. The foreign trade policy in 2004-09 emphasized the need to boost agricultural exports, growth and promotion of exports of horticultural products. Horticulture contributes nearly 28 per cent of GDP in agriculture and 54 per cent of export share in agriculture.

1.2 Objective of the Study

The National Horticulture Mission has been launched in April 2005 as a centrally-sponsored scheme to promote holistic growth of the horticulture sector through an area-based regionally differentiated strategies. The scheme is fully funded by the Government and different components proposed for implementation financially supported on the scales laid down. The mission has the following objectives:

- To increase qualitative and quantitative production and productivity of area-specific crops as per the market demand and agro-climatic conditions in compact areas.
- To establish convergence and synergy among various ongoing and planned government programmes in the field of horticulture development.
- To achieve horizontal and vertical integration of programmes by establishing forward and backward linkages.
- To ensure adequate, appropriate, timely and concurrent attention to all links in production, post-production, processing and consumption chain.
- To maximize economic, ecological and social benefits from the existing investments and infrastructure created for horticulture development in the state.
- To promote ecologically sustainable intensification, economically desirable diversification and skilled employment for rural youth, including farm women.
- To promote the development and dissemination of technologies based on the blending of traditional wisdom and new technologies.

To achieve these objectives, the mission would adopt the following strategies:

1. Ensure an end-to-end holistic approach covering production, post-harvest management, processing and marketing to assure appropriate returns to growers/producers.
2. Promote R&D technologies for production, post-harvest management and processing.
3. Enhance acreage, coverage and productivity through:

    - Diversification, from traditional crops to plantations, orchards, vineyards, flower and vegetable gardens.
    - Extension of appropriate technology to the farmers for high-tech horticulture cultivation and precision farming

4. Assist setting up post-harvest facilities such as pack house, ripening chamber, cold storages, Controlled Atmosphere (CA) storages, etc., processing units for value-addition and marketing infrastructure.
5. Adopt a coordinated approach and promotion of partnership, convergence and synergy among R&D, processing and marketing agencies in public as well as private sectors, at the national, regional, state and sub-state levels.
6. Where appropriate and feasible, promote the National Dairy Development Board (NDDB) model of cooperatives to ensure support and adequate returns to farmers.
7. Promote capacity-building and human resource development at all levels.

In this pretext the study tries to see how much achievable are these objectives and thus analyze if it's feasible to focus on horticulture as the source of growth for agriculture sector and whether horticulture can be the source of much aspired second Green Revolution in India. The main objective is to examine the economic feasibility of diversifying into horticultural crops and analyze if India can become more integrated into the global agro trade by exporting high value horticultural products. After the introduction in Section 1, Section 2 of the study analyzes the pattern of shift in cropping structure, present trends in horticulture production and exports in India. In Section 3 the cost-benefit analysis is done and comparison of commodities from foodgrain and horticulture group are presented to evaluate the feasibility of diversification. Section 4 discusses the domestic demand, supply and constraints. The SAFAL market case study is also presented. Competitiveness of horticultural products is analyzed in Section 5 of the study by computing the nominal protection coefficient, and revealed comparative advantage. India's competitors in global trade of horticultural commodities are identified. In Section 6 of the study, other countries' experiences are presented. Section 7 discusses the conclusion of the study along with policy recommendations for making this sector successful in India. For the purpose of this study horticulture refers to only fresh fruits and vegetables. The study focuses broadly on fruits and vegetables and in most cases the analysis results are presented for major fresh fruits and vegetables. Data is used from 1990-91 to 2004-05 which is the latest available for most of the information used in the study.

1.3 Data

Data on area, production and yield is taken from various report of the Indian Horticulture Database, published by the National Horticulture Board (NHB); Area, Production and Yield of Principal Crops in India, the Directorate of Economics and Statistics, the Ministry of Agriculture, for the national level data. FAO statistics website by the Food and Agricultural Organization is used for the international data on area, production and yield. Agricultural Statistics at a Glance' of the years 2002, 2003, 2004 is used to fill in the gaps and for cross-checking the data. Most of the data of India for years 1991 to 2004 is taken from NHB and matched with 1989 and 1999 data from FAO stats. Cost of cultivation data for cereals is taken from the Reports of the Commission for Agricultural Costs and Prices, for crops sown during 2002-03, 2003-04 and 2004-05 seasons. The Wholesale Prices and Arrivals information is referred from report of the Indian Horticulture Database (2005), published by NHB, and publication of the Directorate of Economics and Statistics on prices. Crop-wise monthly data on wholesale prices and arrivals at Delhi, Kolkata, Mumbai and Chennai markets, for years 2004 and 2005, are from NHB. Export and import data on quantity and value are obtained from "India Trades" database of CMIE, PC TAS HS data based on THE UNSD COMTRADE Database System and APEDA. The HS codes of fruits and vegetables used during the study are presented in Appendix Table A1.

2 Past Trends in Area, Production and Exports

2.1 Cropping Pattern Change in India

Agricultural diversification is an important instrument for economic growth. Diversification largely depends upon the opportunities and responsiveness of farmers to technological breakthrough, consumer demand, government policy, trade arrangements and development of irrigation, roads and other infrastructure (Kumar and Mittal, 2003). Changes in cropping patterns are responsive to these factors. The aggregate cropping patterns of the country is represented by the gross cropped area allocation among different crops and commodity groups. India has experienced a considerable degree of crop diversification in term of changes in the area under various crops since the Green Revolution which was largely in favour of foodgrains to meet the objective of self-sufficiency and country's food security. In past one decade, the changes in cropping pattern is more towards the horticulture sector and commercial crops like cotton. Table 1

Table 1: Change in cropping pattern in India, 1990-2004

(Unit: 000' hectares)

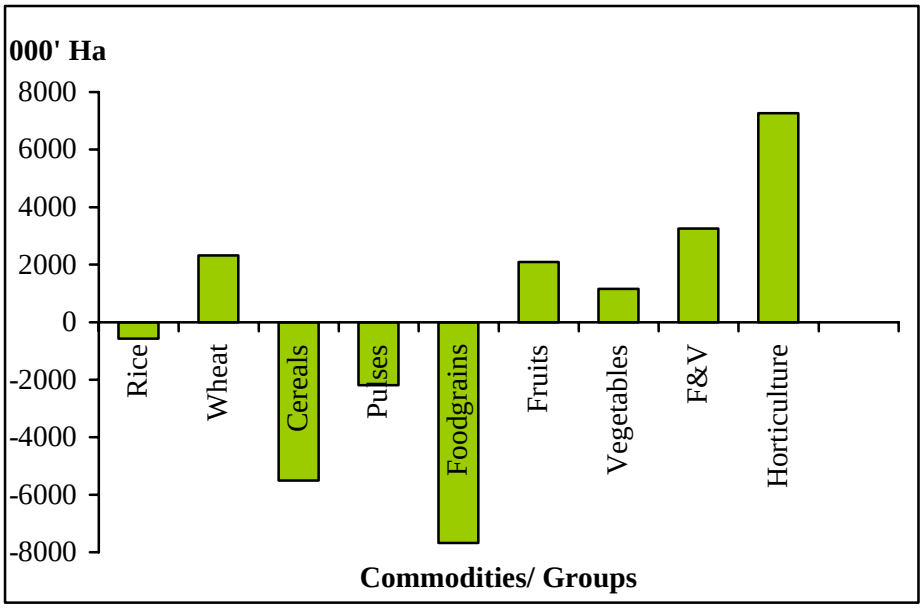
Commodities	1990-95	1995-2000	2000-04	1990-2004
Rice	150.1	1873.3	-2590.0	-566.6
Wheat	843.9	719.0	760.0	2322.9
Coarse Cereals	-5365.4	11.1	-300.0	-5654.3
Cereals	-4500.0	2000.0	-3000.0	-5500.0
Pulses	-2380.0	-1930.0	2120.0	-2190.0
Foodgrains	-6830.0	40.0	-890.0	-7680.0
Oilseeds	1810.0	-3190.0	4230.0	2850.0
Cotton	1595.3	-505.3	390.0	1480.0
Jute and Mesta	-90.0	90.0	-120.0	-120.0
Sugarcane	461.4	172.6	-680.0	-46.0
Fruits	483.0	512.0	1095.0	2090.0
Vegetables	-258.0	915.0	506.0	1163.0
Fruits and Vegetables	225.0	1427.0	1601.0	3253.0
Horticulture	900.0	1856.0	4514.0	7270.0

presents the change in cropping pattern between 1990 and 2004. The changes are presented between the sub-periods 1990-95, 1995-2000 and 2000-04.

The shift in area away from foodgrains -- rice, coarse cereals and pulses is evident from the table. The area under rice has shown an increase till 2000 and after that the area has declined by 2,590 thousand hectares. The area under coarse cereals has declined tremendously in 1990-95 and further in 2000-04. Area under pulses has also seen a decline till 2000 which later revised due to shortfall of pulses and also implementation of the mission to revise the pulse sector. But overall the foodgrain sector had experienced a decline in area of about 7,680 thousand hectares in last one-and-a-half decades. This shift in area from foodgrains is towards the oilseeds, cotton, fruits and vegetables.

The change in cropping pattern from foodgrains to horticulture is illustrated in Figure 1. The overall magnitude of decline in area under foodgrain (-7,680 thousand hectares) is very close to the magnitude of increase in area under horticulture[2] (7,270 thousand hectares) in the period 1990-2004.

Figure 1: Change in cropping pattern, 1990-2004



Within the horticulture sector, the change in area under cultivation for different groups is presented in Table 2. In total area spices have seen a maximum area shifting under them from the conventional cropping. The gain of area under spices has been 3,150 thousand hectares, the maximum change seen is after 2000. The gain in area under spices is 43.3 per cent of the total area gain under horticulture. The total area gain for plantation has been 11.06 per cent with only 0.87 per cent area gain under flowers. The total area shift under fruits and vegetables is 44.75 per cent which is almost equivalent to the spices area gain. Vegetables have seen a small decline in area under it in 1990-95, which later recovered.

Table 2: Change in area under horticulture groups in India, 1990-2004

(Unit: 000' hectares)

Commodities	1990-95	1995-2000	2000-04	1990-2004	% change in area
Fruits	483	512	1095	2090	28.75
Vegetables	-258	915	506	1163	16.00
Plantation	435	129	240	804	11.06
Spices	211	284	2655	3150	43.33
Flower	29	16	18	63	0.87
Horticulture	900	1856	4514	7270	100.00

[2] In this context horticulture includes fruits, vegetables, plantation crops, spices and flower.

A significant change for area under vegetables is seen in 1995-2000 with an additional increase in area in 2000-04. The most prominent is the fruits group, which sees an increase of 28.7 per cent in total horticulture area gain. The gain in area in last 4-5 years is equivalent to the change in area in the 1990s. This gain in area under horticulture and mainly under fruits and vegetables is a collective impact of the diversification of production pattern of the producer and the increased demand of consumers due to shift in their consumption pattern (discussed in Section 4.1).

Most important crops in terms of change in area in India

Fruits: Mango, Banana, Lemon/ Lime, Mosambi, Sapota, Orange.

Vegetables: Potato, Brinjal, Onion, Tomato, Okra, Cabbage, Peas.

Table 3 and Table 4 present the change in the area among major fruits and vegetables under the broad groups. In the category of fruits, the major change in area is for mango. The area under it has increased by almost double the changes observed in the last decade. The share of mango in total fruits area change is about 42.3 per cent. The other fruits like banana, lemon, mosambi, sapota, orange and guava have seen 3-5 per cent of change in area of the total fruit area change. In contrast, the area under apples has seen a decline in recent years. Among vegetables, the area under potato has increased by 35 per cent in the last 15 years. Brinjal and onion are the next important ones with an area increase of 28.9 per

Table 3: Change in area under major fruits in India, 1990-2004

(Unit: 000' hectares)

Fruits	1990-95	1995-2000	2000-04	1990-2004	% change in area
Apple	23.5	22.7	-9.1	36.2	1.73
Banana	54.4	36.7	60.0	145.8	6.98
Lime/Lemon	38.0	58.2	3.7	93.9	4.49
Mosambi	11.5	-2.4	113.8	122.9	5.88
Orange	14.7	29.9	19.9	64.5	3.09
Grapes	10.8	9.6	15.0	27.8	1.33
Guava	37.6	16.6	13.8	68.0	3.25
Litchi	-0.7	5.0	6.4	10.7	0.51
Mango	205.5	235.9	442.9	884.3	42.31
Papaya	24.4	9.2	2.8	27.8	1.33
Pineapple	7.6	6.9	3.1	24.1	1.15
Sapota	20.5	24.4	61.0	105.9	5.07
Total Fruits	483.0	512.0	1095.0	2090.0	100.00

Table 4: Change in area under major vegetables in India, 1990-2004

(Unit: 000' hectares)

Vegetables	1990-95	1995-2000	2000-04	1990-2004	% change in area
Brinjal	134.2	38.5	57.6	336.3	28.9
Cabbage	40.1	27.0	44.9	113.0	9.7
Cauliflower	17.2	36.3	-18.1	35.4	3.0
Okra	208.5	-80.1	7.9	136.3	11.7
Onion	72.2	53.4	145.0	262.1	22.5
Peas	77.0	95.3	-42.6	99.0	8.5
Tomato	66.6	104.4	37.5	208.5	17.9
Potato	173.5	102.3	331.0	407.2	35.0
Sweet Potato	-11.9	-26.7	22.5	0.0	0.0
Tapioca	-22.7	25.3	27.8	30.4	2.6
Lettuce	4.2	4.0	0	8.2	0.7
Pumpkins and gourds	27	25	0	52	4.5
Beans	5	2	0	7	0.6
Cassava	-19.2	25.3	-13.5	-7.4	-0.6
Total Vegetables	-258.0	915.0	506.0	1163.0	100.0

cent and 22.5 per cent respectively. The area under cauliflower and green peas has seen a decline in the last few years. The area under cassava has seen a decline by 0.6 per cent in the total vegetable area. Cassava does not have much of domestic demand and is generally cultivated in contract farming mode for exports. In fact India has the highest yield in cassava production in the world (refer Section 4.2). The other major vegetables which have seen an increase in area are cabbage, okra, peas and tomato.

2.2 Production Trends in India

During 1990-2004, in the horticulture sector, the production of vegetables is the highest followed by fruits. Fruits and vegetables combined form the major contributor to the total horticulture production. As shown in Figure 2 (data in Appendix Table A2) vegetable production has been constantly increasing, with only a slight decline observed in last few years. Fruits show a constant linear increase in production. A constant trend is observed in production of plantation, spices and flowers also.

Figure 2: Production Trends of Horticulture in India

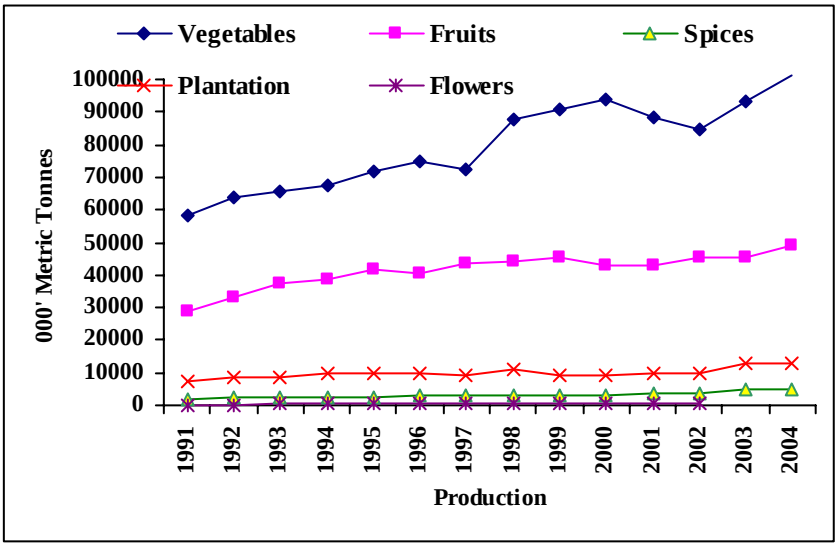


Table 5 presents the growth rate in area and production of fruits and vegetables over period and sub-periods. For fruits the area growth had been 3.28 per cent in 1990-95 which increased to 6.67 per cent in 2000-04. The production in fruits grew at the rate of 9.73 per cent in the initial period but later the growth had been declining. The area under vegetables increased at the rate of 3.15 per cent in 1995-2000 which later declined and the same period also observed high production growth. Overall area growth had been 3.38 per cent and 2.10 per cent for fruits and vegetables respectively during 1990-2004. In the same period the production growth had been 3.06 per cent and 3.95 per cent for fruits and vegetables respectively.

Table 5: Average annual rate of growth in area and production

(Unit: per cent)

Period	Fruits		Vegetables	
	Area	Production	Area	Production
1990-95	3.28	9.43	-1.00	4.67
1995-00	2.58	1.62	3.15	6.22
2000-04	6.67	3.32	1.82	2.08
1990-04	3.38	3.06	2.10	3.95

The share of major fruits and vegetables in area and production of fruits and vegetables is presented in Tables 6 and 7. The share of commodities over the period has not varied much. The only notable change is the decline in the production share of mango and potato.

Importance in terms of share in area

Fruits: Mango (39.52%) and Banana (10.67%)

Vegetables: Potato (19.38%), Brinjal (7.56%), Tomato (7.36%) and Onion (7.18%)

Importance in terms of share in production

Fruits: Banana (32.91%) and Mango (23.54%)

Vegetables: Potato (23.70%), Brinjal (8.15%) and Tomato (7.72%)

Table 6: Area and production share in total fruits, 1990-2004

(Unit: per cent)

Commodity	Area				Production			
	1991	1995	2000	2004	1991	1995	2000	2004
Apple	6.77	6.47	6.2	4.65	4.01	2.93	2.84	3.53
Banana	13.36	12.9	12.14	10.67	27.21	31.55	32.77	32.91
Lemon	2.57	3.16	4.24	3.38	2.44	2.22	3.19	3.13
Mosambi	2.49	2.47	2.08	3.92	2.88	2.12	2.69	4.22
Orange	4.14	3.99	4.23	3.7	3.69	2.8	3.22	2.51
Grapes	1.13	1.06	1.17	1.21	2.33	1.45	2.45	3.14
Guava	3.27	3.92	3.83	3.26	3.82	3.62	3.78	3.42
Litchi	1.72	1.45	1.39	1.21	0.85	0.88	0.96	0.75
Mango	37.49	38.22	39.26	39.52	30.57	26.05	23.31	23.54
Papaya	1.57	1.82	1.81	1.47	2.81	3.2	4.16	5.21
Pineapple	1.99	2.12	2.02	1.64	2.68	2.58	2.83	2.49
Sapota	0.95	1.42	1.86	2.68	1.38	1.37	1.72	2.15
Other Fruits	22.55	21.01	19.76	22.69	15.31	19.24	16.07	13.01

Table 7: Area and production share in total vegetables, 1990-2004

(Unit: per cent)

Commodity	Area				Production			
	1991	1995	2000	2004	1991	1995	2000	2004
Brinjal	3.47	8.14	8.14	7.56	4.70	9.00	9.00	8.15
Cabbage	3.17	4.09	4.09	3.93	4.73	5.39	5.39	5.87
Cauliflower	3.63	4.12	4.12	4.10	5.12	3.46	3.46	5.00
Okra	3.97	8.07	8.07	5.61	3.22	5.63	5.63	3.57
Onion	5.93	7.41	7.41	7.18	8.04	5.70	5.70	5.03
Peas	3.18	4.20	4.20	5.11	1.45	3.27	3.27	3.20
Tomato	5.17	6.67	6.67	7.36	7.25	7.60	7.60	7.72
Potato	20.30	20.79	20.79	19.38	31.09	26.32	26.32	23.70
Sweet Potato	2.44	2.64	2.64	1.82	1.93	1.59	1.59	1.07
Tapioca	4.49	4.28	4.28	4.06	9.96	7.60	7.60	7.21
Lettuce	2.00	2.17	2.17	1.92	1.25	1.07	1.07	0.84
Pumpkins and Gourds	5.54	6.28	6.28	5.76	5.04	4.47	4.47	3.73
Beans	2.56	2.77	2.77	2.40	0.65	0.56	0.56	0.45
Cassava	4.49	4.28	4.28	4.06	9.96	7.60	7.60	7.21
Other Vegetables	29.68	14.09	14.09	19.75	5.59	10.74	10.74	17.24

The world production data is obtained from the FAO statistics database and ranking of the top five countries in the world are ranked according to their production levels (Tables 8 and 9) for fruits and vegetables respectively. India's ranking in these produce are also presented in the tables.

Table 8: Ranking in production of fruits in other countries, 2004

Fruits	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	India Ranks
Apple	China	USA	Poland	Iran	France	10
Banana	India	Brazil	China	Ecuador	Philippines	1
Lemon	Mexico	India	Argentina	Iran	Brazil	2
Citrus fruits/ Mosambi	Nigeria	China	Guinea	Syrian Arab	Japan	8
Orange	Brazil	USA	Mexico	India	Spain	4
Grapes	Italy	France	Spain	USA	China	16
Mango and Guava	India	China	Thailand	Mexico	Indonesia	1
Papaya	Brazil	Mexico	Nigeria	Indonesia	India	5
Pineapple	Thailand	Philippines	Brazil	China	India	5

Table 9: Ranking in production of vegetables in other countries, 2004

Vegetables	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	India Ranks
Brinjal	China	India	Egypt	Turkey	Japan	2
Cabbage	China	India	Russia	Korea	Japan	2
Cauliflower	China	India	Spain	Italy	France	2
Onion	China	India	Korea	Japan	Iran	2
Peas	India	China	France	Egypt	Belgium	1
Tomato	China	USA	Turkey	Italy	Egypt	6
Potato	China	Russia	India	Ukraine	USA	3
Sweet Potato	China	Uganda	Nigeria	Indonesia	Viet Nam	9
Lettuce	China	USA	Italy	Spain	India	5
Pumpkins and Gourds	China	India	Ukraine	USA	Egypt	2
Beans	China	USA	Indonesia	Turkey	France	6
Cassava	Nigeria	Brazil	Thailand	Indonesia	Congo	8

In the world production of fruits India is the biggest producer of banana and mango. India is the second largest producer of lime. China is the other biggest producer of these produce in the world. European countries are the leaders in grapes production with India ranking sixteenth in the world. Brazil leads in the production of orange and papaya and Thailand in pineapple.

India and China are the world leaders in the major vegetable production. For brinjal, cabbage, cauliflower, onion and pumpkins China is the biggest producer followed by India. India ranks first for green peas. In spite of potato being the number one among the the vegetable production in the country, India ranks third in the world production. For tomato India ranks sixth in world production.

India ranks first in the world production

Fruits: Banana and Mango

Vegetables: Green Peas

2.3 Export Trends

India exports fresh fruits and vegetables and also the processed fruits and vegetables. But in this study we deal only with fresh fruits and vegetables. The India Trades database. (Table 10) provides the quantity and value of exports of fresh fruits from India to the world. India's exports of fruits in quantity terms increased from 102 thousand tonnes in 1991 to 488 thousand tonnes in 2004 and in value terms this increase is Rs. 348 crore in 1991 and Rs. 3,404 crore in 2004. The export quantity increased by more than four times in the last 15 years and the value of exports by 10 times.

The major fruits exported in terms of quantity are mango (53.5 thousand tonnes), grapes (38.9 thousand tonnes), orange (31.5 thousand tonnes), apple (23.2 thousand tonnes), banana (12.8 thousand tonnes), other citrus fruits (11.4 thousand tonnes) and lemon (10.5 thousand tonnes). In value terms grapes and mango exports earn the maximum foreign exchange for India.

Table 11 show that onion and potato are the most important ones among the fresh vegetables, both in terms of quantity exported and value. Tomato and pumpkin are also among our major fresh vegetables exported to the world but their volume is very

Table 10: Exports of fresh fruits from India to the world

(Unit: Quantity in tonne; value in Rs. lakh)

Commodity	Quantity				Value			
	1991	1995	2000	2005	1991	1995	2000	2005
Apple	3075.2	6507.6	5476.6	23225.2	183.5	678.0	884.3	2635.0
Banana	290.2	966.1	6289.7	12817.7	6.3	89.6	1280.8	1342.8
Lemon	147.0	289.6	2360.0	10523.5	4.7	28.0	326.2	835.8
Other Citrus Fruits/ Mosambi	215.0	452.7	242.4	11378.6	3.3	29.0	34.8	1444.3
Orange	6611.2	11764.7	24019.2	31528.4	239.1	665.5	2375.5	3300.7
Grapes	5347.7	16813.4	14005.6	38898.3	854.6	4049.0	5513.8	12643.8
Guava	237.3	233.5	2101.5	3339.8	21.2	21.6	272.1	692.6
Litchi		5.8	299.2	545.0		3.5	73.8	70.9
Mango	19378.3	25414.4	34631.2	53480.0	3121.6	4502.7	7154.9	8961.1
Papaya	272.5	320.9	12660.0	3701.0	28.5	44.9	2076.1	531.2
Pineapple	197.2	116.8	137.5	1765.6	13.8	8.6	38.0	245.2
Sapota	1299.4	2600.4	1572.1	951.1	102.3	268.5	243.1	105.1
Other Fruits	3865.0	14868.7	22925.0	29184.1	353.7	1510.7	4001.3	4852.5
Total Fruits	102068.6	215332.3	316760.8	488790.7	34831.2	153023.2	311666.2	340400.0

Note: *Blank spaces indicate no exports in this period; other fruits include sapota and litchi also*
Source*: India Trades Database*

Table 11: Exports of fresh vegetables from India to the world

(Unit: Quantity in tonne; value in Rs. lakh)

Commodity	Quantity				Value			
	1991	1995	2000	2005	1991	1995	2000	2005
Brinjal				669.7				314.7
Cabbage		18.1	18.0	99.5		0.2	2.1	10.6
Cauliflower		24.5	21.1	95.3		1.5	3.1	16.9
Onion	240042.2	401281.5	260475.3	870216.9	9084.3	20461.9	20270.1	64411.9
Peas		317.1	1128.1	2132.7		68.2	205.9	443.1
Tomato	117.1	1072.5	1232.7	7446.1	7.1	62.9	121.6	589.4
Potato	1530.4	15755.4	28200.2	65996.1	48.9	669.3	1395.3	3175.5
Sweet Potato	1.4		14.4	330.1	0.1		3.0	24.4
Lettuce	3.3		5.0	656.0	0.2		0.8	131.8
Pumpkins	83.5	34.8	82.5	2079.9	4.0	0.7	40.1	318.24
Beans			20.6	1258.6			3.8	145.8
Cassava	2.5		62.9	90.0	0.3		12.3	32.3
Other Vegetables	4074.2	6127.0	24834.1	18566.5	231.9	476.0	3644.7	1873.0
Total Vegetables	297968.8	525784.1	613013.9	1410369.8	14662.6	39576.8	94195.0	172458.0

Note: *Blank spaces indicate no exports in this period*

Source*: India Trades Database*

low. Brinjal had recently been added to the export list. The volume of exports of both fruits and vegetables has seen a rise since 1990.

Major exports from India

Fruits: Mango, Grapes, Orange, Apple, Banana, Other Citrus Fruits and Lemon.

Vegetables: Onion, Potato, Tomato, Pumpkins

The countries where India's export market share is maximum for fresh fruits and vegetables is presented in Tables 12 and 13. The commodity-wise analysis show that it is the neighbouring countries where maximum share of India's fruits and vegetables are exported. One of our major trading partners for exports of fresh fruits is Bangladesh. The maximum share of exports of apple, grapes, litchi, mango and oranges go to Bangladesh. In vegetables the maximum share of onion and tomato exports go to Bangladesh. Brinjal has found the market in UK, Saudi Arabia, the Netherlands and France, with 63.4 per cent share of total brinjal exports going to UK. Among our neighbouring countries, Nepal receives bulk of India's exports of cauliflower, potatoes, banana, citrus fruits other than orange and lemon. UAE imports more than 60 per cent of India's exports of papaya, pineapple, sapota, lemon and pumpkins. Other major exporting countries for India for fresh fruits and vegetables are Malaysia, Singapore and Saudi Arabia.

India's major export partners

Fruits: Bangladesh, Nepal, UAE

Vegetables: Bangladesh, Nepal, UAE, UK, Malaysia

Table 12: Major countries and share (%) of exports of fresh fruits from India

Commodity	Country 1	Country 2	Country 3	Country 4	Country 5
Apple	Bangladesh	Nepal			
	89.19	9.37			
Banana	Nepal	UAE	Saudi Arabia	USA	
	51.74	19.18	6.48	4.66	
Grapes	Bangladesh	Netherlands	UK	UAE	
	37.85	19.26	14.96	13.47	
Guava	Saudi Arabia	Kuwait	Yemen	Netherlands	USA
	35.48	10.65	8.97	8.84	6.31
Lemon	UAE	Nepal	Oman		
	76.30	12.31	4.41		
Lichi	Bangladesh	UK			
	88.89	6.86			
Mango	Bangladesh	UAE	Nepal	Saudi Arabia	
	60.77	19.33	6.36	4.30	
Orange	Bangladesh				
	97.77				
Other Citrus Fruits	Nepal	Bangladesh	Saudi Arabia	Oman	UAE
	73.75	9.24	6.44	5.47	4.83
Papaya	UAE	Nepal	Saudi Arabia		
	68.82	9.03	4.68		
Pinapple	UAE	Nepal	Saudi Arabia	Oman	Spain
	58.45	12.67	10.44	7.38	4.90
Sapota	UAE	UK	Bahrain	Saudi Arabia	
	68.12	9.56	9.30	4.51	

Table 13: Major countries and share of exports of fresh vegetables from India

Commodity	Country 1	Country 2	Country 3	Country 4	Country 5
Brinjal	UK	Saudi Arabia	Netherlands	France	
	63.40	7.62	7.51	7.46	
Beans	Nepal	UAE	UK	Qatar	Saudi Arabia
	31.30	28.43	18.19	11.19	4.72

Commodity	Country 1	Country 2	Country 3	Country 4	Country 5
Cabbage	Maldives	UK	Bahrain	Singapore	
	75.10	10.70	7.44	4.97	
Cauliflower	Nepal	USA	Malaysia	Maldives	Qatar
	36.39	24.95	11.44	9.44	6.39
Onion	Bangladesh	Malaysia	UAE	Sri Lanka	
	41.25	20.34	13.35	12.11	
Lettuce	Singapore	Malaysia	UAE	Canada	
	74.61	9.33	6.56	4.34	
Peas	UAE	Bangladesh	Nepal	Saudi Arabia	France
	34.67	21.19	11.55	11.45	4.98
Potatoes	Nepal	Sri Lanka	Mauritius		
	64.52	21.14	4.71		
Pumpkins	UAE	Nepal			
	74.32	4.48			
Sweet potatoes	Malaysia	UAE	Maldives		
	49.07	37.52	10.53		
Tomatoes	Bangladesh	Nepal			
	83.81	9.29			

The other major exporters[3] of these fruits and vegetables in the world are presented in Table 14 and Table 15 for major fresh fruits and fresh vegetables respectively. China, India and USA are the world's largest producers of fruits and vegetables. In the exporters list China, USA and countries of Europe are the leaders. India is the second largest exporter of citrus frits like mosambi, mango and guava combined and the world's largest exporter of onion. China is the leading exporter of apple, and mosambi and ranks second in the world for export of cabbage, peas and sweet potato.

Table 14: Exports of fresh fruits by other countries to the world, 2005

Commodities	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	India Ranks
Apple	China	Chile	France	Italy	USA	28
Banana	Ecuador	Costa Rica	Philippines	Belgium	Colombia	44
Lemon	Spain	Mexico	Argentina	Turkey	S. Africa	17

[3] This information is collectively computed from PC TAS and FAO database, 2005.

Commodities	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	India Ranks
Other Citrus Fruits/Mosambi	China	India	Israel	Thailand	Netherlands	2
Orange	Spain	S. Africa	USA	Egypt	Morocco	21
Grapes	Chile	Italy	USA	S. Africa	Turkey	17
Guava and Mangoes	Mexico	India	Brazil	Pakistan	Peru	2
Papaya	Mexico	Malaysia	Brazil	Belize	USA	9
Pineapple	Costa Rica	Philippines	Belgium	Côte d'Ivoire	France	29

Table 15: Exports of fresh vegetables by other countries to the world, 2005

Commodities	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	India Ranks
Brinjal	Spain	Jordan	Mexico	Netherlands	China	24
Cabbage	USA	China	Netherlands	Spain	Poland	48
Cauliflower	Spain	France	China	USA	Mexico	42
Onion	India	Netherlands	China	USA	Egypt	1
Peas	Guatemala	China	Belgium	Russia	Netherlands	17
Tomato	Spain	Mexico	Netherlands	Syrian Arab	Jordan	27
Potato	Netherlands	France	Germany	Belgium	Canada	17
Sweet Potato	USA	China	Israel	Indonesia	Egypt	35
Lettuce	Spain	USA	Italy	Netherlands	Belgium	28
Pumpkins and Gourd	Spain	New Zealand	Mexico	France	Netherlands	74
Beans	France	USA	Kenya	Netherlands	Spain	24

In spite of being one of the world's largest producer of fruits and vegetable, India does not have much of export volumes, mainly due to huge domestic demand. Besides this there are supply constrains and huge post-harvest losses which leads to lower actual available produce (see Section 4).

As discussed in the previous section, India has seen diversification in the cropping pattern away from foodgrains towards horticulture and more towards fruits and vegetables. India is among the largest producer in the world of the fruits and vegetables, but does not have much of the share in the exports. To emerge as a major exporting nation India needs to produce surplus. Besides efficient and good practices brought in agriculture, more area is needed to be shifted to horticulture production. Though a cost-benefit analysis, a feasibility check is done, so as to analyze if it is economically profitable and feasible for the farmers to shift their land to horticultural produce. These issues are discussed in next section.

3 Feasibility of Shift Towards Horticulture

This section deals with a cost-benefit analysis, which will help in determining the profitability of farmers to diversify their land to horticultural production from the conventional practices of cultivation. The cost-benefit ratio (CBR) is computed as an indicator of economics of investment criterion. This ratio helps in judging the feasibility of investing in the proposal. The cost-benefit ratio is a simple calculation that depicts the total financial return for each rupee invested in cultivation. If the cost-benefit ratio is 3.56, it means that for every rupee invested in one hectare of land under cultivation for a given produce, the return is about Rs. 3.56 per hectare after the sale of the produce.

The cost-benefit ratio is defined as:

Cost-benefit ratio (CBR) = Gross Returns / Cost of Cultivation

Where:

Gross Returns = Yields * Price

The cost of cultivation is the total cost in cultivation. Among the cost definitions of A1, A2, B1, B2, C1 and C2, which were given by the Commission for Agricultural Costs and Prices (CACP), the ideal one is C2 which is used to compute the CBR for cereals. The cost estimate of cereals is obtained from the published reports of the CACP. The C2 definition of cost includes the cost value on all the inputs, depreciation, and rent and the implicit value of land and family labour. For the horticultural produce, the estimate of cost is made available in the computations done by researchers and officials working with the National Horticulture Mission. The cost data on horticulture products is not available in published format and most of the estimates are obtained through primary survey and compilation of different input costs from various sources. In computation of the cost information for horticulture produce, the establishment cost is a very important component. Since fruits have a gestation period (setting up an orchard and getting the commercial benefits), the total cost of establishing and managing an orchard is spread over a period to have the average annual estimate of the cost of cultivation. The establishment cost included expenditure on inland preparation, cost of planting material, labour costs on dig pitting, layout design, input costs, among others. The maintenance cost include expenditure on fertilizer, manure and pesticide, labour, irrigation, harvesting,

post-harvest handling and the transportation. For fruit orchards, intercropping is very common, especially during the gestation period. All the costs are net of the returns from these intercropping. The average annual costs are worked out taking into account the number of years of the gestation period, i.e. when the orchard becomes commercially viable.

In the context of the study the CBR is computed for major cereals in various major states of production and similar exercise is repeated for some fruits and vegetables in Table 16 Table 17 respectively. The results in Table 16 show that for wheat, the gross returns are marginally more than the cost of cultivation only in Punjab, Haryana and Gujarat. In all other states the cost and benefit ratio is either close to one or less than one. This implies that in most states, farmers who cultivate wheat are not able to meet the cost of production. For paddy also the ratio is less than one, except for farmers in Punjab and Haryana. Rice, the staple food in southern India, has huge areas under paddy cultivation. But the scenario shows that it's difficult to meet the cost of production for the farmers who produce rice and wheat.. The reason why farmers continue to cultivate the staple foodgrains is that part of the produce is for self -consumption, also these farmers take farming activity on part time. Their incomes are supplemented from other sources too. If the implicit cost of family labour and land is not included in these calculations then there are some positive income also to meet household expenses. Although these estimates are based on 2002 published data, but even then it would not make much difference because the prices of inputs are increasing. The wheat and rice market prices have also increased but the yields are continuously declining, thus in the long run the cost of cultivation is rising; these huge costs are making it unprofitable for farmers to cultivate the staple food. For other coarse cereals, the CBR is less than one and in some cases it is even less than 0.5. This also explains the shift in area away from cereals as explained in the earlier section.

Table 16: Cost-Benefit Ratio for major cereals

Crop	State	Cost of Cultivation (Rs/ ha)	Gross Returns (Rs/ ha)	Cost-Benefit Ratio
Wheat	Bihar	14467.65	13147	0.91
	Gujarat	16736.91	21688	1.30
	Haryana	22178.73	25710	1.16
	Himachal Pradesh	10401.50	7324	0.70
	Madhya Pradesh	12736.68	11781	0.92
	Punjab	22930.99	28314	1.23
	Rajasthan	19181.62	20166	1.05
	Uttar Pradesh	16272.82	17193	1.06
Paddy	Andhra Pradesh	27043.45	25408	0.94
	Assam	13444.19	12084	0.90
	Bihar	12304.27	9816	0.80
	Haryana	23422.17	27654	1.18
	Karnataka	27563.44	26238	0.95
	Kerala	24338.38	21791	0.90
	Madhya Pradesh	13188.46	9801	0.74

Crop	State	Cost of Cultivation (Rs/ ha)	Gross Returns (Rs/ ha)	Cost-Benefit Ratio
	Orissa	16803.45	13513	0.80
	Punjab	23577.39	33516	1.42
	Tamil Nadu	28696.19	25949	0.90
	Uttar Pradesh	15844.29	14549	0.92
	West Bengal	21579.37	15144	0.70
Jowar	Andhra Pradesh	12486.22	6255	0.50
	Karnataka	7297.99	4512	0.62
	Madhya Pradesh	7467.59	4292	0.57
	Maharashtra	13225.02	6223	0.47
	Rajasthan	6148.13	1679	0.27
	Tamil Nadu	12752.01	8331	0.65
Bajra	Gujarat	10149.56	7935	0.78
	Haryana	10043.75	4650	0.46
	Maharashtra	12080.39	6093	0.50
	Rajasthan	4908.29	2729	0.56
	Uttar Pradesh	9218.35	5223	0.57
Maize	Andhra Pradesh	11983.11	10506	0.88
	Bihar	12577.38	9447	0.75
	Himachal Pradesh	9329.25	6220	0.67
	Karnataka	13484.35	11156	0.83
	Madhya Pradesh	6933.62	3982	0.57
	Rajasthan	13300.99	6018	0.45
	Uttar Pradesh	11239.72	7041	0.63
Ragi	Andhra Pradesh	15768.19	6453	0.41
	Karnataka	13125.17	6256	0.48
	Tamil Nadu	19471.02	11833	0.61

Source: *Reports of the Commission for Agricultural Costs and Prices, for crops sown during 2002-03, 2003-04 and 2004-05 seasons (for cost of cultivation).*
Note: *C2 definition of cost of cultivation is used.*

Table 17: Cost-Benefit Ratio for certain fruits and vegetables

Crop	State	Cost of Cultivation (Rs/ ha)	Gross Returns (Rs/ ha)	Cost-Benefit Ratio
Mango	UP	11365	52264	4.6
Lichi	Bihar	14122	23798	1.69
	UP	15411	40257	2.61
Grape	Karnataka	224041	342375	1.53
Guava	North India	90956	177576	1.95
Onion dry land	Karnataka	14227	23152	1.63
Onion irrigated	Karnataka	44932	111259	2.48
Bhindi	Karnataka	52314	89218	1.71
	Maharashtra	44122	57812	1.31
	AP	40788	62569	1.53
Brinjal	AP	58692	112652	1.92

Crop	State	Cost of Cultivation (Rs/ ha)	Gross Returns (Rs/ ha)	Cost-Benefit Ratio
	Karnataka	52576	112292	2.14
	Maharashtra	87530	111909	1.28
Beans	Karnataka	33093	59748	1.81
Tomato	Karnataka	109544	220214	2.01
Sapota	North India	12311	45720	3.71
	North India	24192	52457	2.17
Aonla	UP	15214	40257	2.65
Gherkin	Karnataka	27145	29789	1.1
Okra	AP	36003	57675	1.6

Source: *Information collected during personal visits to the research institutes and communications with people working with the National Horticulture Mission.*

In Table 17 the CBR is computed for some of the fruits and vegetables, for which information was available.[4] These can be indicative and be generalized for fruits and vegetable sectors as a whole. For mango, after five years of plantation the fruit is ready for marketing. The maximum production is derived only after 10 years. Based on the economics of 10 years of mango plantation in Uttar Pradesh, with 100 plants per hectare, the annual CBR is computed at 4.6. Aonla and litchi are the intercrops in this region but in the calculation of CBR the returns from these intercrops are discounted. Litchi in Uttar Pradesh, irrigated onion, Tomato and brinjal in Karnataka, sapota in North India, Aonla in Uttar Pradesh have a CBR of more than 2. This indicates that the gross returns are double the cost of cultivation of the produce. None of the horticultural crops presented in the table shows CBR less than 1 or even on its margin. This is indicative of the economic benefit of crop diversification towards fruits and vegetables. The marketing costs are also included in the calculations. If the markets are brought close to the farm gate or in the supply chain the produce is directly procured from the farm gate then it will be more beneficial for farmers, as they will be getting a better price for the fresh produce. In addition, the cold storage facility provided in the transportation would preserve the quality further, so that the consumers get better quality. This would further reduce the post-harvest losses and thus the quantity saved in the process will be addition. to the net availability.

The CBR of horticulture is more than the CBR of cereals. This implies that it is profitable to cultivate fruits and vegetables rather than cereals. The economic feasibility of shift of land away from cereals to horticulture produce is justified. But this feasibility does not imply shifting all the land away from cereals. The need is to re-allocate land in a manner that the optimal output and income can be generated, keeping in mind the domestic

[4] The information used for the computation pertains to the year 2005. It is only after the launch of the National Horticulture Mission that information on cost of cultivation of horticulture produce is being recorded. But no data is yet published.

demand, export targets and improving the economic conditions of the farmers. Keeping food security of the country as the prime concern, the poor, the small and marginal farmers should try to diversify and increase the income levels. Regions where productivity of rice, wheat and other basic cereals have declined, or not profitable for farmers to produce, the farmer needs to diversify his cultivation portfolio. In year-round cultivation, even if small amount of land is diversified towards horticulture commodities, and more importantly towards vegetables, then the income level of the farmer can improve.

Besides the issue of diversification for improving incomes, the shift is also needed to meet the increasing domestic demand of fruits and vegetables. There are various supply constraints which are keeping the per unit productivity and per unit availability low. These factors are discussed in detail in the next section. The supply chain efficiency is an important issue which needs to be taken into account along with the production diversification to reap the maximum benefit from the changed scenario.

4 Domestic Demand, Supply and Constraints

Diversification in both the production and consumption pattern is observed in India. The economy is moving from being a supply-driven economy to a demand-driven economy thus with the change in consumption pattern of the population the production diversification is also evident. This section deals with the current demand and supply situation and also gives projections for fresh fruits and vegetables till 2015. This section highlights the constraints in the supply chain and suggests some policy reforms. The SAFAL market case study is also presented and evaluated to show how this intervention has brought about a change in the prevailing traditional market structure.

4.1 Domestic Demand and Supply

According to Engel's law with the economic growth and increase in per capita income, the consumption would shift from the staple food to high value commodities like fruits and vegetables, milk and milk products, fish and eggs. The NSS consumer expenditure data[5] shows that the share of fruits and vegetables in the household budget has increased from 9.7 per cent in 1983 to 13.7 per cent in the budget for 1999-2000 (Mittal, 2006). The annual per capita consumption of vegetables has seen an increase from 47.6 kg per person in 1983 to 76.1 kg per person in 1999-2000 (Table 18). Fruits consumption also saw an increase from 3.2 kg per person per annum to 11.8 kg per person per annum during this period. The increase in consumption levels of vegetables and fruits has been quite similar in both the rural and urban areas.

Demand projections are made on the assumptions about population, urbanization, poverty

[5] The National Sample Survey Organisation (NSSO) collects data on household consumption expenditure at the national level in the form of various rounds by adopting sample survey techniques. The present study uses data from the consumer expenditure survey of the National Sample Survey (NSS) rounds number 38, 43, 50 and 55 pertaining to the periods 1983, 1987-88, 1993-4 and 1999-2000, respectively.

and economic growth. The estimates of the past population growth are available from the population census conducted every 10 years. These estimates assume that the urban population proportion in total population will follow the past trends. For the projections we have assumed the growth scenario to be 8 per cent GDP growth. The adjustment for domestic saving rates is also made. Separate expenditure elasticity (Appendix Table A3) are used for fruits and vegetable groups to estimate future domestic demand (Table 19).

Table 18: Annual per capita consumption of fruits and vegetables in India

(Unit: kg/person/annum)

Groups	1983	1987-88	1993-94	1999-00
Vegetables				
Rural	46.0	50.2	59.8	74.3
Urban	50.8	56.9	64.5	79.1
All India	47.6	52.4	61.5	76.1
Fruits				
Rural	2.8	9.7	15.7	9.6
Urban	4.2	15.7	25.4	15.6
All India	3.2	11.7	19.3	11.8

Table 19: Projected domestic demand of fruits and vegetables in India

Year	Total Demand (million tonnes)		Per Capita Demand (kg)	
	Fruits	Vegetables	Fruits	Vegetables
Base year 2000	12.37	79.15	12.04	77.07
2010	17.43	103.16	14.78	87.51
2015	21.06	119.12	16.67	94.28
2020	25.47	137.25	18.93	102.00

Note: *Scenario of economy growing at 8 per cent per annum.*

Total domestic demand for fruits is expected to increase to 17.43 million tonnes by 2010 and 25.47 million tonnes by 2020. For vegetables, this demand is expected to be 103.16 million tonnes by 2010 and 137.25 million tonnes by 2020. Demand for both fruits and vegetables is expected to rise at the rate of 4-5 per cent per annum in the next 15 years. The per capita demand is also expected to rise at the same rate.

This huge increase in the demand of fruits and vegetables for domestic consumption is a challenge to be met by the country. Along with this is the goal to produce horticultural products for exports, which can act as an engine of growth to the agricultural sector. Due to food security concerns, lack of credit with farmers to diversify, and lack of the risk-taking attitude of farmers, it is difficult to allocate large areas of land for horticulture. Diversifying land away from cereals to horticulture remains a constraint in spite of it being more profitable for farmers to produce horticulture products than cereals. The way out is to increase our productivity and remove the other supply constraints.

Table 20: Production forecast of vegetables and fruits in India

Year	Area (million ha)	Yield (tonnes/ha)	Production (million tonnes)
Vegetables			
1999-00	5.82	14.4	83.8
2010-11	6.49	20.2	131.1
2015-16	6.49	23.5	152.5
Fruits			
1999-00	3.74	11.8	44.3
2010-11	4.43	15.1	66.9
2015-16	4.43	16.9	74.9

Source: *Kumar and Kumar (2003)*

The National Horticulture Mission aims to double the production of fruits and vegetables by 2010. Tables 20 and 21 project the future production and supply of fruits and vegetables in India for 2015-16. Based on 1999 as the base year, it is estimated that the production of fruits and vegetables would increase to 66.9 million tonnes and 131

Table 21: Supply of vegetables and fruits in India

Year	Production (million tonnes)	Post-harvest losses (per cent of production)	Supply (million tonnes)
Vegetables			
1999-00	83.8	19	67.9
2010-11	131.1	19	106.2
2015-16	152.5	19	123.5
Fruits			
1999-00	44.3	25	33.2
2010-11	66.9	25	50.2
2015-16	74.9	25	56.2

Source*: Kumar and Kumar (2003.)*

million tonnes respectively by 2010 and almost double by 2015. Due to huge post-harvest losses the actual supply of fruits and vegetables would be 20-25 per cent less than the production. This will help in meeting the domestic demand on the margin leaving no scope for increasing our export potential. Thus it is required that efforts should be diverted to minimize and remove the supply constrains and make the supply chain efficient in order to improve the horticultural and agricultural growth rates.

4.2 Issues in Supply Chain Efficiency

In spite of India's wide range of soil and climatic conditions the horticulture sector is facing several constraints. Major constraints in production and marketing in fresh fruits

and vegetables as listed in the literature[6] are non-availability of quality seeds, inadequate irrigation facilities, lack of soil testing facility and extension staff. Inefficiency in pest management, credit availability constraint, high cost of production, lack of information, huge post-harvest losses, lack of roads, cold storage, inadequate space, poor market network and high transportation cost. A lot of research initiatives and investments have already gone in, which have resulted in the growth in the supply of fresh fruits and vegetables in the past decade. But a lot more needs to be done especially in the field of research and investment to improve the infrastructure conditions and reduce the post-harvest losses in the sector so that the per-unit productivity and per capita availability of fruits and vegetables is increased. The general constraints faced by this sector are the timely delivery, grading, packaging, good quality, poor market infrastructure, agro-processing plants, marketing credit, proper pricing, uniform grading and standardization of weights and measures; inadequate and poor dissemination of market information, poor post-harvest handling, low and declining productivity.

Declining Yields

The most important factor impacting the horticulture sector's growth is the low and declining productivity. As presented in Table 22 for fresh fruits and Table 23 for fresh vegetables, the decline in productivity as well as the low productivity rates as compared to the world's high-yields is quite visible. For fresh fruits, the citrus fruits, mango and

Table 22: Trends in yield for major fruits in India

(Unit: tonnes/hectares)

Commodity	1993	2003	Gains in Yield	Potential Yield (Highest in the World)
Apple	6.3	7.6	1.3	France (37.8)
Banana	27.6	27.8	0.2	Costa Rica (52.5)
Citrus Fruit	9.0	8.5	-0.5	Spain (51.2)
Lime/Lemon	10.1	8.9	-1.2	Turkey (30.5)
Other Citrus Fruits	11.5	10.4	-1.1	-
Orange	8.9	6.8	-2.1	USA (35.4)
Grapes	18.1	25.5	7.4	Egypt (21.9)
Guava	10.8	11.1	0.3	Guatemala (26.8)
Litchi	5.6	8.9	3.3	-
Mango	8.3	6.0	-2.3	*
Papaya	22.7	29.1	6.4	Brazil (46.8)
Pineapple	16.2	15.3	-1.0	Costa Rica (59.9)
Sapota	13.8	7.6	-6.2	-
Total Fruits	11.7	9.8	-1.9	-

Note: **World yields are from FAO, 2006. This database includes guava and mangoes together.*

pineapple the yield in 2003 has declined as compared to a decade ago. Mango has the highest share in our exports, and with its low yield the horticulture sector would be hit. Also the area under mango plantation remained static because of land constraint. The

[6] Kumar, Sant, P.K.Joshi and Suresh Pal (2004)

existing mango plantation requires rejuvenation or replanting. Rejuvenation, a short-term measure, has helped to retain or increase the productivity by a few years but the orchard owners feel that the need to replant the orchard. As per the existing forest rules, cutting of trees is not allowed and hence replanting the orchard can't take place, which is why increasing the productivity of mango is facing several hindrances.

For fresh vegetables the decline in yield has only been seen for peas in last decade, although the gains in the yield are almost negligible for sweet potato, pumpkin, lettuce and beans. On the other hand, in cassava production, India has the highest yield in the world. For all the fresh fruits and vegetables, the potential yield possible is higher than the existing yields. For cassava, the higher yields can be explained by the fact that the domestic consumption of cassava is almost negligible and mostly cassava is cultivated

Table 23: Trends in yield for major vegetables in India

(Unit: tonne/hectare)

Crop	1993	2003	Gains in Yield	Potential Yield (Highest in the World)
Brinjal	15.3	16.4	1.1	Japan (34.0)
Cabbage	15.5	21.7	6.2	Korea (63.0)
Cauliflower	15.2	18.5	3.3	Morocco (45.0)
Okra	10.3	10.3	0.0	-
Onion	10.9	11.3	0.4	Netherlands (51.2)
Peas	8.4	6.7	-1.7	Belgium (18.3)
Tomato	14.3	16.2	1.9	Portugal (85.7)
Potato	16.6	18.8	2.2	Belgium (48.4)
Sweet Potato	8.5	8.9	0.4	Japan (275.2)
Tapioca	24.5	27.0	2.5	-
Lettuce	6.6	6.6	0.0	USA (36.8)
Pumpkin & Gourd	9.7	9.7	0.0	France (38.2)
Beans	2.7	2.8	0.1	Belgium (17.4)
Cassava	24.5	27.9	3.4	India
Total Vegetables	13.5	14.8	1.3	-

under contract farming on commercial scale for exports. If the information about the production undertaken on commercial and non-commercial basis is looked into, then it is quite possible that the average yield level may appear far satisfactory. This further implies that if the farming is taken up in an organized manner with the use of inputs, their application, and harvesting techniques imparted to the producers then the yield level can be raised.

Supply Chain Management

One of the weaknesses of the supply chain is that it is a multi-layered marketing channel lacking in infrastructure. Efficient supply chain requires strengthening all the levels of infrastructure such as the inputs delivery, credit, irrigation, improved procurement, minimizing post-harvest loses, cold storage chains, better and efficient processing and marketing techniques, efficient storage, warehouse and also efficient and competitive retailing. The infrastructure to improve efficiency and the linkages of the supply chain is very poor, which is affecting the growth potential of the horticulture sector. Timely availability of inputs, development of organized input market and infrastructure for its storage and distribution will add to the productivity of the sector. Development of cold chain network will help in reducing the post-harvest losses of fruits and vegetables. Improving the post-harvest management means an overall improvement in the per unit productivity. Cold chain infrastructure will require a huge sum of Rs. 18,000 crore to Rs. 20,000 crore investment in the next five years.[7] Investment is required to build the cold storage chain from the refrigerated trucks which procure the produce from the farm gate, then pre-cooling chambers, cooled area for sorting and grading the produce, refrigerated trucks for transferring the produce to the market of distribution or part of delivery. The development of this chain requires huge investment in technology, infrastructure and maintenance. A study by Raghunath et. al (2005) has estimated that with strengthening the supply chain the benefits to consumers and producers can increase by 20-25 per cent in the most perishable commodity like tomato. Due to inefficiency in the supply chain the price received by the farmers is only about 24 to 58 per cent of the retail price the consumer pays.

Post-harvest Management

Another issue in the supply chain is the inefficient post-harvest management. The proper integration of post-harvest technology into marketing supply-chain is crucial. Cultivable waste of about 24-40 per cent is reported because of the inefficiency. Post-harvest management does not only mean reducing waste but also maintaining the quality. The post-harvest technologies aim to address some of these issues by optimizing quality, safety and by reducing waste. Poor handling of produce lowers market quality and can substantially reduce producer returns. Our difference in prices between the farm and the retail is highest in the world. Improved handling methods and the resolution of regulatory requirements allow access to more distant domestic markets and also international markets. Appropriate production practices, careful harvesting, and proper packaging, storage, and transport contribute to good produce quality. Post-harvest management needs to focus on enhancing value through the application of cost-efficient and environmentally sound post-harvest techniques, to reduce losses and increase efficiency. Changes in production methods can also affect post-harvest product quality. Post-harvest technology of fresh fruits and vegetables in recent years gained enormous momentum to save losses during harvesting, handling, storage and transpiration quality and quantity. The extent of losses of fruits and vegetables in India is estimated at about Rs. 10,000 crore to 12,000 crore per annum, and the loss of quantity ranges between 10 per cent and 80 per cent in the most perishable fruits and vegetables. The major causes of loss are improper handling, poor packing, improper storage, uncontrolled temperature, etc. Thirty

[7] CII in Cold Chain Summit, 2007

per cent of India's fruit and vegetable produce goes waste because of the lack of cold storage chains. Presently, there are about 1,300 cold storage facilities in India, of which 50 per cent is used only for potatoes and a large percentage of these are either underutilized or non-utilized for most of the year. A huge investment is required to meet the gap in the cold chains. There is the need to manage the available resources efficiently and minimize the quality and quantity losses. Proper post-harvest handling requires proper cooling and packing facility, clean and fast transportation, careful handling, proper management of environment -- temperature, relative humidity, ventilation and sanitation. Value can be added to the produce by improving the product presentation through grading, packaging and labeling. Farmers should be encouraged to adopt the 'Good Agricultural Practice' (GAP) Scheme to improve quality.

Marketing Reforms

India can be a market leader in the agricultural sector for horticultural produce if its market functions properly. In this context the biggest challenge that the Indian agricultural sector faces is the integration of different components of the supply chain. On the policy front there is a need to integrate agricultural markets and supply chains. The Agricultural Produce Marketing Committee (APMC) Act prohibits transaction outside the regulated *mandis*, does not allow direct marketing and direct procurement of agricultural produce from farmers' fields. APMC Act restricts the setting up of markets other than by the state governments. This act is coming in the way of a new private initiative in the modern retailing and upgrading of the supply chain especially in the field of fruits and vegetables. In the case of SAFAL market set up in Bangalore, the Karnataka Government had amended its APMC Act in favour of both farmers and consumers. Thus initiatives should also be taken up by other state governments (for details refer to Appendix Table A4) and adopt the model APMC Act which proposes to remove the controls on the movement, storage and marketing of agricultural commodities, and enables setting up of commodity exchanges to enable futures trading. Amendment in the APMC Act will remove the restriction on direct procurement from the farmers and thus would improve the efficiency of the supply chain. This will provide farmers with the freedom to sell their produce where it's more profitable to them rather than in the existing market administered by APMCs. This will also strengthen the contract farming that will create provisions for direct sales of farm produce through contract farming. This amendment would also help in the movement of produce from the surplus state to deficit state creating a single market for agricultural produce and the market integration will further help in price stabilization (Virmani and Mittal, 2006). Amendment to the APMC Act will help move forward in this direction as the horticulture sector can be linked to the futures market along with strengthening the institution of contract farming. The amendment will help to bring in the multinational companies into the market and establishing their retail chains.

Futures Market

Revival of agricultural commodities' futures market in India in early 2000 after the ban in the 1960s has helped in integrating the foodgrains and other agricultural goods markets through price discovery and risk management. Fruits and vegetables can also become part of the futures trading through the national commodity exchanges. At the moment, the

produce because of their perishable nature, short shelf life, inefficient storage facilities and low year-long availability, the horticulture products have not entered the futures trading. The involvement of the private institution in this process will help in getting the horticulture produce linked to markets through more private investment. Development of infrastructure and availability of new techniques in this process will further help in the growth of the horticulture sector. SAFAL Market is collaborating with Multi Commodity Exchange (MCX) for creating a SAFAL National Exchange exclusively for horticulture produce spot trading and the operations are expected to begin by March 2008. This would be an electronic platform for perishable commodities and thus would help in integrating the producers and buyers from different parts of the country. The transparent price system would be able to create price awareness, leading to creating a better price discovery. This would further lead to linking up of all the stakeholders and also reduce post-harvest losses due to storage and transportation. The system would facilitate delivery of the produce from the shortest possible production area, leading to further reduction in the transportation cost. This will be a step forward for the development of the horticulture sector.

4.3 SAFAL Market Case Study

The supply chains in order to run on their efficiency level need to build a long-term relation between the retailers and farmers for procurement and to provide extension services regarding the use of inputs, production technology, information on harvesting, prices, pre-cooling, grading, sorting, packaging and on-farm sorting. The government must initiate strong measures to remove constraints in infrastructur such as setting up of distribution centres, cold chains and link roads to the markets. Ensuring quality and quantity of the produce to the stores is another essential requirement for smooth functioning of the supply chain. If these constraints are removed then a regular and uninterrupted supply of the produce is assured. Setting up of an alternate terminal market by SAFAL Market is a move in this direction.

The existing traditional system of wholesale market is one where a commission agent procures the produce from the farmers at a price after deducting his commission charge and then sells the produce in the wholesale market to traders and retailers. There might be more than one commission agent in between this chain. This kind market has unorganized small farmers who do not have the power in controlling the market. They have very little say in the final consumer price. The produce is sold through the commission agents who have no interest in the quality of produce but in the commission charges as the wholesale markets are poorly designed and congested (Coulter, 2004). The traditional Indian markets have a non-existent infrastructure of packing, grading, sorting and cold storages. The commission agents and traders dominate the supply chain and are the major price setters, thus most often farmers are dependent on them for credit. Farmers are not aware of the price setting mechanisms as the system is not transparent and thus don’t have any incentive to produce efficiently. Wholesale markets are not clean, and lack cold storage network causes huge wastage of fresh produce, ranging between 20 per cent and 40 per cent, is a common site.

Institutions like cooperatives, contract farming and growers' association are considered to improve producers access to markets, minimize transaction costs and remove production constraints. It is believed that a single gateway to the regulated markets would save time and improve efficiency. Ever since India's National Agriculture Policy has envisaged the participation of the private sector through contract farming and land leasing arrangements to allow accelerated technology transfer, capital inflow and assured market for crop production, especially of oilseeds, cotton and horticultural crops, investment in food processing industry on part of the private sector is being encouraged. This would help farmers of fruits and vegetables through backward linkages of such investment. There is a greater need that the role of private institutions is to be encouraged as the government's ability to intervene is seriously constrained by resources (Chengappa, 2006). Vertical coordination of farmers with cooperatives, contract farming and retail chains would facilitate them to deliver better output due to lower market risk, better infrastructure, public investment, acquired extension services, created awareness to prevailing and new technologies, better prices, stable income, etc. Its multiplier effect helps in increasing incomes, output and employment (Birthal et. al, 2007).

Previously, marketing of fruits and vegetables was undertaken by the farmers' co-operatives only. Now a number of big corporate houses like the Reliance, ITC, Aditya Birla Group, Godrej and Bharti Airtel Group have entered the retailing of fresh fruits and vegetables. Some of the retail and wholesale stores are already in operation by the name of Reliance Fresh, Choupal Fresh, Namdhari's Fresh etc. ITC, Metro and Adani Fresh are also entering the wholesale market. Exports of fresh fruits and vegetables are being done with EUREPGAP certification by Namdhari's Fresh and Bharti Airtel. They have developed a supply chain with forward and backward linkages operating in an efficient manner with heavy investments in infrastructure and cold chain. These business houses have indicated that contract farming may get them timely, consistent and adequate supply of produce of good quality.

The National Dairy Development Board (NDDB) has started the Fruit and Vegetable Unit of SAFAL at Delhi, which is one of the first fruit and vegetable retail chains set up as a part of the Mother Dairy Foods Processing Ltd. The retail unit provided a direct link between fruit and vegetable growers and consumers. The other initiative was a fruit processing Plant of SAFAL at Mumbai, a 100 per cent export-oriented unit, which capitalizes NDDB's food processing strength. NDDB has set up an alternate system of wholesale markets in Bangalore as a pilot project. The initiative is named as SAFAL Market and is initiated to fine-tune horticultural growth in India, by a shift in their earlier retail chain model to a wholesale market concept. This market is a move to introduce a transparent and efficient platform for sale and purchase of horticultural produce by connecting growers through Growers' Associations with farmers and wholesale buyers in various markets across the country (SAFAL website). The model involves establishment of an alternate marketing structure that provides incentive for quality and productivity thereby improving farmers' income. Through this approach there is an expected increased integration between growers, wholesalers and retailers into the market system. SAFAL Market operates outside the purview of the APMC Act and the Government of Karnataka

is the first state government to amend the Agricultural Produce Marketing (Regulation) Act to enable NDDB to own and operate such a market.

SAFAL Market is a government initiative located near Bangalore and emphasizes on fresh fruits and vegetables only. Bangalore is a major horticultural producing hub with a total area under horticulture of 15.3 lakh hectares. Bangalore has a huge floating population of around 8 per cent of the total city population and the per capita demand of horticultural produce is very large, because the city is fast growing due to the boom in information technology jobs. The state has a number of horticultural satellite markets and four major wholesale markets. The existence of large and diverse market functionaries like commission agents, pre-harvest contractors, push cart vendors, etc., indicate existence of competitive environment in the horticulture market in Bangalore (Chengappa and Nagaraj, 2005). Bangalore has seen a number of retail chains and new models being initiated in last few years, but SAFAL market is the first one of its kind to establish a terminal wholesale market. The impact of its operations are evident on farmers, traders and retailers. The following sections would highlight on the structure and functioning, supply chain, forward and backward linkages, constrains and achievements in this terminal market.

4.3.1 Structure and Functioning

To modernize the marketing of horticulture produce, an alternate system was introduced that operates parallel to, and in addition to the present system, and provide incentive for quality and productivity thereby improving farmers' income by avoiding pre-contracting and commission agents. The SAFAL Market is an establishment of an auction market through clock auction, backward linkage through farmer associations and a forward linkage in form of cash and carry semi-wholesale and retail stores. SAFAL Market comprises of a terminal market capable of handling approximately 1,600 tonnes per day of fresh fruits and vegetables at full capacity catering to an estimate of 30 per cent of Bangalore's demand (Chengappa and Nagaraj, 2005). The market infrastructure also has the facility of cold storage, grading, sorting and distribution. The business practices at the SAFAL Markets are transparent and competitive, thus the wholesalers are a bit hesitant and need more time to orient themselves to the new system while, on the other hand, growers have rapidly linked themselves with the new model. The farmers are made aware of the demand of the produce in advance by the procurement department of SAFAL and this ensures a consistent supply of produce in line with the market's quantity and quality specifications.

4.3.2 Backward Linkages

The market is supported by 250 Horticultural Farmers' Associations organized throughout India with more than 20,000 members. The farmers' associations are linked to 40 collection centres that are equipped to meet the specific or special requirements of buyers, in terms of quality, packing and weight. Individual growers are being trained in quality management aspects and provided extension services for production

enhancement, by introducing improved varieties, agronomic and plant protection practices, pre- and post-harvest management. Logistics support in terms of packing and transportation of produces is also arranged on behalf of the growers on a pre-fixed charge. More than 200 types and quality of fresh fruits and vegetables are sourced in SAFAL Market through standard quality, grade, weight and packing and is handled by the auction market.

Farmers or the wholesale purchasers have to register themselves with SAFAL Market on a very nominal charge and become its member, in order to involve themselves with the daily transactions. This is necessary to enable the SAFAL authorities to have consistent suppliers and takers and plan their future demand. Farmers cost to market their produce through collection centres of SAFAL has almost reduced by half. A traditional commission agent was charging them 8-10 per cent while the handling charges at SAFAL Market are only 4.25 per cent (Chengappa and Nagaraj, 2005). Farmers are provided payment for their produce on weekly basis in form of account payee cheque. Farmers selling their produce to SAFAL realize 10 to 15 per cent higher profit as compared with traditional channel (Chengappa and Nagaraj, 2005). They gain through proper weighing of produce, low transaction cost, less input cost, efficient transportation, less wastage, right price and extension services. Farmers are ready to supply more than the indent given by SAFAL. Farmers have appreciated the technical service rendered by the SAFAL. Farmers have felt that the SAFAL should make complete procurement of the produce at the farmers' field. Farmers have strong determination to develop their association.

4.3.3 Forward Linkages

Wholesalers participate in auctions at Auction Market Complex or can even bid using Remote Electronic System. The auction takes place in two parallels set up of clock auction halls. Wholesalers find it an added advantage to come at SAFAL terminal market where all the produce is auctioned at the same place rather than fragmented four product-specific wholesale markets in Bangalore. Although the SAFAL Market is located very far from the city and auction takes place in early morning, yet the purchasers find themselves in advantage dealing through SAFAL terminal market. Forward linkage is carried out through 10 to 12 cash and carry stores, owned by the auction market constructed at strategic locations in the city to cater to the requirements of the local retailers. Four distribution centres at the Auction Market Complex cater to the requirements of the large institutional buyers. Cold storage facility is also available for the wholesalers or other market users available on payment basis. Incentives to the wholesalers are assured in terms of availability of quantity and quality of fresh fruit and vegetables, graded and quality checked in wholesaler/retailer friendly packs for easy handling and transport. The state-of-the-art fruit ripening facility, assured quick and efficient dispatch of produce per auction, online wholesale price information of all items in major markets is also made available at SAFAL market to help buyers and suppliers in their decision making.

4.3.4 Constraints

SAFAL Market by and large has been operating successfully in overcoming the constraints that the fresh fruits and vegetables marketing is facing in India. It has been able to establish an efficient supply chain both in backward and forward linkages. An experiment of backward and forward integration provided by NDDB-SAFAL has benefited the farmers immensely (Chengappa, 2006). The up scaling of such models involving the private players and the government playing the role of a facilitator is crucial to make the farmers economically sustainable in the long run. But there are still certain constraints which, if taken care of, will further strengthen SAFAL Market model as a good example to be implemented in many other parts of the country. The backward integration at SAFAL has been able to bring together the farmers' lobby although they are still facing certain resistance and constrains from the wholesale traders. But moving ahead, SAFAL has recently set up a National Exchange of India, which is the country's first spot exchange for trading on perishable agri-commodities including horticulture, floriculture, dairy products and other allied commodities. This will provide online trading access to farmers, milk producers' organizations and traders across the country. The move to introduce high-tech farm terminals will attempt to provide backward and forward linkages and is an outcome of change in approach to agricultural marketing in India. Farmers are satisfied with timely payment, transparency, good price and quality of produce procured through the SAFAL Market.

4.3.5 Suggestions for Improvement

Overall some improvements and new interventions listed below, if designed into the system, will make the SAFAL Market run more successfully. Since SAFAL procures only the produce which complies with certain grade standards, thus the farmers are still forced to partly depend on the commission agents or village merchants to lift their remaining produce. Thus it is more desirable that the entire marketed surplus is collected by SAFAL, which will thus earn the farmers support in the long run. A direct procurement from the field would be an added incentive to farmers. Farmers have not been able to gain full faith in the working of SAFAL as of now as they believe that if they start transaction through SAFAL then they might lose the market through the traditional commission agents and will land them in trouble if this initiative fails.

Because of the better transportation and cold storage facilities, traders prefer to purchase highly perishable commodities from the SAFAL Market while the less perishable commodities (such as onion, potato and garlic) are exclusively procured from the regulated market by the traders. But location disadvantage to traders, inconvenient auction timings and more grading procedures keep many of the traders away from the SAFAL Market. The biggest challenge is to break the long prevailing and the very strong link of the commission agents. The introduction of this system impacts their incomes it is even more difficult to remove them from the supply chain.

SAFAL Market needs to mobilize large buyers like hostels of educational institutions, community hostels, hospitals, canteens of IT establishments in the same area, factories, other food retail chains, etc., in and around Bangalore to increase their traded volumes and run at full capacity. This might come through in next few years once more awareness is created among the farmers and wholesale buyers. A brand image will help them run the organization on higher volumes. More aggressive setting up of semi-wholesale outlets is needed in and around Bangalore to mobilise small buyers. Existing market outlets of Khadi and Village Industries Commission (KVIC), Horticultural Produce Cooperative Marketing Societies (HOPCOMS), Super Bazaars, should be used rigorously. SAFAL should try to meet the credit need of buyers as well as farmers, and play a role more than just being a wholesale market.

These are certain indicators for the SAFAL to take necessary steps in order to attract the traders and farmers and participate in this new initiative. SAFAL Market initiative is an example of improving the supply chain and thus leading to the development of all the stakeholders, with special benefit to the farmers. If the above prescribed suggestions are further included and improved upon the possibility of adoption of such a model market can be a key to the success of horticulture in India. In conclusion SAFAL Market in a short time has been able to increase integration between growers, wholesalers and retailers into the market system in contrast to the present traditional wholesale markets. SAFAL Market being a one-stop-shop for buyers and sellers of fruits and vegetables needs to create awareness in both buyers and sellers to congregate at a point.

5 Competitiveness of Horticulture in India[8]

Commodity that a nation should produce and export is determined by the principal of comparative advantage. The comparative advantage tells about that capability of the country to export a commodity, while the competitiveness of the commodity in the world market is determined by the measure of export competitiveness. Both the competitive and comparative advantage of selected fresh fruits and vegetables are computed and presented in this section. For the export competitiveness the nominal protection coefficient is computed, while revealed comparative advantage is computed to check the export competitiveness of the fruits and vegetables. In the present section the competitive and comparative advantage are computed for only those fresh fruits and vegetables that are being exported.

5.1 Nominal Protection Coefficient (NPC)[9]

In this section of the study we analyze the price competitiveness of selected fresh fruits and vegetables. Many studies have analyzed that Indian horticulture is competitive in terms of prices. Price competitiveness is measured by the concept of nominal protection

[8] For the purpose of the study only export competitiveness and export comparative advantage are measured. These concepts also apply to import competitiveness and import comparative advantage.

[9] Mattoo et. al (2007), Gulati et. al (1994), Gulati and Kelley (1999)

coefficient (NPC) (Mattoo et. al., 2007). NPC is the ratio of the price of domestic produce to the price of imported/exported products, after accounting for transportation cost and other marketing costs. In other word it is the ratio of domestic price and border price or the export reference price net of other costs. NPC basically helps in measuring the divergence of domestic price from the international price thus determines the degree of export competitiveness of the commodity in question (Gulati, et. al, 1994). The competitiveness of the commodities under consideration are treated under export hypothesis that implies that these commodities are treated as exportable and competes with the domestically produced commodities at a foreign port.

$NPC_i = P^d_i / P^w_i$

Where NPC_i : Nominal Protection coefficient of commodity i

P^d_i : domestic (India) price of commodity i.

P^w_i : World reference price (border price equivalent) of commodity i, adjusted for transportation, handling and marketing expenses.

If NPC is less than 1 then the produce is supposed to be competitive, thus implies that domestic prices are less than the international prices and thus India's produce is internationally competitive. Between the commodities lower the NPC more export competitive is the commodity for India. The definitions of domestic price, border price/ reference price are explained in detail before the results are presented. The data required for this computation are extracted from the trade databases obtained by India Trades and Personal Computer Trade Analysis System (PCTAS).

The domestic prices are computed at the four major centres in India -- Delhi, Mumbai, Kolkata and Chennai. These are taken as the representative of markets in the respective regions. The all-India NPC is calculated as the weighted average of NPC estimates at these regional markets, weighted by total arrivals in each market. The domestic regional price is the average monthly (month end) wholesale price prevailing in the local market in these four cities. The data is used for year 2005 which is obtained from the Indian Horticultural Database (2005) published by the National Horticulture Board. The annual price is the weighted average of monthly prices and the monthly arrivals are used as weights (Appendix Table A5-A8).

Border price can be computed either by using the international price adjusted for freight and insurance. Since the information on these components is not readily available or just approximations, the study uses the other way of computing border price. The unit export price, that is the Free On Board (FOB) price, is being used which is derived by dividing value of imports or exports by their respective quantities,[10] In the case of fresh fruits and vegetables the FOB prices are used due to lack of information on international prices.

[10] Due to this method, the quality aspect of the commodity is neglected which can be considered as a drawback.

The relevant border price or reference price used for calculations are obtained after deducting the transportation costs, that is deducting both the domestic and international costs, port clearing charges, marketing costs, trader's margin and the processing cost if any.

The extent to which a product has to be transported, marketed and processed, the cost encored on these impact the incentive a farmer gets from its export. Higher is the cost, lower is the incentive for the farmer to export the commodities. The profit margin and competitiveness reduces with increase in the cost component above the production cost. A high international cost in case of long distance export makes the commodity less competitive if the domestic prices are relatively high. Thus under the exportable hypothesis in order to compete with the foreign markets the domestic price has to be low enough to make room for the transportation costs (Gulati et. al, 1994). Border price needs to be adjusted to the marketing cost and distribution margin also. These consist of interest costs, handling expenses, storage charges, margins of wholesalers and other miscellaneous expenses. No particular data is available on such estimates. Certain primary data information and survey literature information are used to have an estimate of these costs and further used to deduct it from the FOB price to get the reference price and compute the NPC.

The prices used in computation of the NPC are presented in Table 24, based on the methodology discussed above. The average difference in the FOB price and reference price is about 25 per cent of the domestic price. This assumption is used for computing the results and under this scenario the prices are presented in the column of reference price 1. Further, if in future we need to make our commodities more competitive then these transportation costs need to be reduced. Keeping this into consideration the results for the scenario if the transportation cost, processing and margins cost are reduced to 20 per cent of domestic price and 15 per cent of domestic price are also presented as different scenarios. Based on these prices the nominal protection coefficient is computed and presented in Table 25.

Based on the domestic price and reference price the NPC is computed which shows that among fruits it is only for banana and papaya that the NPC is less than one. Thus in the fruits we are competitive only for these two products. In the vegetable category India is competitive in the export of brinjal, cabbage, cauliflower and peas. The NPC ratio is on margin for grapes and tomato. As the total cost of transportation, handling and margins get reduced, more fresh fruits and vegetables get added to the competitive category. This is also illustrated in Figures 3 and 4, as the cost reduces by 5 per cent, grapes and tomatoes become export competitive and a further reduction in these costs add sapota and onion in this category too. Also it is seen that, since the farm gate prices are less than the market price thus a direct procurement from farm gate would reduce the in-between costs of transportation[11] and commissions of the middle men. This would help make some of

[11] Estimates about the transportation costs are picked up from the literature, the most recent one of Mattoo et. al (2007).

Table 24: Domestic price, FOB price and reference price, 2005

(Unit: Rs/Qtl)

Commodities	Domestic Price	FOB price	Reference Price 1	Reference Price 2	Reference Price 3
Fruits					
Apple	2987	1135	851	908	965
Banana	572	1048	786	838	891
Lime/ Lemon	1162	794	596	635	675
Mosambi	1619	1269	952	1015	1079
Orange	2124	1047	785	838	890
Grapes	2466	3250	2438	2600	2763
Litchi	3252	1301	976	1041	1106
Mango	1578	1676	1257	1341	1425
Papaya	761	1435	1076	1148	1220
Pineapple	1213	1388	1041	1110	1180
Sapota	907	1105	829	884	939
Vegetables					
Brinjal	580	4699	3524	3759	3994
Cabbage	371	1064	798	851	904
Cauliflower	497	1768	1326	1414	1503
Onion	622	740	555	592	629
Peas	862	2077	1558	1662	1765
Tomato	600	792	594	634	673
Potato	440	481	361	385	409

Note: *Reference Price 1 is the price with the transportation cost etc as 25 per cent of the domestic price. Reference Price 2 is the price with the transportation cost etc as 20 per cent of the domestic price. Reference Price 1 is the price with the transportation cost etc as 15 per cent of the domestic price.*

the commodities more competitive for exports. Transportation cost in India is about 20-30 per cent higher than that in other countries, which works as an hindrance and a disadvantage to India's exports. When the air transportation is used for exporting produce then the price is about 45 per cent higher than the retail price and in case of maritime transport the price is 25 per cent higher than the retail price. This calls in for development of ports in major port cities exclusively for export of perishables. Due to expensive transportation the Indian produce becomes expensive and lose its competitiveness. Within the country also the transportation infrastructure is very

Table 25: Nominal protection coefficient under exportable hypothesis

Commodities	NPC under Scenario 1	NPC under Scenario 2	NPC under Scenario 3
Fruit			
Apple	3.51	3.29	3.10
Banana	0.73	0.68	0.64
Lime/ Lemon	1.95	1.83	1.72
Mosambi	1.70	1.59	1.50
Orange	2.71	2.54	2.39
Grapes	1.01	0.95	0.89
Litchi	3.33	3.12	2.94
Mango	1.26	1.18	1.11
Papaya	0.71	0.66	0.62
Pineapple	1.17	1.09	1.03
Sapota	1.09	1.03	0.97
Vegetable			
Brinjal	0.16	0.15	0.15
Cabbage	0.47	0.44	0.41
Cauliflower	0.37	0.35	0.33
Onion	1.12	1.05	0.99
Peas	0.55	0.52	0.49
Tomato	1.01	0.95	0.89
Potato	1.22	1.14	1.08

Note: *Scenario 1 if reference price 1; Scenario 2 if reference price 2 and Scenario 3 if reference price 3*

expensive. The fuel price and border taxes make the transportation of produce from one part of the country to other more expensive. In addition there is a traders' margin which is estimated to be 6-8 per cent of the landed cost (import CIF price + port charges).

According to the latest World Bank report (Mattoo et. al., 2007) the biggest obstacles to the competitiveness of India's horticultural exports lie outside the sector rather than inside it. The average price at the farm gate for a typical horticulture product is just 12-15 per cent of the price at which it is retailed. So, a 20 per cent improvement in yields can translate into only 2.4-3 percentage points reduction in the final price, whereas a 20 per cent reduction in international transport costs can reduce final prices by 8-10 percentage points (Mattoo et. al, 2007).

Figure 3: Nominal protection coefficient of major fresh fruits

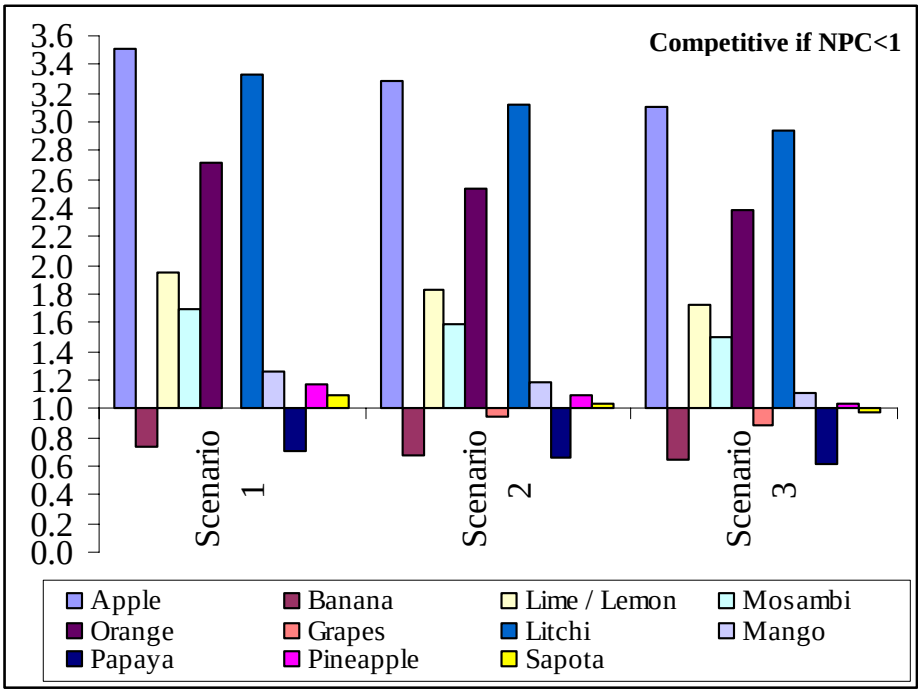
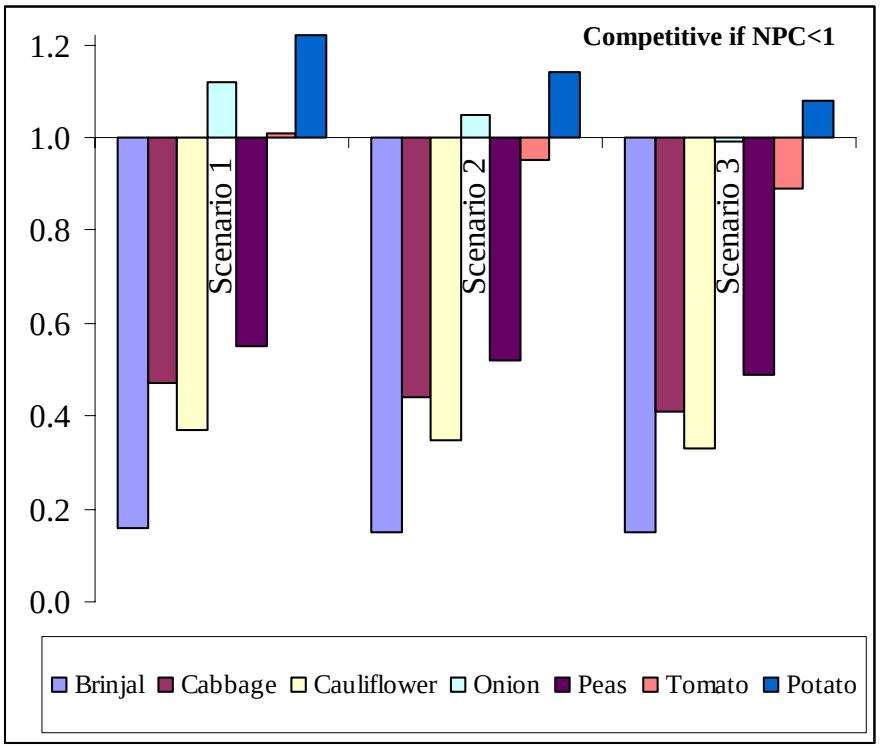


Figure 4: Nominal protection coefficient of major fresh vegetables



5.2 Revealed Comparative Advantage (RCA)

Revealed comparative advantage ratio has been used to study the export comparative advantage of the products. The ratio is defined as:

$R_{ih} = (X_{ih}/ X_{it})/ (X_{wh}/X_{wt})$

Where

R_{ih} = Revealed comparative advantage ratio for India in product h

X_{ih} = India's exports of product h

X_{it} = Total exports of India

X_{wh} = World exports of product h

X_{wt} = Total world exports

The RCA ratio is the share of a given product in a country's exports to its share in world exports. A country is said to have the revealed comparative advantage in the product if the ratio is greater than one. The RCA ratio less than one implies a disadvantage. The ratio is influenced by the individual countries' internal and external trade policies like government interventions, import restrictions, subsidies and high tariffs, etc. Thus, a disadvantage may not be a true picture of the comparative status, but it may also indicate that the trade policies are not in favour of the exports of the produce.

The results of the RCA ratio for major fruits and vegetables are presented in Table 26. The results are presented for the years 1999 to 2005. The ratios are computed based on the HS classification of the products as presented in Appendix Table A1. Among all the major fruits and vegetables that we produce and export the ratio is above one for mango and guava in the fruits group and onion in the vegetables group for all the years. The ratio for these two produce have been increasing since 1999 and the magnitude of the ratio is huge. This implies that the comparative advantage of these produce has increased over time, India has very high comparative advantage. For peas RCA ratio has been above one for years 2002 and 2003 but in 2004 and 2005 again the RCA is less than one. Mosambi had the RCA ratio less than one from 1999 till 2002, after which its ratio was 7 in 2003 which increased to 9.37 in 2004 but has come down to 2.97 in 2005. In mosambi and citrus fruits other than orange and lemon India has gained comparative advantage. For papaya, India had the comparative advantage in 1999, 2000 and 2002, the ratio has now declined to 0.89. This implies that India has lost its comparative advantage in this commodity. The change in pattern of comparative advantage is also illustrated in Figure 5 for selected fresh fruits and vegetables. RCA for grapes declines and later rise up to 1.17 in 2005, implying that grapes become comparatively advantageous for India to export. For all other fruits and vegetables India is not having any revealed comparative advantage in exports.

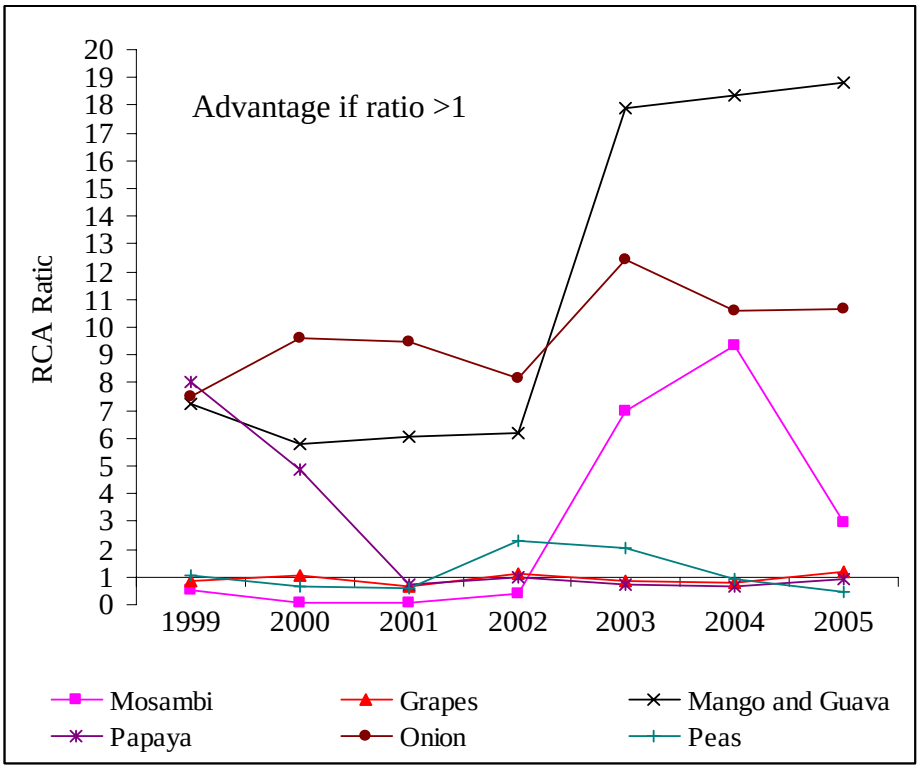
Table 26: Revealed comparative advantage of exports of fresh fruits and vegetables from India to the world

Commodities	1999	2000	2001	2002	2003	2004	2005
Fruits							
Apple	0.12	0.05	0.15	0.13	0.09	0.16	0.21
Banana	0.09	0.14	0.12	0.08	0.07	0.07	0.10
Lemon	0.15	0.25	0.29	0.15	0.23	0.16	0.20
Mosambi	0.54	0.09	0.08	0.40	**7.00**	**9.37**	**2.97**
Orange	0.51	0.54	0.52	0.35	0.59	0.30	0.31
Grapes	0.87	**1.06**	0.69	**1.09**	0.86	0.81	1.17
Mango and Guava	**7.22**	**5.78**	**6.07**	**6.16**	**17.92**	**18.37**	**18.83**
Papaya	**8.01**	**4.85**	0.71	**1.00**	0.75	0.68	0.89
Pineapple	0.04	0.12	0.11	0.07	0.08	0.06	0.11
Vegetables							
Brinjal	0.00	0.00	0.00	0.00	0.22	0.27	0.07
Cabbage	0.00	0.02	0.00	0.00	0.01	0.00	0.00
Onion	**7.48**	**9.59**	**9.48**	**8.15**	**12.41**	**10.57**	**10.63**
Peas	**1.08**	0.69	0.61	**2.32**	**2.04**	0.93	0.45
Tomato	0.01	0.01	0.01	0.08	0.04	0.03	0.05
Potato	0.35	0.35	0.08	0.23	0.46	0.42	0.60
Sweet potato	0.03	0.19	0.10	0.06	0.07	0.03	0.16
Lettuce	0.00	0.02	0.01	0.01	0.05	0.06	0.03
Beans	0.01	0.06	0.00	0.01	0.11	0.13	0.11

Note: *Highlighted in bold are the ones with comparative advantage*

If a commodity has a comparative advantage then it means that the share of this country exports is increasing in the world total share, but this commodity might not be export competitive in price terms. Thus it means that the high delivery cost impacts the competitive of our fresh fruits and vegetables, due to this commodities in which we might have comparative advantage lose in the world market due to high costs of delivery. The best example for this are onion and mango. Mattoo et. al., 2007 confirms that apart from quality problems and policy barriers Indian exporters have to face an important impediment which significantly erodes the production cost advantage enjoyed by Indian farmers. Domestic and international transportation cost is the single largest contributor to the retail price, accounting for nearly 25-40 per cent of the price.

Figure 5: Change in revealed comparative advantage of certain commodities from 1999 to 2005



Export competitive commodities

Fruits: Banana, Papaya

Vegetables: Brinjal, Cabbage, Cauliflower, Peas

Commodities with comparative advantage

Fruits: Mosambi, Mango and Guava,

Vegetables: Onion

5.3 Mapping the States with Export Potential

Various constraints, strengths and development plans of individual states have been highlighted in details in the state horticultural mission documents.[12] Based on these parameters even district clusters in each state has been identified by these mission plans. This section of the study identifies the potential states for the identified fruits and vegetables, for which we are globally competitive and have comparative advantage in production. These states should be targeted for enhancing the export potential of the country. In various states various agricultural economic zones (AEZ) for specific crops primarily for the purpose of exports have been set up under the horticulture mission. Setting up of processing units will help in enhancing the export potential of processed and dried fruits ands vegetables also. Table 27 presents the identified states which have the export potential for exports of selected fruits and vegetables. These states are identified on basis of their share in country's production, which are presented in detail in Table 28.

Andhra Pradesh and Maharashtra are the most important producers of all the identified fruits and vegetables. In Andhra Pradesh AEZ for gapes, mango, and mango pulp have been developed to enhancing exports. For mango, Andhra Pradesh and Uttar Pradesh together have a share of 50 per cent production in the country and a large number of export mango varieties are produces in these two states. AEZ for mango have also been developed in Tamil Nadu and Gujarat. For banana, Maharashtra and Tamil Nadu are the most important identified states. Maharashtra alone has about 80 per cent of country's grape production and also is the leading hub for export of grapes to Bangladesh, the Netherlands, UK and UAE. Mosambi has the highest production in Andhra Pradesh and Maharashtra. For the vegetables in onion, Maharashtra is the lead producer with about one-fourth of country's production. West Bengal and Orissa can be targeted for export of brinjal, cabbage and cauliflower. Uttar Pradesh has the export potential for peas. The identified states are leaders in the production and major suppliers of these fruits and vegetables to other parts of the country. Development of infrastructure, minimizing post-harvest losses could create surplus for exports in these states. The availability of fruits and vegetables in the market has a small window. To make exports feasible, along with the states' production window, the demand window of the potential export markets should also be identified, which will help in targeting the states for exports at a particular time of the year. This would also help in maintaining a continuous supply at the time of demand.

[12] State horticultural missions have major emphasis on fruits and for vegetables only on seed production.

Table 27: States to be targeted for enhancing exports

States	Fruits						Vegetables				
	Mango	Banana	Grapes	Guava	Papaya	Mosambi	Onion	Brinjal	Cabbage	Cauliflower	Peas
Andhra Pradesh	√	√	√	√	√	√	√	√			
Bihar	√			√				√	√	√	
Gujarat	√	√			√		√	√			
Haryana										√	
Himachal Pradesh											√
Karnataka	√	√	√	√	√		√				
Madhya Pradesh		√					√				
Maharashtra		√	√	√	√	√	√	√	√	√	
Orissa								√	√	√	
Punjab				√							√
Tamil Nadu		√	√								
Uttar Pradesh	√			√							√
West Bengal				√	√			√	√	√	√
Assam									√	√	
Jammu & Kashmir											√

Table 28: Share and ranking of states in country's production

States	Fruits						Vegetables				
	Mango	**Banana**	**Grapes**	**Guava**	**Papaya**	**Mosambi**	**Onion**	**Brinjal**	**Cabbage**	**Cauliflower**	**Peas**
Andhra Pradesh	27.0 (1)	7.6 (5)	2.4 (4)	7.2	34.1 (1)	69.2 (1)	9.4 (4)	5.7 (5)			
Bihar	7.5 (4)	5.7		15.2 (1)			1.7	12.3 (3)	15.5 (2)	13.3 (3)	
Gujarat	6.3 (5)	12.2 (3)		5.1	9.3 (5)		19 (2)	8.6 (4)	4.2	4.8	
Haryana							4.6	2.0	2.7	6.0 (5)	4.1
Himachal Pradesh											9.2 (2)
Karnataka	9.5 (3)	8.0 (4)	10.8 (2)	9.0 (3)	9.9 (3)		13.3 (3)	4.5	2.7		
Madhya Pradesh		4.1			1.0		8.3 (5)	2.7	2.7	1.2	2.7
Maharashtra	5.5	27.9 (1)	79.8 (1)	12.6 (2)	21.5 (2)	30.0 (2)	25.6 (1)	5.4	5.7 (5)	6.3 (4)	
Orissa	3.6			5.3			3.8	21.3 (2)	15.1 (3)	14.2 (2)	2.1
Punjab			2.1 (5)	7.6						2.8	5.1 (5)
Tamil Nadu	4.6	21.3 (2)	4.5 (3)	3.8	2.1		4.0				
Uttar Pradesh	22.3 (2)			8.8 (4)			3.3		3.4	2.8	52.4 (1)
West Bengal	4.0	3.2		8.4 (5)	9.9 (4)			31.0 (1)	30.3 (1)	37.4 (1)	6.2 (3)
Assam		3.6			3.9			2.0	7.9 (4)	5.6	
Jammu & Kashmir											5.7 (4)

Note: *Share is in per cent and ranks in parenthesis; Blanks indicate negligible or zero share.*

5.4 Potential Export Competitors

Based on the exports quantity and share from the export data in last five years, the potential competitions to our exports have been identified and presented in Table 27. As shown in the earlier sections majority of India's exports go to the neighboring countries like Bangladesh, Sri Lanka and Nepal. UAE is another important export market for Indian fruits and vegetables. Our biggest competitor is China which has a huge production base with an efficient supply chain and better infrastructural facilities. This can act as disadvantage to India. For some of the produces India has the largest market share in the countries where the product is exported. Grapes is one such commodity. We face competition from Australia in our grapes exports to Bangladesh, and from USA in exports to UAE. India's market share of exports of apple, lemon, pineapple face competition with South Africa and Kenya. For mango, guava and potato, Pakistan is our competitors in the South Asian countries. These countries can give India a tough competition if right export strategies are not adopted.

Table 29: Identified potential competing countries

Crops/ Groups	Potential Competitors
Fruits	
Apple	China, S. Africa
Banana	Oman, Singapore, Philippines
Lemon	S. Africa, Jordan, Iran
Other Citus Fruits/ Mosambi	Spain, France, S. Africa, Thailand, Netherlands
Orange	Bhutan
Grapes	Austraia, USA, S.Africa, Syria, Chile
Mango and Guava	Mexico, Brazil, Peru, Pakistan
Papaya	Malaysia
Pineapple	Thailand, S. Africa, Philippines, Malaysia, Kenya
Vegetables	
Brinjal	Netherlands, Spain, France, Kenya
Cabbage	Spain, Netherlands
Cauliflower	Mexico, Australia, China, Singapore, UAE
Onion	Thailand, Netherlands, China, Pakistan, Indonesia
Peas	Syria, Egypt, Greece, Kenya
Tomato	China
Potato	Pakistan
Sweet Potato	Thailand, Indonesia, Vietnam
Beans	Jordan, Kenya, Oman, Zambia, Iran, Egypt

In spite of our broad production base, due to inefficient post-harvest handling and huge domestic demand, the availability for exports is limited. Poor infrastructure in terms of storage, transport, cargo space, facilities at air/sea ports, vapour heat treatment, etc, insufficient institutional support credit arrangement, promotion of Indian fruits and

vegetables overseas and low research and development efforts in terms of quality and productivity comparable to those in other producing and exporting countries are the major constraints to the export of fresh fruits and vegetables. The institutional arrangements for widening the production base for exports, efficient post-harvest processing/handling and product promotion technology, timely availability of inputs, credits, creation of strong infrastructure are required to be able to protect the exports markets and have good export performance and marketing.

6 Lessons from Other Developing Countries

World trade of fruits and vegetables is estimated to be more than US$60 billion. The world trend is towards increase in fruits and vegetables production in the coming years, but the trend is not the same in all the major producing countries. The largest increase in production for both fruits and vegetables has been in Asia and South America. China, India, Brazil and Chile are the major countries. USA is among the major exporter of these fresh produce and European Union (EU) market is one of the world's largest markets for fresh horticulture produce. This market has been growing steadily in quantity and quality for the past two decades, and presents a significant trade opportunity for a number of developing countries. The consumption of fruits and vegetables across the world has also seen a rise and is likely to increase in future also. This requires further increase in production by diversification, efficiency gains through post-harvest management and increasing per hectare productivity. There are certain developing nations which have success stories to share and lessons to learn from. The experience of the development of the fruits and vegetables sector in Africa, Thailand, Israel and China are presented in this section. These experiences are picked up from the literature for policy lessons.

Africa,[13] Kenya and Côte d'Ivoire

Africa's share of the world trade has declined by nearly 60 per cent, as they remained heavily dependent on export revenues from a limited number of traditional agricultural commodities, such as coffee, cocoa, or cotton, whose terms of trade have, over the past three decades, been continuously declining. But contrary to this trade in high-value agricultural products is growing at 7 per cent annually. The World Bank rural development strategy notes that high-value products like fruits and vegetables provide an opportunity for farmers in developing countries to compete for a share of lucrative export markets (Source: "Reaching the Rural Poor: Strategy and Business Plan," The World Bank, 2003).

Some remarkable successes have been achieved by countries in Africa that have managed to diversify their export base into non-traditional agricultural products with market growth opportunities and higher value such as cut flowers and plant cuttings, fresh fruits and vegetables, as well as processed products such as canned pineapple and pre-cut and pre-packed vegetables. Countries like Kenya, South Africa, Côte d'Ivoire, Uganda or

[13] Omasa (2002) and Minot and Ngigi (2003)

Zimbabwe have experienced over time a sustained growth and expansion in their export earnings from non-traditional agricultural products and have in some cases even emerged as market leaders for some of these products, like pineapple, French beans, baby corn, cut flowers, papaya and mangoes. These products have a relatively high value per unit and/or high perishable character, are produced and processed under intensive use of land, labour, knowledge, financial means and other inputs and are often not exclusively produced for export markets. In view of the comparative advantage of many African countries in producing them, they offer substantial prospects for further export growth in the sub-Saharan Africa due to the relative proximity of the large and growing consumer markets of Europe and the Middle East, as well as the potential increase in demand on the sub-regional and domestic markets.

Success of sub-Saharan Africa is that the most successful exporters - Kenya, Côte d'Ivoire -- launched their horticultural exports relying on basic production factors -- access to logistic infrastructure linking production locations to international consumer markets, availability of production and distribution facilities to control temperature, solar radiation, humidity and irrigation, transparent and guaranteed management information systems, support from facilitating service industry (i.e. finance, input and equipment supply), and entrepreneurial management and horticultural specialists. Kenyan horticultural exports are indeed a success story. Horticulture has become the third largest foreign exchange earner, more than half the exports are produced by smallholders, and smallholders gain from producing for the export market. Côte d'Ivoire is not a big success story because most of the exports are produced on large industrial estates and growth has been uneven. Ivorian exports rely on preferential access to European markets relative to Latin American exporters, raising doubts about sustainability. Many of the lessons of Kenyan horticulture can be applied elsewhere in Africa.

For the fruit and vegetable industry, a number of general strengths and opportunities as well as weaknesses and threats were identified. A strong point is the favourable agricultural and ecological factors, offering the possibility of a large variety of products. Also the rising urban demand and dynamic trading at a regional level provides relatively safe training opportunities. Other strengths are growing market demand for out-of-season produce and favouring geographical aspect. The threats are a mixture of constraints to primary production level and aspects such as difficult access to credits, inadequate cold chains, non-tariff regulations as the European regulation on pesticide residue limits and lack of knowledge of such non-traditional markets as Maghreb and the Middle East.

Kenya saw a strategic horticultural development plan, starting around 1974. Kenyan fruit and vegetable production and exports began to grow more rapidly. Overall, fruit and vegetable exports rose to US$95 million in 1990 or 8 per cent per year in real terms over the period 1974-90. The importance of fruit and vegetable exports in overall agricultural exports increased dramatically during this period. Whereas fruits and vegetables accounted for about 3 per cent of agricultural export earnings in the 1960s and early 1970s, by 1990 its contribution had reached 14 per cent. In the mid-1970s, this growth was driven by investments that increased the capacity of the Kenyan pineapple processing industry. Between 1974 and 1977, pineapple product exports grew more than

sixfold, so that by 1977, they accounted for 65 per cent of Kenyan fruits and vegetables exports. In contrast, the growth in the late 1970s and 1980s was driven by the growth in exports of fresh vegetables and, to a lesser degree, fresh fruit. The diversification into fruits and vegetables was partly motivated by world commodity prices. After peaking in 1977, coffee and tea prices fell sharply in the following years, forcing many farmers to look for alternative income-generating crops. At the same time, export demand for vegetables grew in the 1970s. The demand came from the UK markets where a large number of South Asians, who migrated from Uganda (due to a political conflict there at that time) to the UK, where they settled down. Kenya had the experience of growing Asian vegetables for the local Asian community, so the farmers did not face problem in fulfilling the demand coming from the upcoming market. Another factor behind growth of fruits and vegetable production was the growth in Kenya's tourism industry. Also, the tourism industry increased the demand for high quality fruits and vegetables by hotels and restaurants, giving Kenyan farmers more experience in horticultural production. Thus, the horticultural sector in Kenya has benefited from the development of Nairobi as a regional hub and as an important tourism destination.

The growth in Kenyan horticultural exports is also linked to the increasing involvement of smallholders in the sector. In the early 1970s, no more than several hundred smallholders were producing for the fresh fruit and vegetable export market, accounting for just 10-20 per cent of the total volume. Low international prices for coffee and tea made it economical to involve smallholders in export horticulture. Coffee prices boomed again in the 1980s, but by then many smallholders had acquired skills in horticultural production. At least as important, exporters began to recognize the potential of smallholder to meet the growing European demand. By the mid-1980s, there were 13,000 to 16,000 smallholders involved in growing fresh produce for export. They accounted for 40-65 per cent of the suppliers of French beans, Asian vegetables, mango, avocado and passion fruit for export. Smallholders also play an important role in growing French beans for export. Fresh and canned French beans have become one of the most important horticultural exports from Kenya. The advantage of lower labour and land costs, combined with the rising need for suppliers, who can provide produce throughout the year resulted in a shift towards sourcing French beans and other vegetables in North Africa and sub-Saharan Africa. This growth was the result of continuous experimentation by farmers and traders with alternative institutional arrangements. Alternative institutional arrangements to provide inputs on credit, obtain reliable high quality supplies, and ensure repayment of loans acted in favour of the horticultural diversification and growth. In 1990, around 24,000 contracted smallholder farmers growing French beans and other vegetables.

All the fruit and vegetable production for export is not grown by smallholders. Technological change in production and increasing international competition were also encouraging larger-scale operations and vertically integrated producer-processor operations. According to the FAO, the growth of Kenyan fruit and vegetable exports slowed in the 1990s. Kenya and other horticultural exporters in Africa faced new challenges due to changes in the structure of consumer demand and to the transformation of the food retail market in Europe. Kenya's ability to maintain and strengthen its role in

horticultural exports will depend largely on its ability to adapt constructively to these changes -- rise of supermarkets, increasing concern over food safety, increasing demand for convenience, increasing demand for convenience. Kenya horticulture currently enjoys duty-free access to European markets as a result of the Lome Agreement, which was recently renewed for the period 2000-05. Trade liberalization will, therefore, probably erode this preferential access. An analysis indicates that Kenya may eventually face greater competition from Egypt, South Africa, Chile, Brazil and Thailand if the EU liberalizes imports. Even without trade liberalization, horticultural markets are highly competitive subject to rapid shifts in export competitiveness. Export comparative advantage evolves continuously in response to changes in markets, technology and other competitors. A better strategy would be to provide infrastructure and other public goods and facilitate investment in general, allowing private firms to test the competitiveness of each sector.

In Kenya, unlike other major agricultural sub-sectors where both external and domestic trade has been under tight government controls, the marketing of horticultural products has generally been free of direct government interventions. With the exception of onions, the government has not been directly involved in the pricing or performance of physical functions of horticultural marketing. The role of the government has been minimal and mainly confined to regulatory and facilitative functions. Government is involved in provision of extension services and promotion through research and development. Kenya Agricultural Research Institute (KARI) has entrusted the task of research and development of horticultural products to the National Horticultural Research Institute.

Export channels vary widely, the four largest fruit and vegetable exporters contribute 40 per cent of the production from their own farms. Another channel involves exporters who contract farmers to produce fruits and vegetables for export. The agreements between exporters and farmers are often verbal and therefore subject to frequent disputes. When exporters contract directly with farmers, they are often large or medium-scale farmers Among the four largest fruit and vegetable exporters, about 40 per cent of supplies are obtained from large-scale commercial farms and only 18 per cent from smallholders. A third channel involves various types of intermediaries between the farmer and the exporter. Small farmers and those who do not live in the main production zones often rely on traders or brokers to assemble produce for resale. Sometimes a large farmer who has a contract with an exporter will coordinate the production and marketing of some of the produce by smallholders living nearby. These are more likely to be spot market transactions. A third type of intermediation is community-based organizations. Through self-selection and peer monitoring, such groups also provide some assurance of quality and commitment. Exporters use spot market purchases to fill in gaps between their regular supply. The export sector has become more concentrated over the 1990s, due to the increasing role of supermarkets as importers and the premium they give for reliability of supply, consistency of quality and documentation of production conditions.

Several factors have contributed to the success of the horticultural sector in Kenya and Côte d'Ivoire: a realistic exchange rate, stable policies, a good investment climate, competitive international transport connections, institutional and social links with

markets in Europe, and continual experimentation with the market institutions to link farmers and exporters. Smallholder participation is encouraged by farmer training and extension schemes, investment in small scale irrigation and assistance in establishing links with exporters. Favourable geography and climate allowing the production of tropical fruits such as mangoes, pineapple and avocados, as well as temperate vegetables such as French beans., easy and cheap availability of air transport and sea route to Europe. The growth of the Kenyan tourism industry and the consequent frequency of air connections with Europe have facilitated the development of fresh produce exports to Europe via air freight. In Côte d'Ivoire, much of the horticultural export is by sea freight, so investment and efficient management of the port in Abidjan is of critical importance. Domestic transportation infrastructure is also an important factor since horticultural exports do not tolerate delays in getting to the airport. The Kenyan horticultural sector benefits from an extensive road network in the highland areas. It is estimated that much of the export vegetable production in Kenya takes place within 100 kilometres of the airport. Similarly, banana production in Côte d'Ivoire is concentrated along paved roads near the port.

Another factor that helped in the success is the limited direct government intervention in horticultural markets. State enterprises were actively involved in various horticultural processing operations, often as part of joint ventures with foreign companies. Most of the growth in horticultural exports, however, has been in fresh produce. The investment climate in Kenya was good as compared to many other African countries, which allowed investment in the horticultural sector by the local and international firms. Similarly, Côte d'Ivoire is said to have followed an agriculture-led development strategy and kept direct intervention in agricultural markets to a modest level. Probably the area of greatest direct involvement in the horticultural sector was in the pineapple processing, where joint ventures between private investors and various public institutions were the rule. African governments ventured into the risky area of fresh produce marketing. Both Kenya and Côte d'Ivoire had relatively liberal policies regarding foreign investment and investment by local businesses. In both countries, foreign investment has contributed to increasing the capacity of horticultural production, processing and export.

Both Kenya and Côte d'Ivoire had reputations for political and macro-economic stability in the 1960s and 1970s, which is necessary to elicit long-term investments in productive capacity. Similarly, a realistic exchange rate, which gives exporters the full value of the foreign exchange they generate, is a critical factor in stimulating exports, including horticultural exports. The Kenyan Government has allowed and (in some cases) promoted the development of a wide range of private marketing institutions such as the Fresh Produce Exporters Association of Kenya (FPEAK), local producers' associations, self-help groups and so on. In addition, it has allowed experimentation with a wide range of institutional arrangements between farmers and buyers. In spite of early attempts to oblige processors to work with smallholders, greater leeway is now given for the most economical arrangement to evolve in response to market signals. Over the decades, Kenyan participants in the horticultural sector have accumulated considerable experience in managing the relationship between growers and buyers. Today, contract farming may be more widely used in Kenya than anywhere else in Africa, though conflicts between

farmers and buyers are an almost universal feature of these schemes. In Côte d'Ivoire, the government has created a series of institutions to coordinate horticultural exports with varying success. The presence of the Asian community in Kenya has undoubtedly contributed to horticultural crop development. In addition, the presence of the Asian community made it easier to penetrate the UK market, first with Asian vegetables and later with French beans and other fresh produce.

Both Kenya and Côte d'Ivoire have invested in horticultural research, developing institutions that have their roots in the colonial period. The fact that horticulture often involves new crops or new varieties to satisfy the export market only increases the need for research and extension efforts. Disease control and post-harvest processing are also particularly important in the case of horticultural research. And new sanitary and phyto-sanitary requirements by importing countries create a demand for research into ways to reduce or eliminate pesticide residues and prevent the spread of horticultural pests. Exchange rate policy is particularly important for horticultural exports. A market exchange rate provides greater incentives to produce for exports (including horticultural exports). Furthermore, a liberalized market for foreign currency facilitates the purchase of imported equipment and inputs for production. This is more important for horticulture than for field crops because of the need for imported seed, agricultural chemicals, and specialized equipment. The Kenyan experience demonstrates the importance of allowing a variety of private institutions and marketing arrangements to develop. The horticultural sector in Kenya is characterized by a wide array of institutional arrangements including smallholders selling in spot markets, personalized relationships with traders, implicit contract, explicit contracts, farmer organizations, medium- and large-scale farming, and vertically integrated producer exporters. Many commodity channels involve various scales of production and several types of farmer-buyer linkages. The government can play a role in facilitating institutional innovation through the provision of market information, extension services, mediation of disputes and the establishment of standards.

Linking small farmers to high-value urban and export markets is an important strategy for raising rural incomes and reducing poverty. Such a strategy may also be critical for maintaining export competitiveness. The government can facilitate linkages between farmers and exporters or other buyers by helping to organize farmers groups, establishing ground rules for farmer-buyer contracts, dissemination of information about the lessons learned from successful contract schemes, establishing small-claims courts to address contract disputes, gathering and disseminating information about the past performance of buyers and farmers and providing certification services to reduce the transaction costs faced by buyers trying to purchase from many small farmers. The importance of air freight costs in the competitiveness of export horticulture has implications. The aviation industry is heavily protected in most parts of the world, with regulations controlling access by foreign carriers. The positive contribution of the Asian traders to Kenya’s horticultural development has lessons for other developing countries. Ethnic minority trading communities are a common feature across the world, from the Chinese in Malaysia to the Lebanese in West Africa. Although public and private investment in irrigation has facilitated the growth of the horticultural sector, the implications must be drawn carefully. Large-scale public irrigation projects in Kenya and elsewhere in Africa

have often proven to be uneconomic and unsustainable. Problems have arisen from the high cost of irrigation, the lack of adequate feasibility analysis and problems in managing and maintaining the system after completion. In the past 10 years, most of the investment and increases in capacity in Kenyan irrigation have been carried in the private sector, by large-scale commercial farms and by groups of smallholders.

Clearly, the development of export horticulture depends in part on geography, historical accident, and agro-climatic factors. Because of these factors, some countries do not have the potential for large-scale horticultural development even with the best policies and investment. Many of the factors that have contributed to the success of the horticultural sectors in Kenya and Côte d'Ivoire are, however, subject to influence through policy, regulation, and public investment. Furthermore, most of the lessons derived from the Kenyan and Ivorian examples make sense for the development of commercial agriculture, regardless of whether or not horticulture is involved.

Thailand[14]

Thailand is one of the leading fresh fruit and vegetable producers in Asia and Pacific regions. Country strategic plan to encourage commercial production of fresh produce for export, local consumption and processing has been focused. Thailand being an agricultural producer country, about 60 per cent of the total population is in the agricultural sector and farm certification is a big task. Business cluster of growers and between growers and traders is emphasized to certify in group and to strengthen fruit trade of the country. Also, safety and quality of fresh fruit and vegetable have been emphasized. Food safety and quality management system (QMS) schemes in Thailand's agriculture and food sectors is widely recognized for the growth of the horticulture sector for exports. Thailand has gradually developed QMS of Good Agricultural Practice (GAP) for on-farm production by modifying concepts of international standards since 2001. The system has been developed to assure safety and quality of food, especially fresh fruits and vegetables. The system was announced to public on September 25, 2002, to ensure growers, traders and customers get familiar to the system. Two years later, the government emphasized their policy by campaigning *Food Safety Year 2004* to make people be aware of safe and quality food. The system associated with management system to prevent, eliminate or minimize physical, chemical and biological hazards, to produce free of pests and marketable quality acceptance from farm through distribution of fresh fruits and vegetables for markets and processing. Other agricultural crops such as rice, herbs and field crops are also included. It is also the applicable practices for growers to ensure safety and quality of fresh produce for customers. The on-farm management system is emphasized on integrated pest management (IPM) and integrated crop management (ICM). The system helps in post-harvest management. Key success of quality management system in Thailand is the strong support by government policy makers. The proposed system is accepted and practised by growers and traders. As a

[14] Surmsuk Salakpetch (2005)

result, the trade and consumer awareness for food safety has increased. But still some obstacles have to be removed by increasing the education and extension activities to create awareness for growers and other industry stakeholders (produce collectors, packers, wholesalers, processors and retailers). Consumer groups need to be encouraged to stimulate demand for safe and quality food. Government officials and others involved in the quality management system are encouraged to be educated and well understood at each level in the system. Private sector and others interested in the system are welcome since implementation may be limited by the capacity of government organization to provide resources.

Israel[15]

Israel was established 50 years ago but the agricultural research has started in the then Palestine 75 years ago. The belief that for development of modern agriculture there is a need to invest in research was the motivation for agricultural growth. The developmental stages of the Israeli modern horticulture may be divided into five phases. The first phase saw the establishment of east to handle fruit products like wine grapes and almonds. The reason for promoting crops was the notion that with limited transportation means, limited local demand, and with limited added irrigation these are the best options. With expansion of irrigation facilities in the second phase citrus orchards were developed mainly for export. In the third phase, widening the variation of fruit crops for local consumption and some part for export was initiated. Later in the forth phase due to reduced profitability of export and increase of local demand led to increase in production for the local market at the expense of export. Opening of the markets to importation leads to improvement in production efficiency. Increased interest in the agricultural development led to the concentration of efforts that led to a rapid expansion of this horticultural branch by introducing many new species. At present the aim is to concentrate on niche markets with a high return for specialty product for export and local market and reduce labour involved in horticultural crops. In the local market the efficiency increased due to competition from other countries. Horticultural products that require intensive use of certain production factors will fit in the country where these factors exist in relative abundance. Product differentiation gives the local producers a competitive advantage in specific market niches. One of the means of achieving differentiation is by viewing agriculture as a link on the value-added chain from the producer to consumer, including the retailers. Adjusting the product to the retailers' needs can provide agriculture with a competitive advantage. Fitting the retail marketing outlets to the special characteristics of the fresh and bulky agricultural products can provide an additional advantage.

[15] Erez et. al (1998)

China[16]

China's horticultural economy has comparative advantages with its varied agro-climatic regions, its limited arable land, and its abundance of labour. China is growing 50 per cent of the world's total volume of vegetables and melons. China's 700 million farmers make it to the world's top fruit and vegetable producers. By the end of 2004-05, its farms -- mostly small, family-run operations -- will have grown an estimated 68 per cent of the world's pears, 49 per cent of its table grapes, 48 per cent of its apples, 23 per cent of its potatoes, and 13 per cent of its citrus. China has raised its profile in global fruit and vegetable markets. The value of its exports during 2002-04 were more than double the value from a decade earlier. China's fresh vegetable sales to Japan and several other Asian markets and its apple exports to South-east Asia compete directly with U.S. products. The United States has been the largest market for China's exports of apple juice. China's export competitiveness arises from low costs, a growing processing industry, and policies that encourage fruit and vegetable production. However, China's growing domestic market may absorb more of its production. China is also facing stiff challenges in improving the quality and safety of products, upgrading marketing and distribution infrastructure, and reducing marketing costs. Many fruits and vegetables are high value and are motivating Chinese farmers to diversify from the production of traditional crops such as staple grains (rice, wheat and corn) to horticultural products. For most years since 1990, horticultural exports earned enough foreign exchange to cover grain imports.

The horticultural industry in China is extraordinarily perplexing, characterized by a lack of proper linkage from production to consumption, and frequent government intervention in the composition of production, pricing and the marketing of its commodities. Whether or not horticultural trade will expand depends on government policy regarding food security issues, decisions to increase foreign trade protectionism, or expand policies to increase freer trade. It will also depend on China's ability to increase capacity to process, store, package and transport horticultural products. Although China is the world's largest producer and consumer of horticultural products, the present Chinese horticultural industry is relatively backward and is grossly inadequate to properly support neither inter-province trade nor export, particularly for perishable products. The Chinese horticultural system lacks a critical mass in administrative, marketing, transportation and distribution infrastructures. Also lacking are advanced production, post-harvest and processing technologies, and equipment, marketing skills and export development expertise.

China's substantial increase in fruit and vegetable production is a major factor behind its fast export growth. Market reforms introduced in the late 1970s gave farmers more freedom in planting decisions, allowing them to divert land from grains to more lucrative cash crops. Fruits and vegetables yield high returns per hectare of land, and use more labour. China's production has grown mainly to meet domestic demand (over 90 per cent of fruit and vegetable production is for the domestic market), but the production increase

[16] Marks and Bean (2005), Crook (1997), Wahl et. al (2006).

has facilitated China's increased presence in global fruit and vegetable trade. China's rapid expansion of apple production since the 1980s typifies Chinese farmers' response to the country's market-oriented reform policy. China's apple production rose from 2.5 million tonnes in 1978-80 to 201.2 million tonnes in 2001-03. Since the early 1990s, China has overtaken the United States as the world's largest apple producer and now accounts for more than one-third of world apple production. While apple orchard acreage in China has fallen after peaking in 1996, production has continued to increase because of better management techniques and commercialization of orchards.

China's competitive advantage lies in its low production costs. Material inputs accounted for slightly more than half of production costs, and labour costs accounted for less than half. China's abundant rural labour supply means that wages and labour costs are low. Most work is done by hand, so machinery costs on Chinese fruit and vegetable farms are also low. Small producers serving the domestic market have low land costs, but companies leasing large tracts of land in prime growing regions pay rents similar to those in the United States. However, commercial producers in China's prime fruit and vegetable production areas of eastern Shandong Province pay land costs close to those in the United States. Low production costs are reflected in low retail prices for fruits and vegetables in China. Most of China's fruit and vegetable exports are processed. Lack of cold storage and other infrastructure makes transporting perishable items difficult, and fresh products often do not meet exporters' standards for uniformity and colour.

Processing industries have grown rapidly due to the combination of China's low costs, growing market, and government policy that encourages agricultural processing as a means of helping farmers. Low labour costs are a key cost-saving factor for processors as they are for growers. Many local authorities, eager to create jobs and develop their economies, welcome investment by vegetable- and fruit-processing companies, often providing tax breaks, inexpensive land, or other concessions. Environmental and other regulatory compliance costs for food processors in China are also much lower than in the United States and other developed countries. China's agricultural industrialization policy has aided agricultural processing and trading enterprises, viewing them as key links between small farmers and markets that create badly needed jobs for rural workers. Companies that meet government standards for capital investment, technical prowess, and potential to provide markets and technical knowledge to farmers can be recognized as 'dragon head' enterprises. This designation gives the company prestige, access to markets, authority to contract with villages, and favourable terms for loans from state-owned banks. Fruit and vegetable processors and trading companies are among the most prominent 'dragon head' enterprises. Exporting agricultural products, especially fruits and vegetables, was emphasized as an important way to aid the farm sector in China's 2004 policy statement that gave primary importance to addressing the three rural problems of low rural incomes, slow rural economic growth, and a weak agricultural sector and Chinese fruit and vegetable sector appears to have the potential to solve these rural issues.

China also faces the problems regarding huge post-harvest losses. A conservative estimate based on scant data available to the Chinese Ministries of Agriculture and

Commerce and FAO suggests that up to one-third of all horticultural commodities produced annually is lost before consumption. The emergence of modern supermarket chains with advanced procurement systems is advancing marketing efficiency greatly. The opening up of the wholesale and distribution sectors to foreign competitors in 2005, as a result of China's commitment as a World Trade Organization (WTO) member, is likely to bring even greater competition and efficiency in marketing as well as increased investment in cold chain facilities. Growing domestic demand for fruits and vegetables is providing an increasingly attractive alternative to exports, a factor that may constrain growth in Chinese exports in coming years. As the Chinese economy grows, income gains will be spread more widely over the Chinese population. Development of modern food markets is expanding the array of fruits and vegetables available to middle and lower income households, including those in remote inland provinces and rural areas. More households likely will emulate the consumption patterns of the top-earning households in coming years, and domestic consumption of fruits and vegetables will rise sharply. High quality requirements and strict phyto-sanitary regulations in Japan and other Asian countries deter the entry of Chinese fresh fruits. China is trying to raise quality standards through 'green food' and 'pollution-free' production standards promoted by China's Ministry of Agriculture. These standards prohibit or limit the use of potentially harmful chemicals by growers and set limits on the presence of contaminants in soil, water and air in production areas. These standards are primarily for the domestic market but also are part of a general escalation of quality and safety standards. Many enterprises are contracting with farmers to produce vegetables for export and increasingly for the domestic market. One of the motivations for contracting is to gain direct control over the use of chemical substances. Compared to developed countries such as Australia and the United States, China processes only a small proportion of its annual horticultural production and there is a significant scope to expand the processing and marketing of high quality Chinese horticultural products for the domestic and export markets.

7 Conclusion: Policy and Strategies

Development of agriculture in India needs some critical management inputs particularly that of supply chain management -- collaboration among various stakeholders along with efficient vertical and horizontal integration. The horticulture sector in particular has to prioritize development of research in the issues of genetics, biotechnology, integrated and sustainable production systems, post-harvest handling, storage, marketing and consumer education. Diversification offers an attractive option and a major source of pushing up growth of agricultural sector. While technological up-gradation and associated institutional changes are identified as thrust areas for future development of the horticulture sector, exports are considered to be most important for the growth of the sector. India can look forward to emerge as a major producer of horticultural products and thus secure reasonable market access for its agro exports, which are largely dependent on the competitive technologies that will help in enhancing export potential. This development will also help in overall growth of the economy through generation of extra foreign exchange, creating employment opportunities and also upliftment of the small and marginal farmers, with definite positive implications on income and

employment. The government should create a positive environment that will ensure a mutually beneficial relationship between farmers and organized sector. Along with investment in infrastructure, development of extension activities and linkages with farmers is also an important area where the government can play an influential role. After the successful trials of SAFAL Market in Bangalore, many state governments have expressed their desire to establish similar markets after they have amended their state APMC Acts (NDDB, 2004-05).

The two golden rules for successful development of the horticulture sector are to ensure consistency in supply and provide recorded and demonstrated traceability of products. Thus, production strategies are the most crucial in strategy development. The basic production factors required for high value horticulture production are non-restrictive policies in favour of horticultural development; suitable and controllable climate conditions, availability of labour and horticultural growing skills, basic local general infrastructure for transportation and marketing, i.e. access to road, train, sea, air transport, telecommunications, power and water; and basic local horticultural infrastructure, i.e. access to horticultural inputs and services. Producer strategy should be designed based on financial resources, managerial skills and entrepreneurial capacity. The development strategy should be based on innovation. Production innovations initially focused on efficiency and effectiveness in order to increase yields and lower costs. Now it is important that the production innovations should focus on developing sustainable production techniques, and also focus on adding value in terms of packaging and processing.

India being the land of small and marginal farmers and studies have been advocating the fact that small farmers are going to feed India, it is important to mobilize and help them to diversify to meet the increasing domestic demand of horticulture products. As identified from African nations the small farmers are the key to initiate the horticultural revolution and with technical change and increase in international competitiveness large scale operations and vertical integration takes place. Thus to sustain the growth and development of the small land holder, farmers should be monitored to identify, select and support horticultural and entrepreneurial smallholders. Linking small farmers with high value urban and export markets would lead to the development of the rural sector. An uncontrolled expansion of horticultural production should not be encouraged. Horticultural crop diversification should be encouraged by intercropping horticultural with non-horticultural crops. This will yield more food, more income and better soil health. To increase the production and productivity of fruits and vegetables, introduction of vegetables in the crop rotation and adoption of recommended practices is very important. The use of vegetables in intercropping also helps in increasing the incomes of farmers during the period when the fruit orchard has not become commercially viable. The diversification plan of the horticulture sector needs to identify potential crops area wise and the area under low yielding vegetables and fruits should be shifted to more productive and profitable one.

There is a strong need to strengthen the research on horticultural crops to develop demand-driven technology by improved variety, pest management, etc., in both public

and private sectors. These technologies should be quickly disseminated through government institutions, NGOs and even private participants by encouraging farmers' participation and upgrading their technical capabilities. A small targeted group of talented stakeholders and small entrepreneurs should be identified and assisted in obtaining access to funding, technical assistance and supply chain partners. This small group should be actively encouraged to develop business plans and feasibility studies. The horticultural development requires a minimum set of basic production factors, an optimal crop management infrastructure, post-harvest infrastructure, entrepreneurial management and horticultural expertise, logistical infrastructure and supporting financial infrastructure

Development of horticultural sector should be accompanied by the growth of the agro-processing industry. The opportunity exists to promote the industry by intensifying production of a required, appropriate variety of tomatoes, cucumbers, mangoes, pineapples, lemons, etc., for the products like ketchup, sauce, juice and pickles. Thus the production strategy should target not only meeting the domestic and export demand of fresh products but also of the processed products. There is the need to improve post-harvest operations related to handling, storage and marketing of fresh and processed produce. Volumes saved in post-harvest losses are actually the surpluses generated, without additional cost. The horticulture sector has an immense potential of generating employment. Additional employment can be generated by developing the horticulture-based agro processing units. This sector needs to be developed as an organized industry and has to be run collectively by all the stakeholders with farmers as entrepreneurs.

The sale of fruits is generally through pre-harvest contractors, so that the farmer gets an advanced payment and covers his risk. Vegetables are usually sold through commission agents and very little of pre-harvest contracting is done. Due to this the net returns are generally low. Farmers devote more time to their field crops rather than to the orchards. If the farmer does the marketing of his produce himself then the net returns to him would double. The marketing cost of fruits and vegetables is almost 50 per cent of the total cost of production, thus, there is a need to set up institutional agencies that can advance credit to farmer and motivate them to market the produce themselves. Post-harvest losses in horticultural crops range from 15-50 per cent. At micro level these losses increase the marketing cost of the product and at macro level they also reduce the per capita availability. Thus there is need to develop technologies, methods and mechanics to reduce these losses. There is a need to remove the distortions in the present supply chain and create better integration between the different links of the supply chain and reduce the losses. This will result in a net gain to producers, consumers and to the nation.

Farmers usually procure inputs from the retail market and end up selling their produce in the wholesale market. Buying at retail price and selling at wholesale price is the most uneconomic way doing the business. Thus the involvement of an institutional structure in coordinating the demand of individual farmers can reduce the total cost of inputs to them. The market needs to be demand driven rather than supply driven. The price of the produce should not be based on the prevailing wholesale price but on the basis of cost of cultivation of that produce. Farmers should be their own price setters rather than price

followers. There is also an immediate need to integrate the production, marketing and processing processes of the produce to get maximum benefits from fruits cultivation.

The infrastructural problems pertaining to the cold storage facilities are dual as some places don't have the cold storage while other places have the problem of underutilization of the existing cold storage. The utilization is even lower than 30 per cent of the total capacity in many cases. There are problems with price structure in the processing units, the price offered by them does not justify the prevailing wholesale price or even the cost of production of the produce. Development of competitive international transportation, linked to domestic air, road and rail transport would help in the reduction of post-harvest losses. High air freights are also a hindrance for cost-effective exports.

In exports, large fluctuations in the production of fruits and vegetables causes problems in being a regular trade partner. The window of international demand for the horticultural products is very small. Thus a planned strategy is to be made to target the markets during that period. India can lead in the export of non-traditional fruits like cassava, sapota, litchi and guava. Further ssuccessful implementing of the core marketing strategies will help in future expansion of the domestic and international markets. In this regard the potential states have been identified in the study. But the exports face certain barriers too. Although the Uruguay Round of 1986-1994 and the subsequent WTO agreements along with talks under the Doha Round have brought some significant changes to global agricultural trade, but with respect to horticultural development there are major protection barriers both tariff and non-tariff. To enhance exports there is a need to develop air transport cargo system specialized for fresh fruits and vegetables, along with the airports, roads and rail connectivity with the area of procurements. The country's capability to generate surpluses for exports depends on its ability to tab the potential of small farmers. Thus there is a need to develop the credit structure and farmer export cooperatives. Awareness should be created among the farmers to understand the requirements of the importing countries. These non-tariff barriers need to be understood to get a breakthrough in the market access. For this, assistance from APEDA and exporters' association as well as training to the farmers is necessary. Quality control and longer shelf life are crucial for exports. Organic production of fresh fruits and vegetable is important to capture markets in Europe.

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Appendix

Table A 1: The HS classification used for analysis

Commodities	HS Code	Commodities	HS Code
Fresh Fruits		**Fresh Vegetables**	
Apple	08081000	Brinjal	07093000
Banana	08030000	Cabbage	07051100
Lemon	08055000	Cauliflower	07041000
Mosambi	08059000	Onion	07031001
Orange	08051000	Peas	07081000
Grapes	08061000	Tomato	07020000
Guava	08045010	Potato	07019000
Litchi	08109060	Sweet potato	07142000
Mango	08045020	Lettuce	07051900
Papaya	08072000	Pumpkins	07099030
Pineapple	08043000	Beans	07082000
Sapota	08109030	Cassava	07141000
Other fruits	0810	Other vegetables	07099009
Total Fruits	08	Total Vegetables	07

Source: India Trades database (CMIE), DGFT

Table A 2: Domestic production in horticulture sector

(Unit: 000 tonnes)

Year	Vegetables	Fruits	Spices	Plantation	Flowers
1991	58532	28632	1900	7498	233
1992	63806	32955	2291	8347	261
1993	65787	37255	2515	8866	334
1994	67286	38603	2477	9767	366
1995	71594	41507	2410	9630	366
1996	75074	40458	2805	9730	419
1997	72683	43263	2801	9449	509
1998	87536	44042	3091	11063	556
1999	90823	45496	3023	9278	535
2000	93849	43138	3023	9458	735
2001	88622	43001	3765	9697	580
2002	84815	45203	3765	9697	655
2003	93165	45645	5113	13161	-
2004	101434	49295	5113	13161	-

Source: Indian Horticulture Database (2005) by NHB, GoI

Table A 3: Expenditure elasticities of demand for fruits, India

Income group	Vegetables		Fruits	
	Rural	Urban	Rural	Urban
Very poor	0.44	0.44	0.56	0.57
Poor	0.34	0.37	0.50	0.54
Non-poor low	0.27	0.24	0.47	0.45
Non-poor high	0.18	0.12	0.39	0.39
All Group	0.28	0.30	0.47	0.48

Source: *P. Kumar and Donato B. Antiporta (2001).*

Table A 4: Progress of Reforms in Agricultural Produce Marketing Regulation (APMC) Acts

Sl.No.	Stage of Reforms	Name of States/Union Territories
1.	States/UTs where there is no APMR Act and hence no reforms called for	Kerala, Manipur, Andaman & Nicobar Islands, Dadra & Nagar Haveli, Daman & Diu and Lakshadweep
2.	State where APMR Act already provides for suggested reforms	Tamil Nadu
3.	States/UTs where changes in APMR Acts have been done as suggested (permitted markets in private/cooperative sector, contract farming, and direct marketing)	Madhya Pradesh, Himachal Pradesh, Punjab, Sikkim, Nagaland, Andhra Pradesh, and Rajasthan
4.	States/UTs where changes in APMR Acts have been done partially	Markets in private/cooperative sector – Karnataka (only NDDB), Maharashtra Contract Farming – Haryana and Gujarat Direct Marketing – Haryana, Karnataka, Maharashtra, UP, Delhi and Chandigarh
5.	States/UTs where administrative action is initiated for changes in APMR Acts	Orissa, Assam, Mizoram, Arunachal Pradesh, Tripura, Chhattisgarh, Meghalaya, J&K, Uttarakhand, Goa, West Bengal, Uttar Pradesh, and Pondicherry
6.	States where there is no progress	Bihar and Jharkhand

Source: Acharya, S.S. (2006), "Agricultural Marketing Reforms: Status and Road Map", National Institute for Agricultural Marketing, Jaipur.

Table A 5: Main market arrival months

Crop	Months of market arrivals
Apple	July to October
Banana	March & June to November
Lemon	January to April June to December
Mosambi	January, April November to December
Orange	November to May
Grapes	February to July
Mango	April to August
Papaya	February to June
Pineapple	August to October January to February
Sapota	February to June
Pomegranate	February to August
Brinjal	October to August
Cabbage	October to February
Cauliflower	November to February
Okra	April to October
Onion	October to May
Peas	December to February
Tomato	October to April
Potato	December to April

Source: Indian Horticulture Database (2005) by NHB, GoI

Table A 6: Annual weighted average wholesale price (Rs/Qtl), 2005

Commodity	Chennai	Delhi	Mumbai	Calcutta
Apple	4017.55	2979.35		2768.62
Banana	508.03	618.06	652.00	408.31
Lime /lemon	864.85	1232.84	725.45	1197.05
Mosambi	1508.86	1321.32	2686.10	1216.32
Orange	1690.93	2261.56	2668.84	1312.87
Grapes	2256.02	2324.56	2336.50	3005.80
Litchi		3738.81		2425.52
Mango	1636.55	1654.13	1686.00	1263.37
Papaya	479.71	777.63	734.06	1037.36
Pineapple	1070.17	1601.15	861.18	894.28
Sapota	530.13	958.75	706.53	1093.78
Pomegranate	1752.37	2201.97	1150.99	2393.31
Brinjal	632.22	520.71	471.40	902.28
Cabbage	293.01	470.87	361.64	350.74
Cauliflower	856.55	429.06	396.64	548.17
Okra	715.34	961.95	1448.00	698.69
Onion	706.56	635.71	409.80	687.72
Peas	1133.04	848.89	791.56	991.12
Tomato	622.25	611.00	511.14	760.49
Potato	627.07	391.97	484.75	457.21

Source: Self Computed from information obtained from Indian Horticulture Database (2005) by NHB, GoI

Table A 7: Total market arrival in 2005, (in tonnes)

Commodity	Chennai	Delhi	Mumbai	Calcutta
Apple	6310.00	414638.00		14275.00
Banana	49900.00	152546.00	29950.00	38657.00
Lime /lemon	11090.00	82255.00	6990.00	14506.00
Mosambi	6740.00	15353.00	8512.00	9404.00
Orange	5920.00	77864.00	22640.00	25196.00
Grapes	6500.00	37611.00	23705.00	18013.00
Litchi		10962.00		6456.00
Mango	14557.00	252957.00	5860.00	66344.00
Papaya	3710.00	31043.00	23056.00	4076.00
Pineapple	3480.00	15623.00	10385.00	6004.00
Sapota	3030.00	34197.00	5440.00	2494.00
Pomegranate	7750.00	36724.00	24300.00	13630.00
Brinjal	10820.00	36344.00	43200.00	19429.00
Cabbage	18870.00	21535.00	23165.00	20876.00
Cauliflower	5660.00	20987.00	17965.00	22782.00
Okra	3883.00	14435.00	1330.00	4217.00
Onion	85180.00	235042.00	93290.00	140895.00
Peas	1085.00	31700.00	8000.00	5263.00
Tomato	88780.00	94077.00	84315.00	27782.00
Potato	25640.00	199428.00	80242.00	73044.00

Source: Self Computed

Table A 8: Weighted average country price and market arrivals, 2005

Crop	Domestic Price (Rs/ Qtl)	Total Arrival (tonnes)
Apple	2987	435223
Banana	572	271053
Lime/lemon	1162	114841
Mosambi	1619	40009
Orange	2124	131620
Grapes	2466	85829
Litchi	3252	17418
Mango	1578	339718
Papaya	761	61885
Pineapple	1213	35492
Sapota	907	45161
Pomegranate	1881	82404
Brinjal	580	109793
Cabbage	371	84446
Cauliflower	497	67394
Okra	902	23865
Onion	622	554407
Peas	862	46048
Tomato	600	294954
Potato	440	378354

Source: Self Computed

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