Final Report

Capacity Building for Improving Trade Competitiveness and Price Realization of Indian Agriculture

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List of Abbreviations

NAAS	: National Academy of Agricultural Sciences
WTO	: World Trade Organization
APEDA	: Agricultural and Processed Food Products Export Development Authority
SPS	: Sanitary and Phyto-sanitary Standards
TRIPS	: Trade Related Intellectual Property Rights
LOP	: Law of one price
NPC	: Net Protection Coefficient
EPC	: Effective Protection Coefficient
PSE	: Producer Subsidy Equivalent
DRCR	: Domestic Resource Cost Ratio
VECM	: Vector Error Correction Model
ARDL	: Auto Regressive Distributed Lag Model
FAO	: Food and Agricultural Organization
UNCTAD	: United Nations Conference on Trade and Development
AGMARKNET	: Agricultural Marketing Information System Network
IGC	: International Grain Council
TFP	: Total Factor Productivity
OECD	: Organization for Economic Cooperation and Development
OGL	: Open General License
ADF	: Augment Dicky Fuller test
SEA	: Solvent Extractions Association
AoA	: Agreement on Agriculture

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Chapter 1

Introduction

1. 1 Motivation for the study

Globalization and Indian agriculture

Globalization is a process of unifying the diverse world economies under one umbrella to facilitate freer trade, which aims overall growth and welfare. India too is part of globalization and liberalization; however, liberalization is not just withdrawal of the state from economic activities, but creation of newer forms of alternate organizations, which enable the country's agriculture and industry to face competition in the international market (NAAS report[1], 2001a). In this context, India adopted significant policy reforms in order to ensure the country's overall welfare in general and agricultural sector and peasants in particular. Role of agriculture and allied activities remains crucial as it provides livelihood for 52 per cent of the population in the country (Economic survey, 08-09) and 80 per cent of the farmers are small and marginal category.

The share of agricultural trade in agricultural GDP has been increased since 1990–91. During recent times, India is facing challenges on the import side when the international prices go very low, imports become cheaper, causing fall in domestic prices of agricultural commodities. Further, In India post-harvest and sanitary infrastructure is poor and massive investment in this area will be essential to ensure a level-playing field in external trade in agriculture (NAAS[2], 2001b). Global competition also forces domestic businesses to innovate and improve the quality of their products (Weidenbaum[3], 2003).

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[1] NAAS Report on the national workshop of 'Globalization of Agriculture: Research and Development in India', organized by the National Academy of Agricultural Sciences (NAAS) at the Kerala Agricultural University Main Campus, Trichur, during 2–3 February 2001 published in Current Science, Vol. 80, No. 12, 25 June 2001a.

[2]NAAS. (2001b). Globalization of Agriculture: R & D in India. Policypaper 10. Available at http://www.naasindia.org/Policy%20Papers/pp10.pdf as on 31.07.2009

[3]Weidenbaum, M. 2003. Weighing the Pros and Cons of Globalization. Available at http://www.wilsoncenter.org/topics/pubs/Weidenbaum.pdf as on 31.07.2009

Agricultural trade status

Beyond several constraints in production and marketing of agricultural commodities, performance of Indian agricultural and allied sector is noteworthy in global context. India is the largest producer of milk, cashew nuts, coconuts, tea, ginger, turmeric and black pepper. It is the second largest producer of wheat, rice, sugar, groundnut and inland fish and third largest producer of tobacco. India accounts for 10 per cent of the world fruit production and it is the largest producer of banana and sapota. Though India's share in world agricultural export and imports has been increasing over the years, it is still a marginal player as it accounted 0.94 per cent of world imports as well as 1.56 per cent of world exports in 2006-07.

At country level, agricultural sector contributed 12.2 per cent of national exports in 2007-08. India's agricultural exports have increased from Rs. 6,013 crores in 1990-91 to Rs. 77,770 crores in 2007-08. Rice, tea, coffee, oilmeals, fruits and vegetables, cashew and sugar are the major agricultural exports. India's export share in world trade is given in Table 1.1 for select commodities and products.

Table 1.1 India's share in world agricultural commodities and products exports

(Value terms in per cent)

Commodity/ Product	1970	1975	1980	1985	1990	1995	2000	2006
Rice	0.6	0.6	3.7	5.6	6.4	21.51	10.2	15.8
Vegetables and fruits	1.2	1.5	1.1	1.4	0.8	1.0	1.3	1.4
Sugar and preparations	1.0	4.8	0.3	-	0.1	-	0.9	0.8
Coffee	1.0	1.6	2.1	1.9	1.7	2.9	2.3	2.3
Tea	33.4	31.3	27.7	26.2	22.1	15.7	14	9.6
Spices	20.5	13.3	14.5	19.3	7.7	8.7	10.3	-
Feed	-	-	1.6	1.5	2.2	2.2	2.3	3.7
Tobacco	2.5	3.2	4.4	1.8	0.8	1.9	0.7	0.9
Cashew nut shelled	81.98	71.37	46.90	59.75	59.17	60.10	47.36	39.43

India being a signatory member of WTO, aimed to have a larger share in world agricultural trade and hence benefiting in terms of increased national welfare. Removal of restrictions on trade of primary agricultural commodities as well as setting up of food processing units and ease licensing policy promoted agricultural exports from India in post-WTO period. At the same time, India's agricultural imports also have increased from Rs. 1,206 crores in 1990-91 to Rs. 29,777 crores in 2007-08. Edible oils, pulses and cashewnuts[4] are the major agricultural imports[5]. India's import share in world trade is given in Table 1.2 for select commodities and products.

Table 1.2 India's share in world agricultural commodities and products imports

(Value terms in per cent)

Commodity/ Product	1970	1975	1980	1985	1990	1995	2000	2006
Palm oil	0.00	0.78	16.84	11.95	5.50	8.32	18.00	9.05
Rapeseed oil	0.12	2.32	18.86	17.36	0.16	0.95	1.73	0.00
Soybean oil	9.64	0.30	20.34	12.30	1.16	1.78	6.72	15.54
Sunflower oil	0.75	0.00	0.00	0.06	0.00	2.05	11.88	1.41
Wheat	7.52	10.96	0.58	0.25	0.07	0.02	0.00	0.03
Pulses	0.14	0.08	1.60	7.31	10.06	7.22	4.21	15.81
Cashew nut with shell	57.15	32.27	4.01	34.54	55.46	74.59	87.70	95.89

Trade competitiveness of agricultural commodities

There are several studies on assessment of agricultural trade performance (Datta *et al*[6], 2001 and Chand[7], 2003) and implications of trade on several dimensions (Chand[8], 1999; Gulati[9], 2002 and Mittal[10], 2007) in India. For certain commodities like basmati rice and spices; India has a niche market access in spite of competition[11]. Export earnings from traditional group consisting of tea, coffee, spices, and tobacco suffered mainly due to sharp fall in international prices as quantity of export in most cases did not decline. Export of oilmeal, which was the second biggest item of export after marine products, suffered serious setback due to decline in international prices and quantity of exports. Export value of marine products, and groups of livestock and horticultural products maintained the tempo of growth,

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[4] India is largest importer of cashewnut with shell and re-export the processed cashewnuts (shelled)
[5] Source: DGCI&S, Ministry of Commerce, Kolkata.
[6]Datta, Samar K., Milindo Chakrabarti and Madalsa Gandhi. 2001. Composition of India's Agri-Exports: Changes in Post Reform Period. In Implications of WTO Agreements for Indian Agriculture. CMA Monograph No. 191. pp137-168
[7] Agricultural Marketing and Trade In India, Indian Journal of Agricultural Marketing, pp 368
[8] Trade Liberalisation and Net Social Welfare: A Study of Selected Crops, Economic and Political Weekly, 52(34)
[9]Indian Agriculture in a Globalizing World.American Journal of Agricultural Economics. Vol. 84 (3)
[10] OECD Agricultural Trade Reforms: Impact on India's Prices and Producers Welfare. Indian Council for Research on International Economic Relations. Available at http://www.icrier.org/pdf/WorkingPaper No195.pdf as on 02.06.2009
[11]Economic Survey. 2001. available at http://indiabudget.nic.in

continuing from pre WTO period. This showed that post WTO situation was favourable to export of high value food products[12].

Trade competitiveness of commodities varies across space and time. It is largely influenced by cost, output prices, production structure and quality. Export of agricultural commodities from developing countries like India is posed to a risk; in terms of gap in quality and food safety standards at the international markets. To bridge those gaps and improve competitiveness of agricultural commodities at world markets, India has made several significant reforms at institutional level. These reforms enhanced the access to international markets with Sanitary and Phytosanitary (SPS) measures and Trade Related Intellectual Property Rights (TRIPS). Setting-up of National Codex Committee and widening of export basket by Agricultural and Processed Food Products Export Development Authority (APEDA) are the other formal institutional reforms to enhance both domestic and international marketing[13].

Price realization and flow of benefits

Though India is major producer of several commodities, farmers' price realization in domestic markets as well as share in export prices is low. Small share of export price is attributed mainly due to price volatility in international markets and market inefficiency. Variability in agricultural prices continues to be matter of concern, not only for developing countries like India but also for developed countries. In general, markets provide price signal for the players and those price differences are expected to pass-through among the markets. On one hand, full transmission of price shocks can indicate the presence of a frictionless and well functioning markets; while on the other extreme a total absence of transmission indicate the isolation. Existence of strong price linkage between markets warrants efficient allocation of resources for maximizing the welfare (Baffes and Ajwad[14], 2001). Therefore, the degree of price transmission can provide a broad assessment of efficient market functioning and price signals that are passing-through consistently between different markets.

[12] Chand, Ramesh. 2005. Post WTO Agriculture Trade and Agenda for Negotiations on Agriculture. Policy Brief 23, NCAP, New Delhi, pp 2

[13] Kumar, Anjani. 2004. Agricultural Trade Liberalization Reforms: Effects on Agricultural Marketing Institutions. NCAP Annual Report 2004-05, New Delhi, pp 30.

[14] Baffes, John and Mohamed Ihsan Ajwad. (2001).Identifying Price Linkages: A Review of the Literature and an Application to the World Market of Cotton. Applied Economics, 33, pp 1927-1941

FAO study by Conforti[15] (2004) indicated a considerable degree of linkage between India's domestic and world reference prices. His estimates indicated evidence of long run equilibrium in the spatial transmission between the domestic and the world reference prices of wheat, maize, cassava, milk powder, and to some extent rice. However, fluctuations in world market prices were in general transmitted to countries' export unit values, but not to producer prices due to government intervention (Hazell *et al*[16]., 1990).

Farmers' capabilities and capacity building

Although India enjoys advantages in exporting some commodities, in the post-GATT period international trade has become highly competitive and the competitive advantage of some of these commodities would be lost due to the infrastructural advantage prevalent in the competing countries. The country's export basket needs to be widened to marine products, fruits and vegetables etc. However, systems to cater to the export market yet to be develop. Information flow along the value chain is very weak. Exporters have to take special care in maintaining the quality at all stages of exports.

Most of the farmers being the suppliers of raw materials (commodities), they are price takers and flow of benefits arising out of value addition is insignificant. In addition to that, changes in prices either in domestic or international markets do not benefit farmers adequately due to lack of bargaining power, lack of access to information, knowledge, technology, and capacity and organizational capabilities.

However, for enhancing farmers' capability; National Commission on Farmers[17] (2006) insisted the institutional support to Farmers' Associations and SHGs to improve competitiveness by spreading awareness of the opportunities available for external agricultural trade. Further, quality and trade literacy programmes have to be launched across the country to increase the efficiency of the farmers. Export

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[15]Conforti, Piero. (2004) Price transmission in selected agricultural Markets. FAO Commodity and Trade Policy Research Working Paper No. 7

[16]Hazell, P., Jaramillo, M. and Williamson, A. 'The relationship between world price instability and the prices farmers receive in developing countries', Journal of Agricultural Economics, Vol. 41, (1990) pp. 227–243.

[17]cari.res.in/NCF%20Reports%20and%20Presentations%2004...2006/Fifth%20and%20Final %20Report/Vol%20II-5th%20Report.pdf as on 24.07.2009

capabilities can be enhanced by increasing productivity and promoting modernization of agriculture.

1.2 Major issues

With this background in mind, the present study addresses four major issues. First, how to widen India's trade base in international markets (As India has remained a marginal player in world agricultural trade[18] despite being a big country, major producer of several agricultural commodities). Second, is India able to influence the world market in terms of price, quantity and quality. Third, whether Indian farmers and exports benefit out of any rise in international prices or able to cope up the price shocks/volatility. Fourth, how to improve farmers' knowledge and organizational capabilities to benefit from trade opportunities available in different commodities. For addressing the above issues in the context of growing global competition, it is crucial to assess the trade competitiveness of Indian agricultural commodities in terms price, quantity and quality in comparison with major global payers; and understanding the market integration and price transmission between markets so as to build the capacity of Indian farmers who lacks knowledge & technology, financial and organization capacity in order to gain from trade opportunities.

1.3 Scope of the study

Broadly, the present study has been planned to cover four major objectives. First, understanding the structure of India's major agricultural exports and imports in comparison with major global players. Two, trade competitiveness of selected agricultural commodities in terms of price, quantity and quality will be assessed. Third, price realization of farmers and assessing the influence of price changes on domestic and international markets will be examined. Finally fourth, understanding of the existing institutional support and suggestions for building the capacity of farmers for better price realization and improving the trade competitiveness will be discussed.

[18] Annual Report of Ministry of Agriculture, 2006 available at http://agricoop.nic.in/annualreport06-07/agricultural%20trade.pdf

Limitation of the study

Since the study has covered only few states of India, the results cannot be generalized to others states.

1.4 Plan of the study

The study is organized into ten chapters. Chapter 2 discusses about brief review of literature, analytical framework and methodology of the study. Chapter 3 highlights the results of rice crop analyzed under foodgrains. Chapter 4 summarizes the study results of oilseed group: groundnut and castor. Chapter 5 presents the results of sugarcane crop covered under sugar crops. Chapter 6 tabulates the results of cumin crop in spices group. The results about cashewnut and tea are presented in Chapter 7 (Plantation crops). Chapter 8 provides the study results about mango crop under Fruits. Up on request made by Ministry of Agriculture and Cooperation, a special chapter (Chapter 9) has been prepared on “the synthesis about post-harvest losses of fruits, vegetables and other perishable commodities in India” and included even though it may not come under present context of discussions. Finally, the main findings of the study, conclusions and policy implications are summarized in Chapter 10. All the detailed analysis of data was organized by crop-wise in the Appendix.

Chapter 2

Review of Literature and Methodology

2.1 Brief review of literature

World trade has been booming over the past two decades, and developing countries share of the total pie has been expanding. The share of developing countries in exports of manufactured goods to industrial countries has risen dramatically, as has their share in exports of manufactured goods to developing countries (table 2.1). Their share of agricultural exports in trade to other developing countries has also risen, although not as much as in manufactured products. But the share of developing countries in agricultural exports to the industrial world has stagnated. Of course, simple statistics such as these cannot prove a causal link, but they are consistent with the hypothesis that developed economies' barriers to agricultural trade have effectively stifled this segment of global trade.

Table 2.1 Share of Developing countries' exports in the World Trade

	1980/81	1990/91	2000/01
Total agricultural exports	35.4	32.2	36.3
To developing countries	9.5	8.9	13.4
To industrial countries	25.8	23.3	22.9
Total manufacturing exports	19.3	22.7	33.4
To developing countries	6.6	7.5	12.3
To industrial countries	12.7	15.2	21.1

Source: United Nations Statistics Division, Comtrade database.

Doha Negotiations

Recognizing the importance of the negotiations, developing countries have emerged as a powerful force. One of the more striking differences between the ongoing Doha Round negotiations and previous multilateral rounds is the much greater leverage of developing countries, due at least in part to their large and growing share of world trade. This became evident, if it had not been before, at the Ministerial Meeting in Cancún in 2003.The many loopholes in the Uruguay Round Agreement on Agriculture (URAA) and how they were exploited to keep high-income markets heavily protected, which were well documented. Tariffs remain much higher in agriculture than in manufactured products (fig 2.1).

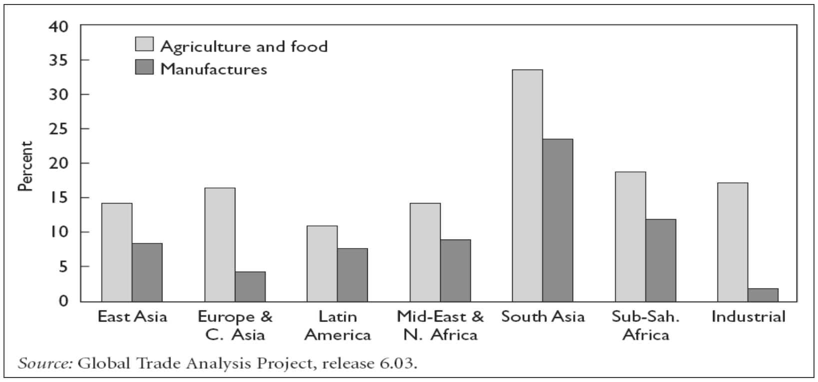


Fig 2.1 Average tariff by Region, 2003

While this pattern is characteristic of trade regimes in all regional groups, the discrepancy is most remarkable in high income countries. But the level of tariffs, while high, greatly understates the degree of protection in the trade regimes in high-income countries because many products are afforded even higher levels of support by nontariff measures such as export subsidies and tariff rate quotas, which are applied to products covering close to 30 percent of agricultural production in these countries (fig 2.2).

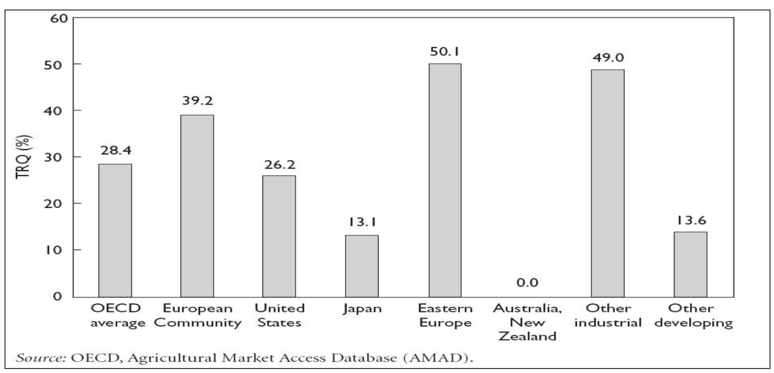


Fig 2.2 Coverage of tariff rate quotas, 2003

Tariff rate quota systems and the nontransparent mechanisms through which they operate create an additional layer of protection and more difficulties for developing country exporters. The antidevelopment bias of the trade regimes is amplified by the extent to which tariff structures are escalated, with higher rates applied as the degree of processing increases, discouraging developing country exporters from moving up the value chain. And finally, while most protection is given through some form of trade measure, substantial additional support is provided by direct budgetary payments to farmers (fig 2.3).

One lesson from implementation of the URAA is that the political economy of agricultural protection in high-income countries is such that when reduction is required in one mechanism of trade-distorting support, another mechanism often pops up to replace it. Given the array of support instruments available, it follows that to guarantee increased trade opportunities for developing countries, the agreement must include strict disciplines on all fronts.

That food aid is a subject of negotiation is surprising to some, but an examination of historical patterns shows clearly that aid has been used as a means of dumping surplus production. Food aid has been most abundant when it has been least needed (when world market prices are low) and vice versa (fig 2.4).

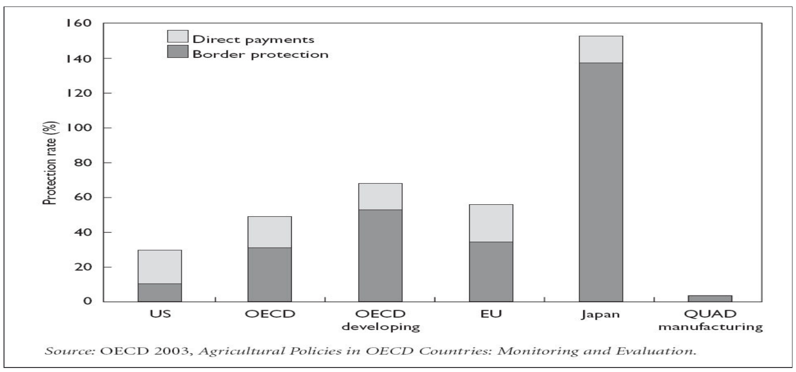


Fig 2.3 Border Protection and Direct Payments in High-Income Countries, 2000–2002

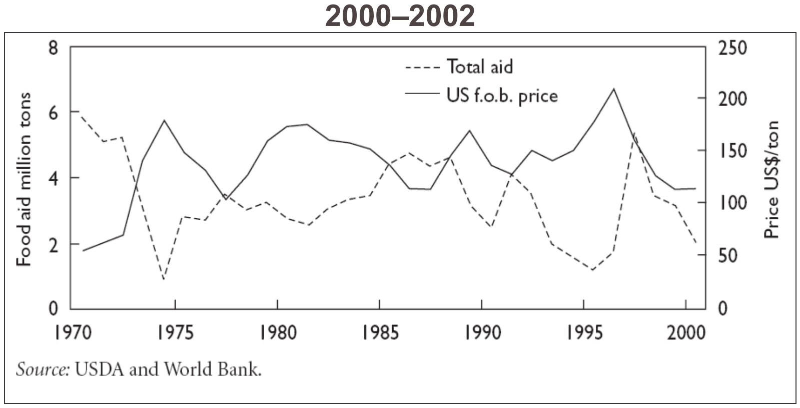


Fig 2.4 Food Aid and World Prices

India's policy changes

Until well into the 1990s, agricultural imports were not so large as to cause panic (figure 2.5), despite declining tariffs (import weighted averages), because quantitative restrictions remained in place. Even after some imports were liberalized, imports were not a problem because of the high international prices during 1995–97.When international prices crashed thereafter to extraordinarily low levels, imports rose. Following removal of remaining quantitative restrictions during 1999–2000, imports registered a decline, perhaps owing to the increased tariff levels.

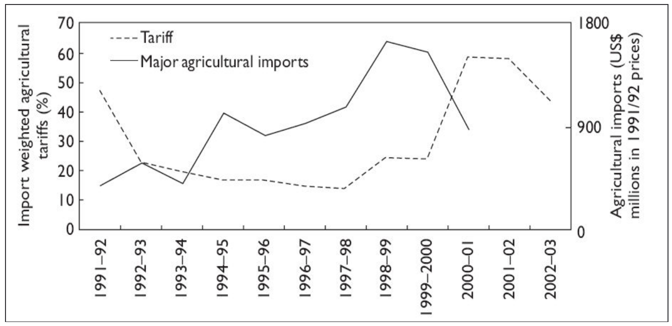


Fig 2.5 Agricultural Imports and Tariffs in India, 1991/92–2002/03

At the time of the Uruguay Round negotiations, Indian agriculture was reasonably competitive (Gulati and Kelley 1999; Gulati*etal.,*1994), so trade liberalization would not necessarily be expected to have an adverse impact. Commodities such as rice and wheat, India’s major staples, turned out to be efficient import substitutes and export competitive for several years (figures2.6 and 2.7).

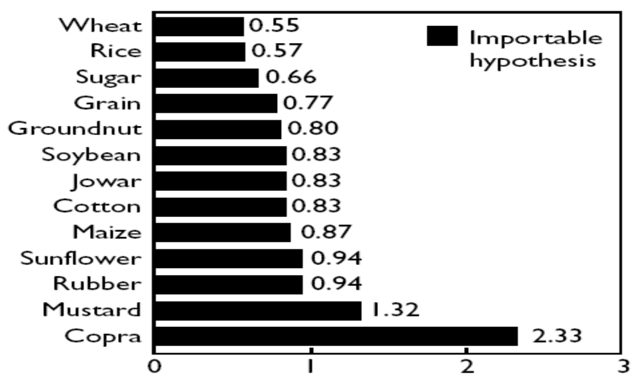
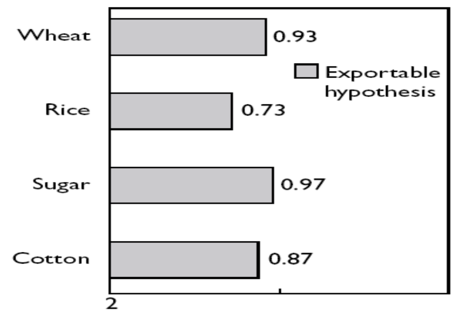


Fig 2.6 Nominal protection coefficients for selected Agril. commodities, 1991-97

Most other pulses and coarse cereals appeared to be efficient import substitutes, although not export competitive. The only major uncompetitive commodity seemed to be oilseeds and edible oils, which are produced at high cost in India. Milk was also of concern, although trends in the 1990swere encouraging (Sharma and Gulati 2002).



Source: **Gulati and Pursell (2000).**

Fig 2.7 Nominal Protection Coefficients for Selected Agricultural Commodities, 1992–97

Managing import competition

India's experience with liberalization in agriculture reveals that managing import competition is a multidimensional problem and often sector specific. As imports of vegetable oils suggest, an inefficient domestic sector can be significantly undermined by import competition. While this is to be expected with trade liberalization, it imposes significant adjustment costs on developing countries. While there may be efficiency gains for the economy overall, the losers (in this case the oil processing industry) will cry foul. To manage a smooth transition, governments need to acknowledge that and determine how to minimize the adverse impact of import competition without sacrificing efficiency.

Liberalization of the cereals sector highlights three distinct issues. First, even commodities that are efficient import substitutes can occasionally turn uncompetitive, particularly when world prices fluctuate substantially. A key issue is how developing countries can deal with such a situation, so that farmers, particularly small and resource-poor farmers, are protected from devastating price declines. Second, because of the link between domestic pricing and trade policies, trade policies are often held hostage by domestic lobbying groups, and developing countries need to know how to negotiate such conditions. Third, as the case of wheat clearly demonstrates, there is a need to recognize the link between import liberalization and export policy and to coordinate the two, particularly for commodities that are importables in some years and exportables in others. The experience with wheat and onions is relevant here.

Finally, as the case of dairy imports shows, sometimes managing import liberalization depends at least partly on the policies of other countries. The central issue here is how developing countries can influence policies in other countries and use the multilateral trade negotiations to advance their concerns for managing import liberalization.

Border protection policies

Perhaps the most important aspect for developing countries to consider is border protection to buffer domestic markets against dramatic drops in world prices that lead to import surges. Even when production in a country is competitive and imports pose little threat during times of normal prices, import surges can occur when world prices collapse. Under such circumstances the production base of vulnerable sections of the farm population can be wiped out. In the United States, Congress authorized four emergency packages of market-loss assistance payments during 1997–2001 totaling more than $34 billion (Gulati and Hoda 2002) to cope with the sharp fall in prices. Developing countries, unlike the United States, do not have the resources to compensate farmers in that way. Thus they need to look to other measures. Bound tariff rates, when set high enough above applied rates, offer some scope for raising tariffs when prices crash. When applied rates and bound rates do not differ, there may still be some scope for renegotiating tariffs (as India did), although compromise is often required. For instance, although edible oils are generally bound at 300 percent in India, soybean oil continues to be bound at 45 percent, which acts as an anchor on the overall tariff that can be imposed on other edible oils. However, in cases of dramatic and persistent price declines, as during the late 1990s, more effective measures are needed.

India and other developing countries might negotiate in the WTO for the right to use special safeguards. Countries can invoke special safeguard provisions to raise tariffs above bound rates when there is an import surge. Under the URAA, the right to use special safeguards has been claimed primarily by developed countries. The special agricultural safeguards provision is far simpler to administer in developing countries than are general safeguard measures, which require proof of serious injury to domestic industry. Also helpful for developing countries using special safeguards would be the ability to impose countervailing duties without establishing material injury (Gulati and Hoda 2002). Many developing countries lack the administrative capacity to prove that their countervailing duties against actionable subsidies are justified. Also important is abolition of the "peace clause," so that countries can impose countervailing duties equivalent to the export subsidy.

Other instruments for managing import competition in agriculture are tariff rate quotas, variable levies, and price bands. Though effective in offering import protection, these instruments have numerous problems. With tariff rate quotas it is doubtful that developing countries could administer the quotas in a transparent manner, without giving in to political influence. Moreover, it is in developing countries' interest to press for phasing out tariff rate quotas, whose use by developed countries has been found to severely restrict market access for developing country exports. Variable levies are incompatible with the WTO provisions, and a WTO panel has ruled that Chile's price band system was inconsistent with the provisions of the WTO since it acted as a variable import levy and often exceeded Chile's bound rate (WTO 2002).

Another possibility is seasonal tariffs, as proposed by the edible oil and oilseeds sector in India. Higher tariffs during the domestic harvest season and lower tariffs in the domestic lean season would protect the interests of both consumers and producers. India's experience also highlights the need to coordinate import and export policies. While import liberalization tends to lower the prices of importables, export liberalization tends to increase the prices of exportables.

"Behind the Border" Reforms

Often neglected but equally important are domestic policy reforms. Domestic pricing and marketing reforms continue to be the weakest link in Indian agriculture. Thus, while the government holds mammoth stocks of food (estimated at about 60 million tons in January 2009), a large number of Indians suffer from poverty and malnutrition. Because of political pressures from various interest groups, the government often ends up pursuing economically unsound policies. India's experience with maize shows what can happen. When maize was being imported following import liberalization, domestic prices crashed and farmers lobbied for state governments to procure maize. Two states bent to this pressure and procured close to 2 million tons of maize in less than a year to prop up domestic prices. When this happens repeatedly, farmers' production decisions are guided by administered prices rather than market forces, undermining the very logic of trade liberalization.

Rather than buckling to pressure for procurement, governments need to encourage the use of other domestic instruments and institutional innovations. Hedging instruments to ensure against price risks can help to protect farmers. Greater vertical integration of farmers with user industries could also help (oilseed farmers with vegetable oil industry, maize farmers with feed industry, wheat and rice farmers with the millers, and so on). Commodity futures trading would also mitigate risks arising from volatile prices.

2.1.1 Market integration and price transmission

Market integration is defined as the degree of price transmission between two either vertically or spatially related markets. The operational definition of market integration is known as the law of one price (LOP)—identical products sell at a uniform price across different markets. Homogeneous commodities follow the law of one price (Monke and Petzel 1984).The assumption required for the LOP to hold is of profit maximization and priceless transportation, distribution and resale. If LOP holds for a product in all the markets then it would be characterized as an integrated market. In the domestic economy if LOP holds then domestic market integration exists (Bradford and Lawrence 2004).

Lack of integration is referred to as segmentation. A market is geographically segmented if the location of the buyer and seller influences the terms of transaction in a substantial way (that is, by more than marginal cost of physically moving the goods from one location to another). A perfectly competitive market should be fully integrated (Knetter and Goldberey 1996). The premise of full price transmission and market integration corresponds to those of the standard competition model, in a frictionless undistorted world, the LOP is supposed to regulate spatial price relations (Conforti2004).It was inferred that significant transaction costs effect market prices (Meyer 2004).If the difference in prices between the two regions is only because of transport cost then the markets are said to be spatially integrated (Ravallion 1986). Spatial market integrations refer to co-movements of prices and more generally, to smooth transmission of price signals and information across spatial separated markets (Goletti, Ahmed and Farid, 1995).These definitions of price discrimination and market integration have important consequences for measurement and interpretation. Price data is not purely a function of market integration.

Measurement of market integration can be viewed as basic data for developing an understanding of how specific markets work (Ravallion 1986). Integrated markets do not necessarily imply efficient spatial allocations (Knetter and Slaughter 1999). It is worth considering what price dispersion actually reveals about integration. What factors make arbitrage costly and thus enable price discrimination. In order to understand long run market segmentation we need to study price details market wise; product by product. Deviation in the LOP is not merely because of product differentiation.

Palaskas and Harriss (1993) attempted to answer the question of how markets work, by evaluating the behaviour of prices of staple foods and then by explaining the price behaviour with reference to market institutions. In making inferences about market efficiency from the data on prices, the concept of integration has been central. In the domestic market, laws regulating the distribution and resale of commodities, information, transportation cost and other transaction cost can result in price differentiation (Knelter and Goldberey, 1996). Distance between a pair of markets explains price variations to an extent. In case of consumer prices for final goods, similarity in tastes is a positive factor in price integration across state/ regions. Within industry production activities matter for price dispersion in intermediate goods but not for final goods (Knetter and Slaughter, 1999).

Variation in demand elasticity due to income and availability of substitutes can also lead to price dispersion. Theoretically, price dispersion across markets arises as a result of differences in demand characteristic across groups of consumers and the ability of firms to exploit differences in demand because of costs of resale across markets. In the case of differentiated products if prices differ but have a high degree of substitutability in production or consumption, shocks from changes in supply and demand of one product are transmitted to other products in the commodity group (Monke and Petzel, 1984). Supply sources are more important than demand sources in driving prices (Alexander and Wyeth, 1994). This mechanism leads to price linkages across the differentiated products that can be identified statistically. Integrated markets are defined as markets in which prices of differentiated products do not behave independently.

Pricing along production chains will depend exclusively on production costs, with all firms producing on the highest isoquant compatible with their isocost lines. Price transmission is affected by transport and transaction cost, market powers, increasing returns to scale in production, exchange rates and border and domestic policies (Conforti 2004). Transportation costs may cause the relative prices of two qualities to differ across regions by an amount unrelated to the original prices (Monke and Petzel, 1984). Transportation cost can act as wedge between different markets, which need to be overcome by the total price differences between two locations or industries to allow for arbitrage and integration to take place between different markets. This treatment can be assumed to be stationary that is, proportional to traded quantities rather than fixed. Along the production chain some agents might behave as price makers while others as price takers, depending on the degree of concentration of each industry. Testing for price transmission can be interpreted as an exercise to check the degree of efficiency of the markets, in terms of extent of congruence with competitive models, or as a test for market integration. In India within the domestic market, price transmission appears to be fairly complete between the wholesale and the retail price (Conforti 2004).

Many studies have looked into market integration indirectly through econometric analysis rather than examining the transportation system, interviewing traders, tracking shipments and looking for unexploited arbitrage opportunities (Baulch 1997). If data were available on trade flows and transfer costs in addition to prices it would have been simpler to test market integration, but such this data is rarely available in a way that is comparable to price data. It is also inadvisable to estimate transfer cost based on intermarket price differentials. In such cases the price differentials between the two markets does not reflect the cost of moving produce between them. Applied econometric analysis for market integration based on price data alone has been used in various studies, because they neglect the role of transaction costs (Meyer 2004).

Knetter and Slaughter (1999) identify a high level of market integration with rapid decreases in costs of resale relative to other costs in the economy. The link between these factors is difficult to establish due to data constraints. Ideally, we would like to know whether the permissible range of price dispersion is rising or falling relative to the product price itself. Price measures do not always permit very strong conclusions about the changing nature of market integration.

2.1.2 Comparative advantage and competitiveness

The theory of comparative advantage in its simplest form states that a nation can enhance efficiency in resource use and hence net welfare, by producing and exporting commodities in which it is relatively efficient and importing commodities in which it is relatively not so (Gulati *et al*., 1994). Thus, what commodities or products a nation should produce and export, and what commodities it should import under free trade is determined by the principle of comparative advantage.

The competitiveness of countries in the long run are influenced by three major factors (Naik 1999), 1. Comparative advantage 2.Country's ability to develop comparative advantage and 3.Country's ability to develop competitive advantage. Comparative advantage refers to the resource endowment of a country, which enables it to produce goods cost effectively. A country's resource endowment in terms of soil, agro-climate conditions and human resources may enable it to produce certain crops at comparatively lower costs than others. The theory of comparative advantage in it's simplest form states that a nation can enhance efficiency in resource use and hence net welfare, by producing and exporting commodities in which it is relatively efficient and importing commodities in which it is relatively not so.

A very simple measure of comparative cost advantage in producing various agricultural commodities can be derived by estimating the value of output per unit of input cost. The higher the ratio of gross value of output to it's cost, greater is the comparative cost advantage or efficiency in producing the commodity in question. The region specific ratios estimated in this fashion for different crops can be used in ranking the comparative cost advantage of different regions in producing different crops (Naik *et al.,*2004).

There are several global competitiveness indices – namely nominal protection coefficient (NPC), effective protection coefficient (EPC), producer-subsidy equivalent (PSE) and domestic resource cost ratio (DRCR) which are used for measuring comparative advantage, gains from free trade, and losses from market distortions for agricultural commodities (Tweeten, 1992; Gulati, Sharma and Kohli, 1996; Datta, 1996; World Bank 1997; Gulati and Sharma, 1998; Datta, 1999).

In this study, we have used NPC, which is Nominal Protection Coefficient, a simplified method for assessing competitiveness, and DRCR which is often used to measure comparative advantage. DRCR can provide information about a country's inherent advantage in producing the commodity with respect to its non-tradable resources even not economically utilized (mainly value of the by-products viz,, stalk, straw, husk, shell or fibre etc.,) though it also uses border price in computing the ratio. The NPC, which measures the degree of protection provided to the domestically produced commodities, is a good measure of competitiveness of countries for a given policy regime, if international market prices are determined purely by market forces. However, in many countries the government support to and policies with respect to agriculture distort free trade and WTO AoA will require changes in the support and policies. In this situation, the DRCR, on the other hand, can provide information about a country's inherent advantage in producing the commodity with respect to its non-tradable resources, though it also uses border price in computing the ratio.

2.2 Conceptual framework

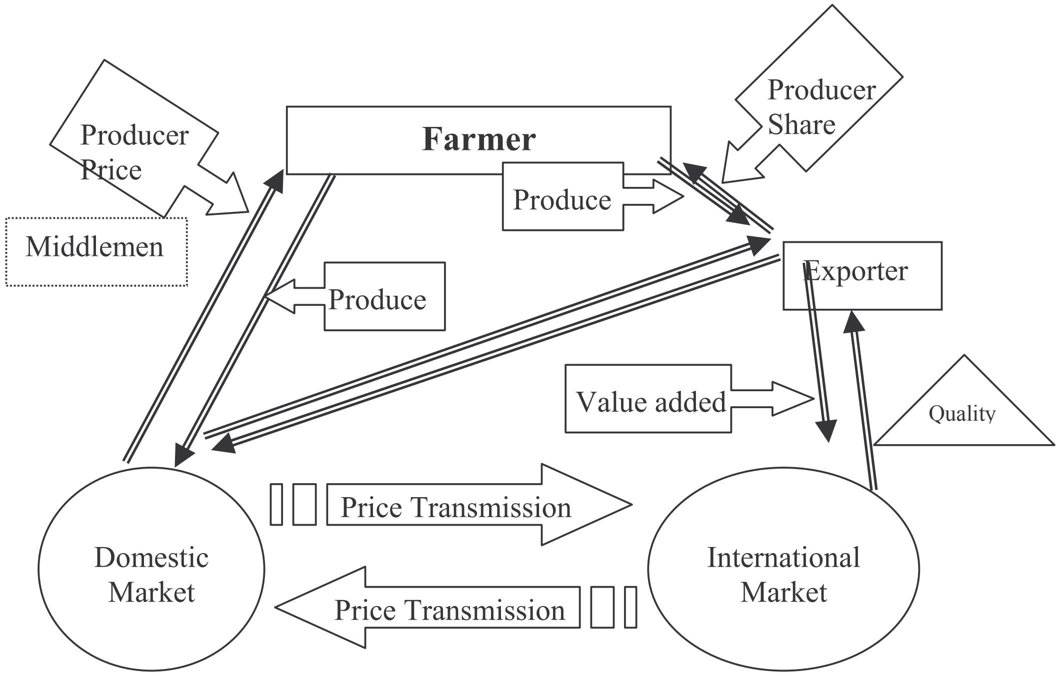


Figure 2.8 Conceptual framework of farmers price realization and price transmission mechanism

Conceptual framework given in figure 2.8, illustrates the simplified links between farmers and markets (both domestic and international). Farmers sell their produce either through middlemen or directly by themselves in the domestic market with little value addition. Farmers' price realization is relied the quality, quantity of the product and existing demand at the given point of time. However, farmers can also participate in the international markets through exporters (or themselves[1]) subject to proper value addition. Exporters / farmers could realize price according the quality standards and the quantity supplied in the international markets. Price signals are transmitted across the markets (both domestic and international) and price changes in one market are expected to influence the other. Those changes will be accordingly passed through all the players at different levels.

2.3 Analytical tools and techniques

Assessment of the change in trade pattern can be done using the time series data on quantity and value of exports and imports of various principal agricultural

[1] Farmers direct participation in the world market is marginal

commodities. Secondary data will be obtained from Agricultural Statistics at a Glance, web data sources like FAO, CMIE and *India Trade* for the periods between 1985-86 and 2007-08, which would bring out the picture; 10 years before and after the inception of WTO. Collected data will be used to examine the trend / pattern of trade during the above mentioned years and the annual growth will also be calculated. Commodity wise comparison between India and the major global player will be done using SWOT framework.

For the selected agricultural commodities, data on cost of production and output prices will be collected for the selected region / state from different sources which would be supplemented by data obtained from farmers and traders in the domestic markets. Value of tradable and non-tradable inputs and outputs will be used to assess the trade competitiveness of those commodities using DRCR methodology. Secondary data on quantity and quality will be collected for the selected commodities to assess the robustness of trade and quality competitiveness. Further, Extended DRCR frame work will be adopted to address the environmental issues.

Nominal Protection Coefficient (NPC)

It is the simplest of the indices and measures the divergence of domestic price from international prices, and therefore determines the degree of export and import competitiveness of the commodities in question. This measure helps in estimating the level of protection under exportable or importable hypothesis depending upon whether the country is a net exporter or a net importer of the commodity. The level of protection given to the commodity has also been studied by estimating the net protection coefficient (NPC) as:

$$NPC_i = P_i^d / P_i^b$$

Where P_i^d=Domestic wholesale price of "i"th commodity at specified place and time

P_i^b= Border price (CIF or FOB) of "i"th commodity at same place and time

When there is no protection given to the commodity, its domestic price is equal to it's border price (CIF or FOB) price and the NPC is equal to one. NPC more than one indicates that protection is given to the commodity and therefore, trade liberalization is the situation would reduce the domestic price. Conversely, when NPC is less than one, it indicates that the commodity is taxed and trade liberalization in this situation would raise the domestic price. The impact of trade liberalization on domestic prices is studied by computing reference prices that take into account costs of marketing, transport, etc within the country.

NPC can be estimated under two main hypothesis, i.e. importable hypothesis and exportable hypothesis. Under importable hypothesis the commodity in question is regarded as an import substitute, i.e., there is an imported commodity that competes with the domestically produced commodity. Here, the relevant price of the commodity is international price inclusive of the international transportation costs between the exporting and importing country and port clearance charges. If this commodity competes in the regional market then the transportation costs to that market and the various marketing costs and trader's margin have to be included in this price. The measure allows us to judge, whether a particular commodity is an efficient import substitute.

Under exportable hypothesis the commodity in question is treated as an exportable and competes with the domestically produced commodity at the foreign port. The relevant border or reference price under this hypothesis is obtained considering the transportation costs (both domestic and international), port clearance charges, marketing costs and trader's margin, and processing costs necessary to make the commodity tradable. This measure reveals whether a particular commodity export is competitive. In this study we have identified a common export destination for Indian commodity export and included transportation and other costs to that country from India and a major competing country.

A variant of the NPC, the nominal protection rate (NPR) is the percentage by which the domestic price exceeds the border price and can be expressed as NPR=100 (NPC-1). While computing the NPC it is important to take into consideration the impact of changes in the domestic policies on the border price.

Domestic Resource Cost Ratio (DRCR)

This method would judge social profitability in producing and exporting a commodity. DRCR computes the value of domestic primary and non-tradable resources in order to earn or save a unit of foreign exchange through production and exchange of the commodity under consideration depending on whether import substitution or export is taking place.

The DRCR is closely related to EPC, which is the ratio of value added in the domestic market to value added in border price. The numerator of DRC is the actual costs of non-traded input where-as the numerator of EPC is residual return to non-traded inputs and are equal in a well-functioning market. Therefore, in the absence of interventions, DRCR=EPC=1. DRCR value less (greater) than 1.0 indicates comparative advantage (dis-advantage). In a competitive trade environment a country will maximize return to non-tradable resources and therefore export those commodities for which DRCRs are low.

One variant of DRCR can be defined as the ratio of normative cost of all those inputs that go into production of a unit of output and the world value of all those inputs. Region specific DRCR's for different crops can be used to determine the comparative cost advantage of different regions in producing different commodities. DRCR is a good measure if distortion in the international price is negligible.

The opportunity cost of non-traded inputs and outputs including byproducts were computed on the basis of their supply (surplus or scarce). The market prices were accordingly adjusted. The subsidy or tax components were also adjusted. The useful parts of the commodities were valued as if made available from tradable commodities. The exact method used for different inputs and outputs are explained at appropriate places for individual commodities.

Ability to develop comparative advantage

Ability to develop comparative advantage would hinge mainly on two major factors. First, technology development and their adoption will be a key determinant in developing comparative advantage. In the years to come technologies especially with respect to seed such as yield saving and yield enhancing would significantly contribute to comparative advantage of countries. For example, cotton has been one of the commodities to have a significant technological development in recent years. Genetically engineered B_t Cotton introduced in 1996 in the United States has been making considerable impact on the cotton sector world over. Many other cotton-producing countries such as China, Australia, Argentina have also introduced B_t Cotton. This can alter the comparative advantage of cotton producing countries through saving in yield and reducing the cost of production. Second, sustainable technologies will be a key factor in maintaining lower cost in the long run. If technologies are extractive in nature and / or disturb soil moisture regime, in the long run productivity will go down or it will increase the cost of production making the country non-competitive in commodity markets.

Ability to develop competitive advantage

Ability to develop competitive advantage will depend on the systems and institutions, which can translate market information into the value chain. For example, Indian cotton is considered as most contaminated cotton in the world. Therefore even if India has cost advantage in production it will be difficult to export unless quality is substantially improved. Contamination occurs due to admixture of varieties at the production stage, inadequate care in harvesting, handling, transportation, etc.

Policy Analysis Matrix (PAM)

The PAM is a computational framework, developed by Monke and Pearson (1987) and augmented by Masters and Winter-Nelson (1995), for measuring input use efficiency in production, comparative advantage, and the degree of government interventions. The basis of the PAM is a set of profit and loss identities that are familiar to any businessman (Nelson and Panggabean, 1991). The basic format of the PAM as shown in Table below is a matrix of two-way accounting identities.

Policy Analysis Matrix

	Value of output	Value of input		Profit
		Tradable	Domestic Factor	
Private Prices	A	B	C	N
Social prices	D	E	F	O
Policy Transfer	G	H	I	P
Source: Monke and Pearson, 1989				

Private profit: N=A-(B+C)

Social profit: O=D-(E+F)

Output transfer: G=A-D

Input transfer: H=B-E

Factor transfer: I=C-F

Net policy transfer: P=N-O

The data in the first row provide a measure of private profitability (N), defined as the difference between observed revenue (A) and costs (B+C). Private profitability demonstrates the competitiveness of the agricultural system, given current technologies, prices for inputs and outputs, and policy. The second row of the matrix calculates the social profit that reflects social opportunity costs. Social profits measure efficiency and provide a measure of comparative advantage. In addition, comparison of private and social profits provides a measure of efficiency. A positive social profit indicates that the country uses scarce resources efficiently and has a static comparative advantage in the production of that commodity at the margin. Similarly, negative social profits suggest that the sector is wasting resources, which could have been utilized more efficiently in some other sector. In other words, the cost of domestic production exceeds the cost of imports suggesting that the sector cannot survive without government support at the margin. The third row of the matrix estimates the differences between the first and second rows. The difference between private and social values of revenues, costs and profits can be explained by policy interventions.

The PAM framework can also be used to calculate important indicators for policy analysis. The nominal protection coefficient (NPC), a simple indicator of the incentives or disincentives in place, is defined as the ratio of domestic price to a comparable world (social) price. NPC can be calculated for both output (NPCO) and input (NPCI). The domestic price used in this computation could be either the procurement price or the farm gate price while the world reference price is the international price adjusted for transportation, marketing and processing costs. The other two indicators that can be calculated from the PAM include the effective protection coefficient (EPC) and domestic resource cost (DRC). EPC is the ratio of value added in private prices (A−B) to value added in social prices (E−F). An EPC value of greater than one suggests that government policies provide positive incentives to producers while values less than one indicate that producers are not protected through policy interventions.

DRC, the most useful indicator of the three, is used to compare the relative efficiency or comparative advantage between agricultural commodities and is defined as the shadow value of nontradable factor inputs used in an activity per unit of tradable value added (F/(D-E)). The DRC indicates whether the use of domestic factors is socially profitable (DRC<1) or not DRC>1). The DRC values are calculated for each commodity in each state. The commodities can be ranked according to the DRC values and this ranking is taken as an indication of comparative advantage or disadvantage within that state. A state will have a comparative advantage in a given crop if the value of the DRC for that crop is lower than the DRC for other crops grown in that state. Although the DRC indicator is widely used in academic research, its primary use has been in applied works by the World Bank, the Food and Agriculture Organization, and the International Food Policy Research Institute to measure comparative advantage in the developing countries. However, DRC may be biased against activities that rely heavily on domestic non traded factors such as land and labor. A good alternative to the DRC is the Social Cost/Benefit (SCB), which accounts for all costs (Fang and Beghin, 1999).The SCB is calculated as the ratio (E+F)/D. Land is a more restricted factor than other domestic factors in India’s crop production. Therefore another indicator, the SCB without land cost (LSB) is used to measure the return to this fixed factor. Higher values of SCB and LSB suggest stronger competitiveness.

One of the main strengths of this approach is that it allows varying degrees of disaggregation. It also provides a straightforward analysis of policy-induced effects. Despite its strengths, the PAM approach has been criticized because of its static nature. Some do not consider the results to be realistic in a dynamic setting (Nelson and Panggabean, 1991). One of the ways to overcome this limitation is to conduct sensitivity analysis under various assumptions.

The most difficult tasks for constructing a PAM are estimating social prices for outputs and inputs and decomposing inputs into their tradable and non-tradable components (Yao, 1997). For computing social prices for various commodities including both outputs and inputs, world prices are used as the reference prices in the study. The raw sugar price FOB Caribbean and U.S. runner, 40 to 50 percent shelled basis CIF Rotterdam are used at the representative prices for sugar and groundnut respectively. These world prices are obtained from various commodity yearbooks published by USDA. The world prices are adjusted for transportation costs and marketing costs to be comparable with farm gate prices. For imported commodities, social prices at the farm gate are calculated by adding marketing costs from the respective CIF Mumbai/Kandla prices (Calculated by adding ocean freight charge to the FOB price) in domestic currency. Similarly, for exported commodities, social prices at the farm gate are calculated by adding marketing cost from the respective world reference price in the domestic currency, converted to domestic currency. Freight rates from Gulf ports and Rotterdam are collected from Pursell and Gupta (2001) and added to the FOB Gulf and CIF Rotterdam prices. These prices are converted to domestic currencies using market exchange rates and finally, marketing costs are added to compare with farm gate prices.

Following Pursell and Gupta (2001), marketing costs consist of an interest charge for two months at an 18 percent rate applied to the CIF prices plus Re 10 per metric ton to represent other marketing expenses. Similar procedures are used for calculating input shadow prices for fertilizers and pesticides. Following Gulati and Kelley (2000), the social valuation of land is calculated as the ratio of net returns to land to average of NPCOs of competing crops. Net returns to land is calculated as the gross value of output-cost of production + rental value of owned land. Another important component of this analysis is the disaggregation of nontraded and traded inputs. Based on

Monke and Pearson (1989), who suggested that decomposing all input costs is a tedious task and has only a very insignificant effect on results, some inputs such as land, labor, farm capital depreciation, animal power and manure are assumed to be totally nontradable. Once the inputs are disaggregated into tradable and nontradable components, PAMs are constructed for each crop. The accounting prices of various outputs and inputs for which international prices were not available were arrived at by shadow pricing them. The shadow pricing factors were logically determined considering components of each cost and nature of distortions in their market prices. In case of non-tradable outputs (byproducts) crop stalks were valued as a source of domestic fuel and other wise treated as straw as a source of dry fodder.

Stationarity test (Augmented Dickey-Fuller (ADF) test)

Since interdependence among prices is related to their current as well as past levels, we employ a multivariate co-integration technique to study price interdependence rather than estimating a structural relationship. A number of studies in the recent past have used time series techniques to test for price interdependence using co-integration technique. Unlike the earlier approaches which ignored time series properties (non-stationarity of the data series), the co-integration methodology captures long run properties also when dealing with the non-stationary data. The fundamental insight of co-integration analysis is that although many economic time series may tend to move upwards or downwards over time in a non-stationary fashion, group of variables may drift together. If there is a tendency for some linear relationship to hold between a set of variables over a long period of time, such relationships are identified with the help of co-integration technique.

Testing for co-integration at the first step requires testing the order of stationarity of the variables. Integration tests are prerequisite for co-integration. The order of integration (existence or absence of non-stationarity) in the time series was checked by the ‘Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979) and ‘Phillips and Perron (PP) test (Phillips and Perron, 1988). However, the present study is mainly concentrated on the ADF test rather than PP test.

Market cointegration tests

The issue of price linkages in product markets both at local and international levels has been studied in the literature extensively either under the notion of the law of one price (Protopapadakis and Stoll[2], 1983, 1986[3]; Ardeni[4], 1989) or under the notion of market integration (Ravallion[5], 1986; Gardner and Brooks[6], 1994; Baulch[7], 1997). Integration between markets either national or international is one of the important phenomena, which needs to be checked through cointegration tests. Price transmission is expected to take place between the integrated markets (domestic-domestic or international-domestic) over short and long term basis. Transmission of changes in world prices into various domestic prices of agricultural commodities can be estimated through a VECM frame work and estimation of long-run as well as short-run impacts on prices are also possible. To accomplish this, various prices viz., international prices (reference market price), country's export and import prices, wholesale price and producer price are to be collected from various sources. FAO, UNCTAD, AGMARKNET and Agricultural Statistics at a Glance are the few important sources providing the information on prices.

Vector Error Correction Model

On the basis of the properties, the test for unit roots was applied also to the residuals of the static regression between each pair of prices, in order to test for co-integration following the Engle and Granger[8] (1987) procedure. Where co-integration arose, a set of Auto Regressive Distributed Lag (ARDL) models were specified and estimated as follows:

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[2]Protopapadakis, A. A. and Stoll, H. R. (1983) Spot and futures prices and the law of one price, *Journal of Finance*, 38, 1431-55.
[3]Protopapadakis, A. A. and Stoll, H. R. (1986) Some empirical evidence on commodity arbitrage and the law of one price, *Journal of International Money and Finance*, 9, 335-60.
[4]Ardeni, P. G. (1989) Does the law of one price really hold for commodity prices? *American Journal of Agricultural Economics*, 71, 661-669.
[5]Ravallion, M. (1986) Testing market integration, *American Journal of Agricultural Economics*, 68, 102-109.
[6] Gardner, B. and Brooks, K. M. (1994) Food prices and market integration in Russia: 1992Ð1993, *American Journal of Agricultural Economics*, 76, 641-646.
[7]Baulch, B. (1997a) Transfer costs, spatial arbitrage, and testing for food market integration, *American Journal of Agricultural Economics*, 79, 477-487.

[8]Engle, R.F. & Granger C.W.J., 1987.Cointegration and error correction: representation, estimation and testing. *Econometrica*, 55, 251-276.

$$pd_t = a + \tau T + \sum_{j=1}^{J} \beta_j pd_{t-j} + \sum_{k=0}^{K} \gamma_k pw_{t-k} + e_t \qquad \text{---- (1)}$$

Where, *pd* are the countries' (logarithm of the) import unit values in time *t*, *pw* is the (log) world reference price, *a* is an intercept, *T* is a time trend, *e* is the error term, and *t* is the period index.

Where the null of absence of co-integration is rejected in the Engle and Granger (1987) procedure, the adjustment taking place around the long run equilibrium can be modelled through an Error Correction (ECM) specification, such as:

$$\Delta pd_t = a + \delta T + \rho[pd_{t-1} - \lambda_1 pw_{t-1}] + \sum_{j=1}^{J} \beta_j^* \Delta pd_{t-j} + \sum_{k=0}^{K} \gamma_j^* \Delta pw_{t-k} + h_t$$

in which the coefficient = (1−Σ) *j* ρ β usually named "ECM coefficient", indicates the short run adjustment of prices toward the long run equilibrium, and λ1.is the same as the one calculated from the ARDL model in (1).

Results reported here include for each commodity the parameters and the *t* statistics for the long run equilibrium, together with the results of the estimation of the corresponding ECM specifications. In order to test for Granger non-causality between the pairs of prices, model (1) and its reverse form have been estimated by dropping the contemporaneous coefficients, according to

$$pd_t = a + \tau T + \sum_{j=1}^{J} \beta_j pd_{t-j} + \sum_{k=1}^{K} \gamma_k pw_{t-k} + e_t$$

$$pw_t = a + \tau T + \sum_{j=1}^{J} \beta'_j pd_{t-j} + \sum_{k=1}^{K} \gamma'_k pw_{t-k} + z_t$$

Both equations were tested for γ*k*β*j* γ'*k*β'*j* significantly different from zero for any *j*, *k*. Acceptance of the null implies that past values of the series on the right hand side are not adding information on the actual values of the series on the left hand side, on top of what is provided by its own past values. If this happens in both equations, then neither of the two series is Granger-causing the other, while if the null can be rejected in one of them, the price appearing on the left hand side will be Granger-causing the other. Given that a co-integrating relation must exist between the two series involved if Grangernon- causality is rejected in at least one of the two equations, this test has been used here firstly, as a confirmation of the test for the long run equilibrium;

secondly, to understand which of the two price acts as a source of information for the other; and thirdly, to gain qualitative elements to understand the results, in terms of the causality direction. Rejection of the null in both the equations is to be considered as indicating a model misspecification or incompleteness, as it implies that both series are being Granger-caused by some third unknown variable. This test was performed, on monthly data, for those pairs of prices showing the presence of long run equilibrium.

All these above time series analysis will be performed based on the availability of adequate number of data points. Hence, it is applicable to few important commodities. However, the results were obtained based on the available and accessible information.

Chapter 3

Foodgrains: Rice

In India, paddy has been cultivated since ancient period. Paddy is a primary foodgrain crop of India and occupies about 37 percent of the area under foodgrains and contributed more than 40 percent of foodgrains production in the country. More than 50 percent of country's population depends fully or partially on rice as it constitutes the main cereal food crop of the diet. States like Andhra Pradesh, Assam, Kerala, Orissa, Tamil Nadu and West Bengal, rice consumption accounted for more than 80 percent share in total cereal intake.

India's rice trade

a. Non-Basmati

In 1950, India produced 20 Million MT of rice. Not enough to feed its population. It had to resort to aid and imports to feed its teeming millions. Today, the situation is vastly changed, the country produces over 130 million MT of paddy and about 90 million MT of rice, more than enough to feed its population. In the last few years, India has emerged as a significant exporter of Non-Basmati rice to the world markets. This has also led to the International Grain Council (IGC) according the status of a Member Exporter to the country (AIREA[9], 2009).

Indian Non-Basmati Rice has now penetrated many markets in rice importing countries all over the world. Saudi Arabia imports almost half a million tons of Non-Basmati rice, every year from India. India's Permal rice and parboiled rice varieties have made a place for themselves in the market and also in other markets in the Middle East and Africa. Large quantities of non-basmati rice is also exported from India to Nigeria, Bangladesh, South East Asia, Europe and other parts of the world (Fig 3.1 and Table 3.1).

[9]http://www.riceofindia.com/standards_for_indian_basmati.htm as on 12.08.2009

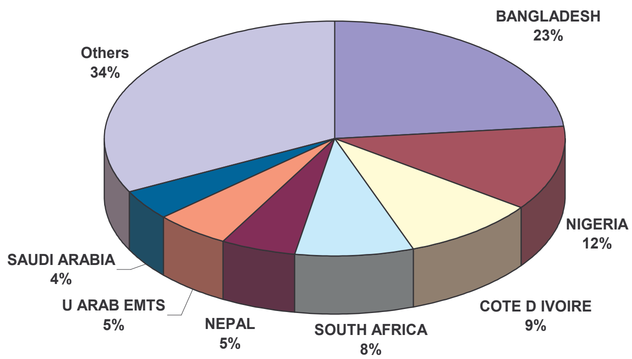


Fig 3.1: Major Importers of Indian Non-Basmati Rice

b. Indian Basmati

Indian Basmati is long grain aromatic rice with a unique, pleasing and appetizing aroma. It is the aroma that gives basmati its novel characteristics unmatched by any other rice grain anywhere else in the world. It is grown in a small part of the Indo-gangetic plains, at the foothills of the mighty Himalaya Mountains, in the North of the country. The area in which basmati rice grows is geographically well defined and includes the states of Punjab, Haryana, Uttaranchal, Western Uttar Pradesh and the southern part of Jammu and Kashmir. The climate, soil and water in this region combine to give Indian Basmati its unique qualities and characteristics. Its unique quality and characteristics cannot be replicated if grown anywhere else. In more ways than one, Basmati is nature's gift to the Indian subcontinent and commands the highest price amongst all the rice varieties in the world. This rice has high amylase content and a firm almost dry texture when properly cooked. The raw kernel is long and slender and increases in length by more than two and a half times when cooked. The best Indian Basmati is aged for at least one year to increase firmness, texture and elongation after cooking. Because of its quality characteristics, basmati rice fetches a higher price in the international market.

The very name of Basmati is derived from ancient Indian languages and means “An aroma that pleases the senses". Farmers have been growing Basmati rice in the country for centuries. Various ancient texts, scriptures (Krishi Sukti) and historical accounts describe and mention this aromatic rice. Archeological excavations at Ahar village near Udaipur railway station have also revealed remains (2000 BC - 1600 BC) of long grained rice considered a possible ancestor of Basmati. Basmati can only be grown once a year (AIREA, 2009). There are many varieties of Basmati rice grown in India. Under Section 5, Seed Act, 1966 of India has notified eleven varieties of Basmati Rice. Details are given below

1. Basmati 370	7. Pusa Basmati - I (IET-0364)
2. Basmati 386	8. Punjab Basmati -1 (Bauni Basmati)
3. Type 3	9. Haryana Basmati-1 (HKR228/IET 10367)
4. Taraori Basmati (HBC-19)	10. Kasturi (IET-8580)
5. Basmati 217	11. Mahi Sugandha
6. Ranbir Basmati (IET-11348)	

Initially, Basmati used to be consumed in the areas in which it was grown. However, with the migration of the ethnic population to various parts of the world, Basmati became reasonably popular with Indians abroad. Later on, it started becoming popular with the locals of these countries and thus the exports of Basmati Rice started increasing gradually. In 1980s, the Government of India opened the export of Basmati Rice and this led to the rapid development of a large market for this rice in the International arena. Over a period of time, the traders who were exporting rice began to invest in automation, yield improvement, packaging and marketing and an ancient product led to the development of a new sunrise industry. Today, exporters are churning out thousands of tonnes of high quality Basmati Rice from their factories. Most of them have attained the status of Export House, Trading House, Star Trading House and Super Star Trading House. With the concept of joint family dwindling rapidly, families have no time to spare for cooking. This has led to the rise of the ready to eat cooked food industry. The Indian rice industry has also launched new products like Heat & Eat, Rice 'n Spice etc. These products are now becoming popular both in India and abroad. As Indian Rice brands and value added products build bridgeheads for themselves in the International arena, the industry is gearing up to increase exports on a sustainable basis and become a significant world-class player in the Rice markets of the world. Major importers of basmati rice are shown in Fig 3.2 and Table 3.2. Saudi Arabia imports nearly half of India's basmati exports, while United Arab Emirates, Kuwait, UK, Yeman, USA and Belgium of the other major importers of Indian Basmati rice.

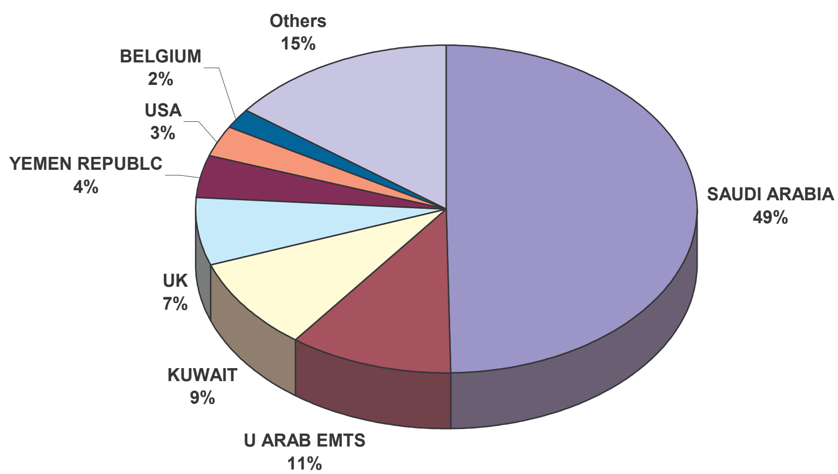


Fig 3.2 Major importers of India's Basmati Rice

Table 3.1: Quantity of value of export of Non-Basmati to different countries from India

Value in Rs. Lakh, Quantity in MT

Country	2005-2006		2005-2006		2006-2007		2006-2007		2007-2008		2007-2008	
	QTY	%	Value	%	QTY	%	Value	%	QTY	%	Value	%
Bangladesh	593,820.29	20.33	54,666.67	17.20	512,920.21	13.85	48,685.84	11.47	1,906,856.37	36.07	264,510.92	35.70
U Arab Emts	167,998.79	5.75	24,031.41	7.56	128,634.54	3.47	23,721.86	5.59	312,181.94	5.91	82,811.41	11.18
Cote d Ivoire	217,285.50	7.44	21,794.59	6.86	337,893.38	9.13	35,202.04	8.30	624,973.62	11.82	69,090.86	9.32
Saudi Arabia	147,241.75	5.04	20,970.42	6.60	133,159.86	3.60	19,283.77	4.54	221,754.75	4.20	41,301.17	5.57
South Africa	267,601.51	9.16	30,683.56	9.65	391,505.54	10.57	44,310.89	10.44	271,693.12	5.14	34,575.05	4.67
Nepal	223,604.29	7.65	15,347.12	4.83	162,241.55	4.38	15,162.37	3.57	231,988.23	4.39	24,518.42	3.31
Nigeria	464,327.03	15.89	55,540.03	17.48	547,632.50	14.79	62,999.37	14.85	204,747.50	3.87	23,861.25	3.22
Guinea	33,737.00	1.15	3,434.98	1.08	99,565.53	2.69	10,183.18	2.40	207,541.03	3.93	21,968.45	2.96
Sri Lanka	1,916.83	0.07	277.56	0.09	872.74	0.02	135.53	0.03	91,414.49	1.73	15,933.15	2.15
Benin	90,504.71	3.10	9,359.18	2.94	111,496.70	3.01	12,548.51	2.96	121,247.82	2.29	13,882.20	1.87
Somalia	131,788.00	4.51	13,929.23	4.38	162,497.69	4.39	18,030.30	4.25	105,145.42	1.99	13,479.55	1.82
Senegal	109,145.04	3.74	10,741.82	3.38	134,855.00	3.64	11,933.53	2.81	132,204.08	2.50	12,661.32	1.71
Togo	61,821.50	2.12	6,836.91	2.15	103,813.00	2.80	10,778.14	2.54	127,706.63	2.42	11,874.80	1.60
Total	2,921,601.93	100.00	317,816.82	100.00	3,702,191.99	100.00	424,307.84	100.00	5,285,916.35	100.00	740,979.46	100.00

Source: DGCIS Annual Export

Table 3.2: Quantity of value of export of Basmati to different countries from India

Value in Rs. Lakh, Quantity in MT

	2005-2006		2005-2006		2006-2007		2006-2007		2007-2008		2007-2008	
Country	QTY	%	Value	%	QTY	%	Value	%	QTY	%	Value	%
SAUDI ARABIA	643,651.51	55.18	166,442.48	54.70	499,584.76	47.77	124,095.96	44.43	543,530.24	45.93	203,834.60	46.92
U ARAB EMTS	62,100.45	5.32	15,957.46	5.24	104,998.09	10.04	30,521.18	10.93	193,102.03	16.32	68,983.28	15.88
KUWAIT	91,335.38	7.83	23,792.74	7.82	109,067.36	10.43	30,687.29	10.99	113,066.57	9.55	40,168.30	9.25
UK	84,715.37	7.26	22,265.53	7.32	71,411.67	6.83	19,622.59	7.03	71,377.56	6.03	29,108.34	6.70
USA	33,285.40	2.85	11,051.68	3.63	34,501.92	3.30	11,467.37	4.11	35,738.68	3.02	14,210.11	3.27
YEMEN REPUBLC	50,388.40	4.32	11,144.83	3.66	40,689.20	3.89	9,321.39	3.34	49,958.53	4.22	13,715.18	3.16
NETHERLAND	18,405.97	1.58	4,269.47	1.40	18,850.61	1.80	4,605.16	1.65	17,851.68	1.51	5,949.42	1.37
CANADA	13,497.95	1.16	4,790.75	1.57	15,869.79	1.52	5,778.83	2.07	13,565.22	1.15	5,754.19	1.32
BELGIUM	31,021.00	2.66	7,630.96	2.51	24,386.50	2.33	5,481.85	1.96	13,346.59	1.13	4,927.46	1.13
GERMANY	12,295.86	1.05	3,397.12	1.12	11,404.24	1.09	3,171.40	1.14	10,797.03	0.91	4,199.11	0.97
QATAR	5,102.50	0.44	1,445.24	0.47	6,214.08	0.59	1,910.45	0.68	13,430.21	1.13	4,039.12	0.93
ITALY	22,808.11	1.96	5,148.28	1.69	9,943.44	0.95	2,468.02	0.88	10,846.64	0.92	3,814.25	0.88
Total	1,166,562.78	100.00	304,309.25	100.00	1,045,714.95	100.00	279,280.87	100.00	1,183,355.75	100.00	434,458.09	100.00

Source: DGCIS Annual Export

Market Integration and Price Transmission in Indian Rice Markets

Long-run Relationships

Export, import and producer prices of rice were examined for any established integration between them over the years. Such integration would provide clue how prices are influencing each other (fig 3.3)

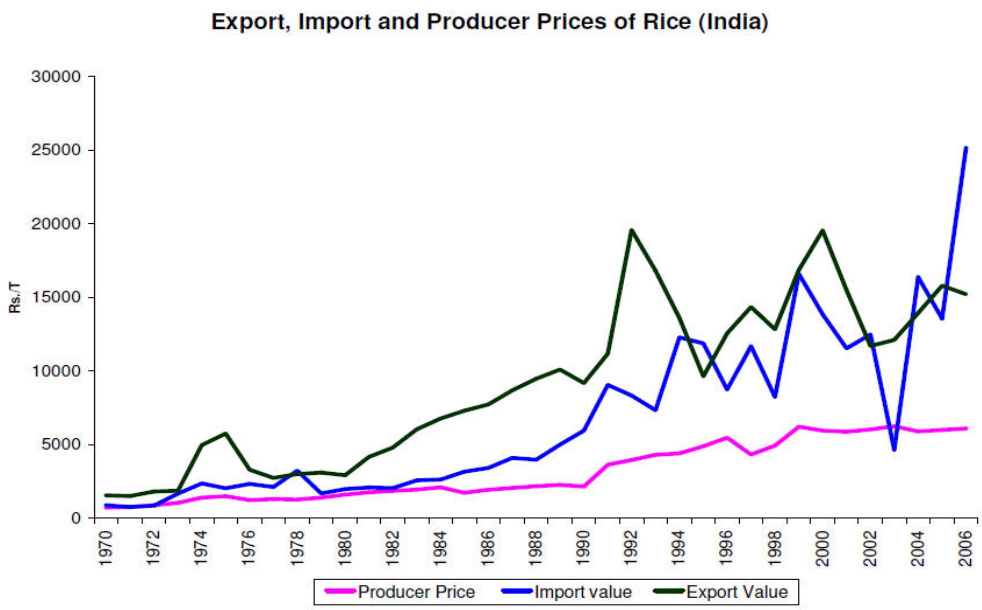


Fig 3.3 Export, Import and Producer Prices of Rice for India

It could be observed from the above figure that volatility is high in both import and export prices as compared to that of producer price. These prices were tested for stationarity before examining for integration. The graphical representation of the unit root rest is illustrated below (Fig 3.4). Left hand side figures show the existence of unit root in the time series as the autocorrelation process decays gradually in all the cases. After first order differencing, these series were again examined for stationarity and found they were free from unit root (right hand side figures). Further the order of integration was tested for different combination of prices in order to find the relationship between those prices. Maximum eigen value and significant trace indicated that producer price and export prices were integrated at order I(1), while other combination of prices were not (Table 3.3).

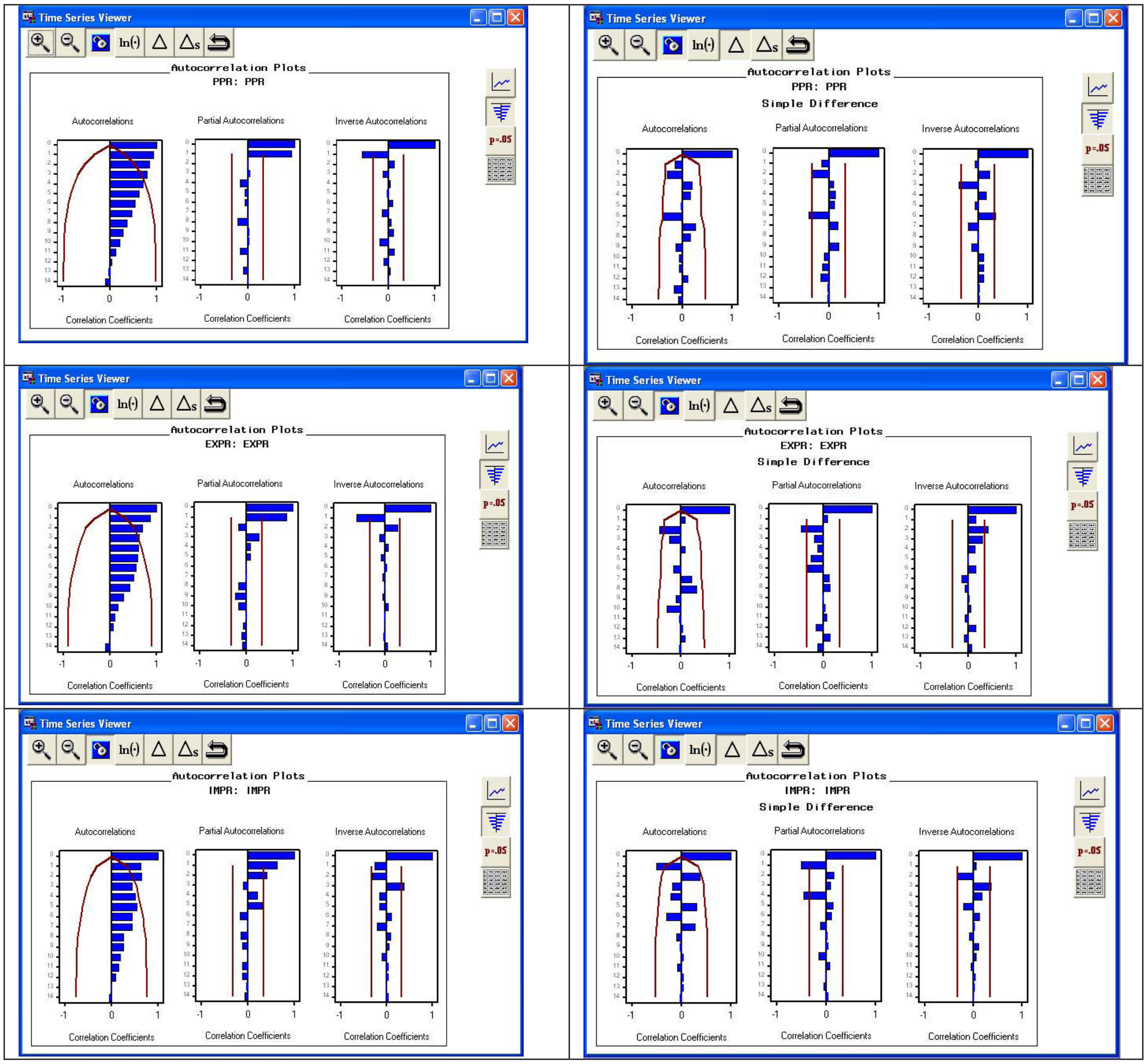


Fig 3.4 Testing the Unit root in different price series before and after differencing

Table 3.3 Testing Cointegration between different price series and the rank using trace

Series	H0: Rank=r	H1: Rank>r	Eigen Value	Trace	5% Critical Value
Producer and Export Prices	0	0	0.5107	25.70	15.34
	1	1	0.0194	0.69	3.84
Producer and Import Prices	0	0	0.2410	9.97	15.34
	1	1	0.0090	0.32	3.84
Export and Import Prices	0	0	0.2390	9.61	15.34
	1	1	0.0013	0.05	3.84

Drift in ECM: Constant; Drift in process: Linear

Table 3.4 Granger-Causality Wald Test for long term integration

Dependant	Independent	Chi-Square	Pr > ChiSq
Producer Price	Export Price	6.65	0.0360
Export Price	Producer Price	26.03	<.0001
Producer Price	Import Price	5.73	0.0570
Import Price	Producer Price	2.96	0.2281
Export Price	Import Price	3.96	0.1380
Import Price	Export Price	0.92	0.6301

Results of Granger Casuality Wald tests presented in Table 3.4, indicate the direction of relationship (unidirectional / bidirectional) between prices. Producer and export prices were influencing each other; while significance of influence of producer price on export price was found high. This result is similar to Conforti[10] (2004), indicated a considerable degree of linkage between India's domestic and

[10]Conforti, Piero. (2004) Price transmission in selected agricultural Markets. FAO Commodity and Trade Policy Research Working Paper No. 7

world reference prices. However, contrast to Hazell *et al*[11]., (1990) found that fluctuations in world market prices were in general transmitted to countries' export unit values, but not to producer prices due to government intervention.

Import price was found to influence producer price a little while the vice-versa was not significant. Import and export prices were independent of each other and their mutual influence was not significant. For VECM estimates ***(long run and short run relationships – see Appendix A1 –A13 tables).***Similarly, the same mechanism has been implemented to wholesale prices of rice at different markets viz., Bangkok (world reference market), All India markets, Kanpur, Bankura and Sambalpur markets (Fig 3.5). Results are presented in Tables 3.5 and 3.6, while test of stationarity was performed and presented in Fig 3.6.

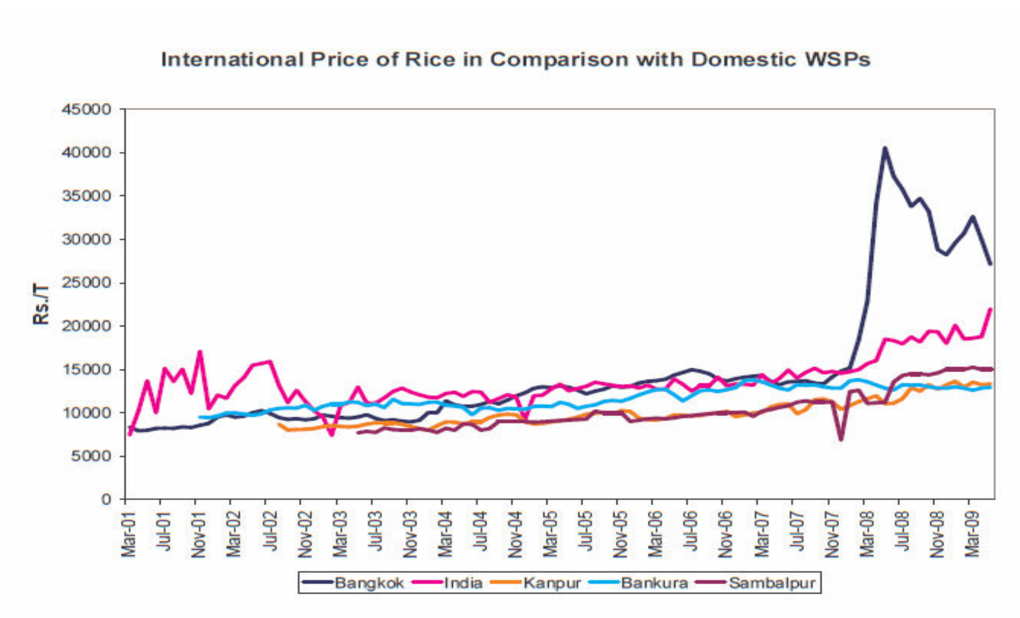


Fig 3.5 Wholesale price of rice: Bangkok, India, Kanpur, Bankura and Sambalpur

[11]Hazell, P., Jaramillo, M. and Williamson, A. 'The relationship between world price instability and the prices farmers receive in developing countries', Journal of Agricultural Economics, Vol. 41, (1990) pp. 227–243.

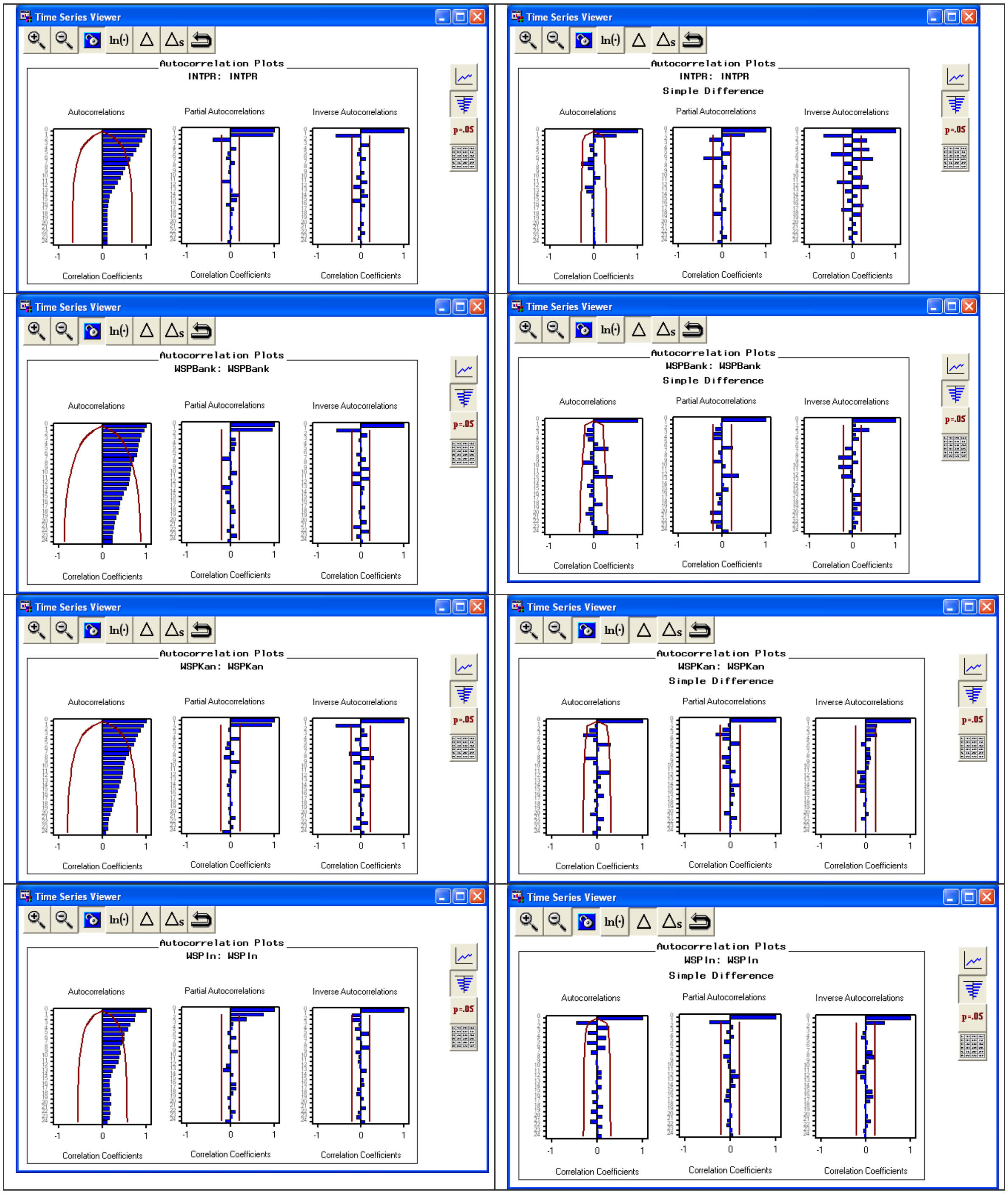


Fig 3.6 Testing the Unit root in different price series before and after differencing

Table 3.5 Testing Cointegration between different price series and the rank using trace

Series	H0: Rank=r	H1: Rank>r	Eigen Value	Trace	5% Critical Value
Bangkok and WSP_India Prices	0	0	0.1665	19.31	15.34
	1	1	0.0168	1.64	3.84
Bangkok and WSP_Kanpur Prices	0	0	0.2294	21.08	15.34
	1	1	0.0029	0.23	3.84
Bangkok and WSP_Bankura Prices	0	0	0.1115	12.22	15.34
	1	1	0.0189	1.70	3.84
Bangkok and WSP_Sambalpur Prices	0	0	0.3493	30.98	15.34
	1	1	0.0066	0.47	3.84
WSP_India and WSP_Kanpur Prices	0	0	0.2724	26.10	15.34
	1	1	0.0083	0.66	3.84
WSP_India and WSP_Bankura Prices	0	0	0.0623	6.04	15.34
	1	1	0.0035	0.32	3.84
WSP_India and WSP_Sambalpur Prices	0	0	0.3702	33.79	15.34
	1	1	0.0134	0.96	3.84
WSP_Kanpur&WSP_Bankura Prices	0	0	0.0698	5.96	15.34
	1	1	0.0021	0.17	3.84
WSP_Kanpur&WSP_Sambalpur Prices	0	0	0.3798	33.92	15.34
	1	1	0.0000	0.0009	3.84
WSP_Bankura&WSP_Sambalpur Prices	0	0	0.0516	4.27	15.34
	1	1	0.0071	0.51	3.84

Drift in ECM: Constant; Drift in process: Linear

Table 3.6 Granger-Causality Wald Test for domestic and international prices

Dependant	Independent	Chi-Square	Pr > ChiSq
Bangkok Price	WSP_India	2.68	0.2619
WSP_India	Bangkok Price	14.92	0.0006
Bangkok Price	WSP_Kanpur	8.72	0.0128
WSP_Kanpur	Bangkok Price	12.80	0.0017
Bangkok Price	WSP_Bankura	6.26	0.0438
WSP_Bankura	Bangkok Price	2.44	0.2945
Bangkok Price	WSP_Sambalpur	8.11	0.0174
WSP_Sambalpur	Bangkok Price	23.00	<.0001
WSP_India	WSP_Kanpur	8.73	0.0127
WSP_Kanpur	WSP_India	14.84	0.0006
WSP_India	WSP_Bankura	2.81	0.2459
WSP_Bankura	WSP_India	0.46	0.7946
WSP_India	WSP_Sambalpur	5.73	0.0571
WSP_Sambalpur	WSP_India	27.38	<.0001
WSP_Kanpur	WSP_Bankura	5.51	0.0636
WSP_Bankura	WSP_Kanpur	4.14	0.1262
WSP_Kanpur	WSP_Sambalpur	19.87	<.0001
WSP_Sambalpur	WSP_Kanpur	6.28	0.0433
WSP_Bankura	WSP_Sambalpur	0.43	0.8052
WSP_Sambalpur	WSP_Bankura	1.18	0.5532

Trade Competitiveness

Trade policy reform in the cereals sector also started in 1994/95, when India liberalized exports of common rice. The following year India's rice exports shot up from less than 1 million tons to about 5 million tons, making India the second largest rice exporter in 1995/96 (figure 3.7). During this time domestic prices were far lower than international prices. However, when international prices crashed in the late 1990s, India's rice exports turned sluggish. In1999/2000 and 2000/01 India even began to import some rice, as domestic prices were comparable to international prices, blunting India's competitive edge. This change is reflected in the nominal protection coefficients during thisperiod.10 Although nominal protection coefficients remained broadly below 1,they do not take into account domestic taxes on rice (such as the purchase tax and mandi tax) of almost 12 percent, which make exports more difficult than the nominal protection coefficient would imply.

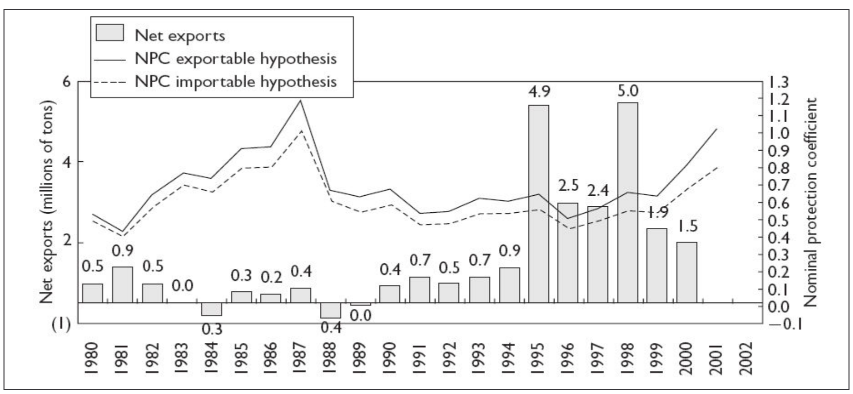


Fig 3.7 Net exports of Rice from India, 1980-2000

Datta (1999) re-examined the global competitiveness of Indian rice using Policy Analysis Matrix and explicitly recognizing varietal difference and considering costs of processing, transport, marketing as well as by-products use. This is done for two years 1994-95 and 1998-99 for three varieties of non-basmati (Haryana Gaurab, UP-71/12 and PR-106) and Basmati. The summary of results is summarized in table below:

Varieties	NPC		DRCR	
	1994-95	1998-99	1994-95	1998-99
Basmati	0.71	0.89	0.48	0.38
Haryana Gaurab	0.66	0.76	0.29	0.32
UP 71/12	0.65	0.81	0.29	0.23
PR 106	0.61	0.59	0.29	0.31

Source: Datta (1999)

The results broadly concluded that in three out of four varieties the competition is declining while the DRCR values suggest in two out of four cases the comparative advantage has improved and in other two cases it has deteriorated.

Mohanty *et al.,* (2002) analyzed competitiveness of rice in major states of India and found it was least efficiently produced crop among five major crops discussed in the study. They found these results are consistent with the government policies of achieving food security in grain through high procurement price and heavy subsidization of inputs.

Similarly Naik *et al*., (2004) computed the NPC under the exportable hypothesis for the period between 1992-93 and 2000. They used the total cost of delivering rice for India and the competitor (Thailand) to a common port of an importing country i.e., Ivory Coast for Parmal variety of rice. The NPC values were remained below one up till 1999-2000. In the last two years, however, the NPCs have been marginally higher than one. This suggests that India may be losing its competitiveness in rice exports.

Trade competitiveness of Traditional Basmati was assessed and given in Table 3.7. This assessment has been done after interview with farmers, wholesalers and processors in Ludhiana during 2010. Though the measures like NPC, EPC and ESC are relatively higher (nearly one), DRCR is as low as 0.32; which indicates that export of Indian basmati rice is much more competitive. Surplus measures like PPA, PPFT and SPFT were positive and TPT was negative, which may be due to high net taxation.

Table 3.7 Policy Analysis Matrix Framework for Traditional Basmati
(under exportable hypothesis)

			Rs. (09-10)$
Domestic Prices	Domestic price of Tradable output@	A	38256
	Domestic price of Non-Tradable output	B	6542
	Domestic price of Tradable input	C	5214
	Domestic price of Non-Tradable input	D	18327
Economic Prices	Border price of Tradable output#	E	42158
	Opportunity cost of Non-Tradable output	F	6542
	Border price of Tradable input	G	5147
	Opportunity cost of Non-Tradable input	H	18541
Surplus	Private Profit under Autarky (PPA)	(A+B)-(C+D)	21257
	Private Profit under Free Trade (PPFT)	(E+B)-(C+D)	25159
	Social Profit under Free Trade (SPFT)	(E+F)-(G+H)	25012
	Total Policy Transfer (TPT)	(PPA-SPFT)	-3755
Competitiveness Measure	Nominal Protection Coefficient (NPC)	(A/E)	0.91
	Effective Protection Coefficient (EPC)	(A-C)/(E-G)	0.89
	Effective Subsidy Coefficient (ESC)	[(A-C)+(H-D)]/(E-G)	0.90
	Domestic Resource Cost Ratio (DRCR)	(H-F)/(E-G)	0.32

$ Authors own estimates
@ Wholesale price collected from Ludhiana after adjusting to transportation costs
# International reference price in Thai market after adjusting to transportation costs

Despite this DRCR measures, Basmati rice has its own niche in world market. Discussion with leading rice exporters would lead to derive some of the points related to export of basmati; especially quality parameters and organic produce. Different grades and quality parameters of basmati rice is illustrated in the table given below.

Table 3.8 Standards for Indian Basmati Rice as per Notification No. 67 (E) dated 23rd January 2003 issued by Ministry of Commerce & Industry, Government of India.

Grade	Minimum Average Precook Length in mm	Min L/B Ratio	Maximum Moisture content %age	Max. Damaged Discoloured Grain %	Max. Chalky Grain / Black Kernels %	Max. Broken & Frag-ments %	Max. Foreign Matter %	Max. other Grain %	Max. other Rice varie-ties %	Max. under Milled & red stripped grain %	Max. Paddy Grain %	Mini-mum Elong-ation Ratio	Max. Green Grain %
1	2	3	4	5	6	7	8	9	10	11	12	13	14
MILLED													
Special	7.1	3.5	14	0.5	3	2	0.10	0.10	5	2.0	0.1	1.7	-
A	7.0	3.5	14	0.7	5	3	0.25	0.10	8	2.5	0.2	1.7	-
B	6.8	3.5	14	1.0	7	5	0.40	0.20	15	3.5	0.3	1.7	-
MILLED PARBOILED													
Special	7.1	3.5	14	0.5	0.1	2	0.10	0.10	5	2.0	0.1	1.5	-
A	7.0	3.5	14	0.7	0.5	3	0.25	0.10	8	2.5	0.2	1.5	-
B	6.8	3.5	14	1.0	1.0	5	0.40	0.20	15	3.5	0.3	1.5	-
BROWN													
Special	7.4	3.5	14	0.5	3	2	0.20	0.10	5	2.0	0.2	1.7	2.0
A	7.2	3.5	14	0.7	5	3	0.50	0.10	8	2.5	0.5	1.7	4.0
B	7.0	3.5	14	1.0	7	5	1.00	0.20	15	3.5	0.8	1.7	6.0
BROWN PARBOILED													
Special	7.4	3.5	14	0.5	0.5	2	0.20	0.10	5	2.0	0.1	1.5	2.0
A	7.2	3.5	14	0.7	1.0	3	0.50	0.10	8	2.5	0.2	1.5	4.0
B	7.0	3.5	14	1.0	2.0	5	1.00	0.20	15	3.5	0.3	1.5	6.0

Source: AIERA, 2009

Case of Sunstar Overseas

Sunstar boasts of superior technology, strategic location, international expertise and a vision that would sustain quality and make consistency, top priority. Sunstar occupies a major share of India's rice exports. For the year 2008-09 our total rice volumes were 1,78,000 MTs over previous year's figure of 1,93,000 MTs. The decline was due to ban of export of non basmati rice. In year 2006-07 this figure was 1,82,000 MTs. Sunstar's domestic sales for the year 2008-09 was

72000 MTs & for 70000 MTs for 2007-08. In the year, 2006-07 we had domestic sale of 69000 MTs. Our consistent, well thought out & acted upon business strategy has given us an edge over competition. No wonder our turnover amounts to 170 million dollars (8000 million Indian rupees) for the year 2008-09, with promising growth figures.

At Sunstar we produce a wide variety of rice to suit all kind of needs of our esteemed customers spread across the globe. We supply to some of the leading brands in the world and directly package rice for renowned international brands as well. Our packaged products are available in all varieties in packaging sizes of 1 to 50 Kgs. Our platter of varieties represents rich Indian heritage coupled with impeccable quality and taste, namely:-

- Traditional Basmati Rice
- Pusa Basmati Rice
- Super Basmati Rice
- Indian 1121 Super Rice
- Indian Long Grain Rice
- Sharbati
- Sugandha

The product portfolio of Sunstar consists of Raw Brown Rice, Steamed Rice, Raw milled rice and Parboiled rice. At Sunstar they produce a wide variety of rice to suit all kinds of needs of our esteemed customers spread across the globe. In order to reach all sections of society, Sunstar has its products under brands: HELLO, GATEWAY OF INDIA, & HELLO ORGANIC. Sunstar takes immense pride in presenting organic basmati rice, organic Pusa basmati rice& organic fair trade basmati rice. We also have organic pulses, spices, ready to eat meals, organic flours. We have also ventured into organic cotton.

Milling and Processing: World class state-of-the-art modern computerized plant installed at Sunstar by internationally acclaimed Buhler has automatically controlled inflow and outflow system. There are three milling plants installed at Sunstar having more than 14 tons per hour capacity, which is one of the largest installed capacities. These plants are equipped with most modern Pre-cleaners, De-stoners, Precision-sizers, Graders, Paddy Separators, Dehuskers, etc. Pre-cleaners and Magnets are used at various stages to ward off foreign material.

The company pays careful attention to ensure that each grain is perfect and each process is carried out under the eagle eyes of a competent and trained manpower. No effort is spared to ensure that the rice that leaves the company premises is of best quality and fully protected against possible hazards during its journey before it reaches the buyer.

Fig.3.8 Quality test at Sunstar Labs

The systematic examination, checking and re-checking of paddy and rice to determine the end product's fool-proof quality is the hallmark of Sunstar. With a battery of hi-tech and top-of-the-line equipment like Lab Kett Meters, Lab De-huskers, Electronic Vernier Calipers, Precision Electronic Weighing Scales, Paddy Separator, Lab-polishers, having a strong back-up of qualified technical team of proven men, nothing is left to change at Sunstar for establishing top quality of paddy before it is put on the processing line. Sunstar is the only rice company to have three in house laboratories to check and recheck through systematic examination of quality of paddy and rice, so that the end product is of full proof quality. The labs are equipped with GLC macho, microscope. Our Physical laboratory is well equipped for quality checks of control sample, in coming material, in process material and outgoing material.

Fig 3.9 Packing Machine at Sunstar Company

SWOT in Rice Trade

Discussion the leading exporter of rice Sunstar and All India Rice Exporters Rice Association, these points were drawn to understand the SWOT of Indian rice trade.

S	• Quality control and testing methods as per international standards • Network of processing facilities • Market intelligence • Import duty on machineries	• Size of domestic market • Inventory carrying cost	**W**
O	• Trained personnel • Packaging cost • Number of intermediaries in domestic market • Efficiency of supply chain • Eco-labeling and environmental regulations	• Global price fluctuations • Cost of quality control • Domestic transportation cost • Shipping cost • Price Policies • Government support in competing country	**T**

Overall, the world prices have declined whereas domestic prices have increased due to increasing minimum support prices. Our ability to compete in the world market will therefore not only depend on the extent to which we can increase productivity but also how we will be able to tune our minimum support prices to the world level. It will also depend on how efficiently procurement and public distribution operations are done and how quality is maintained by the FCI.

Chapter 4

Oilseeds: Groundnut and Castor

4.1 Groundnut

India is the second largest producer of groundnuts after China. Groundnut is the largest oilseed in India in terms of production. It accounted for 35.99 per cent of the oilseeds production of the country during 2007-08. Gujarat is the largest producer contributing 25 per cent of the total production followed by Tamil Nadu (22.48 per cent), Andhra Pradesh (18.81 per cent), Karnataka (12.64 per cent) and Maharashtra (10.09 per cent) during 2006-07.

Groundnut contains on an average 40.1 per cent of fat and 25.3 per cent of protein and is a rich source of calcium, iron and vitamin B complex like thiamine, riboflavin, niacin and vitamin A. It has multifarious usages: It is used not only as a major cooking medium for various food items but also for manufacture of soaps, cosmetics, shaving creams and lubricants. In fact, it plays a pivotal role in the oilseed economy of India.

Distribution

Groundnut originated in the southern Bolivia/north west Argentina region in south America and is presently cultivated in 108 countries of the world. Asia with 63.4% area produces 71.7% of world groundnut production followed by Africa with 31.3% area and 18.6% production, and North-Central America with 3.7% area and 7.5% production. Important groundnut producing countries are China, India, Indonesia, Myanmar, Thailand, and Vietnam in Asia; Nigeria, Senegal, Sudan, Zaire, Chad, Uganda, Cote d'Ivory, Mali, Burkina Faso, Guinea, Mozambique, and Cameroon in Africa; Argentina and Brazil in South America and USA and Mexico in North America.

World Production

Total world peanut production for 2008 was 34.5 million metric tons (USDA data). China led 2008 world groundnut production with 42%, India 18%, USA 7%, Nigeria 5%, Indonesia 4%, Burma 3%, Argentina 3%, Sudan 2%, Vietnam 2%, Chad 1%, Senegal 1%, Congo 1%, Burkina 1% and Brazil 1% of global peanuts for that year.

Mali, Malawi, Guinea, Cameroon, Egypt, Côte d'Ivoire, Uganda, Benin, Central Africa Republic, South Africa, Thailand, Mozambique, Niger, Pakistan Mexico and other peanut growing regions *each* provided less than 1% of the world's peanuts for 2008.

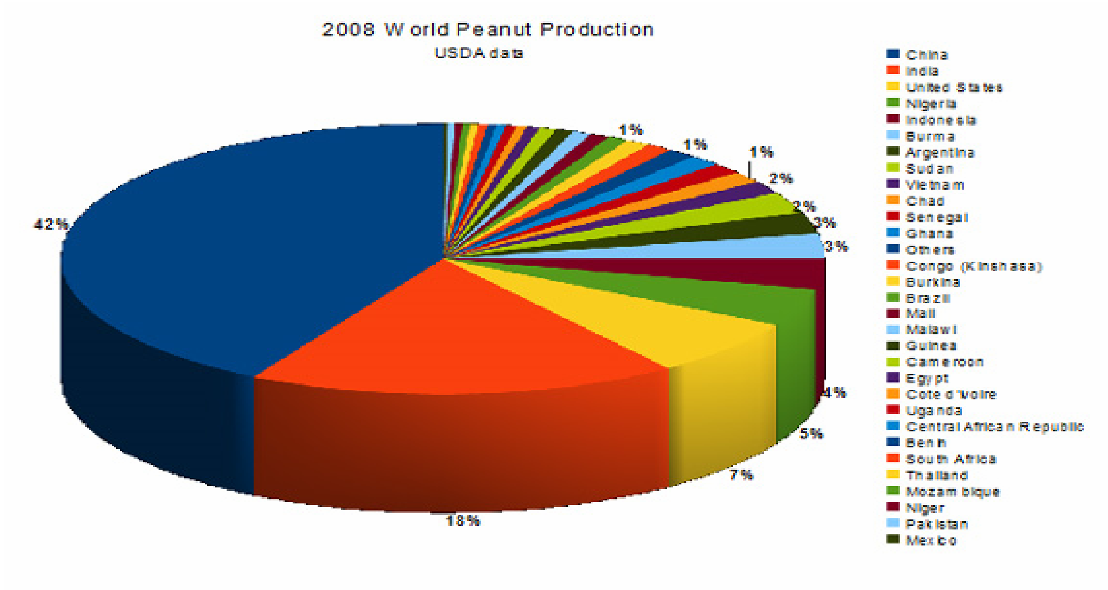


Fig.4.1 World Peanut Production

Table 4.1 Area, Production of major Groundnut producing countries

Country	**2004-05**		**2005-06**		**2006-07**		**Percentage of World in 2006-07**	
	A	**P**	**A**	**P**	**A**	**P**	**A**	**P**
Argentina	251.0	564	222.3	517.0	156.4	315.6	0.59	0.89
Burkina Faso	330.9	301.0	342.6	323.6	331.0	301.0	1.25	0.84
Chad	477.1	448.0	480.0	450.0	480.0	450.0	1.81	1.26
China	5016.4	14471.8	4946.1	14895.1	5125.4	13447.4	19.37	37.71
Congo, Dem	473.6	368.4	456.5	355.1	456.5	355.1	1.73	1.0
Ghana	254.0	258.0	384.0	520.0	350.0	450.0	1.32	1.26
India	6238.1	7027.5	5953.5	4362.8	8000.0	7500.0	30.23	21.03
Indonesia	654.8	1245	646.39	1267.0	682.9	1377.0	2.58	3.86
Myanmar	586.1	731.0	567.1	722.6	575.0	730.0	2.17	2.05
Nigeria	2738.0	2683.0	2782.0	2699.0	2800.0	2700.0	10.58	7.57
Senegal	984.1	943.8	841.7	501.3	900.0	900.0	3.4	2.52
Sudan	1531.3	990.0	1900.0	1267.0	1900.0	1200.0	7.18	3.37
USA	571.3	1939.8	524.7	1506.1	530.9	1879.7	2.01	5.27
Viet Nam	244.6	363.1	246.7	400.4	240.3	400.1	0.91	1.12
World	24041.3	36082.6	24104.7	33303.1	26462.8	35658.4	100.0	100.0

A – '000' ha, P – '000' tons Source: Agricultural statistics, 2009

Groundnut is grown on a large scale in almost all the tropical and subtropical countries of the world (table 4.1). The most important groundnut growing countries are India, China, Nigeria, Sudan and USA. It is grown over an area of 26.4 million hectares with a total production of 36.1 million tonnes and an average productivity of 1.6 metric tons per ha in whole world. India occupies the third place in regard to acreage and in production. Groundnut *(Arachis hypogaea L.)* is the major oilseed crop in India accounting for 45% of oilseed area and 55% of oilseed production in the country. Now India along with china accounts for half of the world's groundnut production.

Table 4.2 Productivity in major Groundnut producing countries

Country	Yield (kg/ha)		
	2004-05	2005-06	2006-07
Argentina	2247	2325	2018
Burkina Faso	910	945	909
Chad	939	938	938
China	2885	3012	2624
Congo, Dem	778	778	778
Ghana	1016	1354	1286
India	1127	733	938
Indonesia	1901	1901	2016
Myanmar	1247	1247	1270
Nigeria	980	980	964
Senegal	959	959	1000
Sudan	647	647	632
USA	3395	3395	3540
Viet Nam	1485	1485	1665
World	1500	1382	1348

Source: Agricultural statistics, 2009

The productivity levels were highest in case of USA followed by China (table 4.2). Argentina occupied third place in productivity. India only secured sixth place in the list and yields were far below than world average yields. Still there is huge scope for India to generate additional productivity.

Table 4.3 Growth and instability in major groundnut producing countries (Prod - MT, Val - int $ '000')

	China		India		Nigeria		USA		Myanmar		Indonesia	
Year	Prod	Val	Prod	Val	Prod	Val	Prod	Val	Prod	Val	Prod	Val
1999	12706157	5926541	5258100	2319067	2894000	1333075	1737000	800809	561679	252245	1157000	545094
2000	14515755	6795389	6480300	2920525	2901000	1343325	1481210	673475	633805	286322	1292000	611298
2001	14471835	6777330	7027500	3195190	2683000	1233006	1939880	900164	731094	334046	1245000	588586
2002	14895099	6975857	4121100	1788959	2855000	1312504	1506150	688073	756622	343472	1259000	595351
2003	13493462	6312139	8126500	3702426	3037000	1396665	1879750	869131	878088	402204	1378000	652374
2004	14410302	6758776	6774400	3045803	3250000	1496550	1945090	894810	916000	419510	1469000	696348
2005	14395479	6782349	7993300	3672741	3478000	1605477	2208930	1026367	931000	429600	1467000	695382
2006	12809561	6016448	4863500	2137399	3825000	1772959	1575980	720501	1023000	472028	1470000	696832
2007	13079363	6133728	9182500	4226948	3835600	1775713	1696728	778851	1000000	460914	1384400	659332
2008	14341075	6754136	7168000	3260903	3900000	1806834	2341630	1090493	1000000	460914	773797	365231
CGR	-0.1736	-0.0922	3.1977	3.4572	4.3799	4.4474	2.3194	2.3993	6.7177	7.0236	-1.0752	-1.0245
C.V	5.79	5.89	23.52	25.19	14.13	14.41	15.77	16.52	19.32	20.11	16.34	16.50

Source: FAOSTAT, 2010

The details of growth and instability in production of groundnut in developing countries are presented in table 4.3. Myanmar showed the highest growth rate in production when compared remaining countries. The next higher growth rate was observed in case of Nigeria followed by India and USA. Indonesia and China showed negative growth in production. Among all the countries, the highest instability was found in case of India's production and its value.

Area, Production and Yield of Groundnut in India

In India, groundnut is grown over an area of 7.5 million hectares with total production of 9.3 million tones and an average productivity of 1.4 metric tons per ha. Its cultivation is mostly confined to the western and southern states, *viz.,* Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu and Maharashtra. 70% of the area and 75% of the production are concentrated in these five states. The other important states where it is grown are Madhya Pradesh, Rajasthan, Uttar Pradesh and Punjab. All India area, production and yield of groundnut from 1950-51 to 2008-09 along with percentage coverage under Irrigation is presented in table 4.4.

Table 4.4 Area, Production and Yield of Groundnut in India
(A – million ha, P – million tons and Y – Kg/ha)

Year	Area	Production	Yield	% coverage under irrigation
1950-51	4.49	3.48	775	-
1960-61	6.46	4.81	745	3.0
1970-71	7.33	6.11	834	7.5
1980-81	6.80	5.01	736	13.3
1990-91	8.31	7.51	904	18.6
2000-01	6.56	6.41	977	17.6
2005-06	6.74	7.99	1187	19.6
2006-07	5.62	4.86	866	19.8
2007-08	6.29	9.18	1460	-
2008-09	6.22	7.34	1180	-
CGR#	0.35	1.21	0.86	
C.V#	14.1	27.1	21.7	-

Source: Agril Statistics at a Glance, 2009
for the period 1950-51 to 2008-09

The groundnut area growth rate was 0.35 per cent for the period 1950-2009. The area under this crop was peak in 1990-91 and from there it showed declining trend. The rate of growth in the production was 1.21 per cent for the study period. Similarly, the productivity growth rate was low at 0.86 per cent per annum. Approximately 19 per cent of the gross cropped area was under irrigation coverage while 81 per cent of area still under rainfed conditions. The instability in production was found to be very high when compared with productivity and area.

Table 4.5 Contribution of Groundnut in India's oilseed production (in lakh tons)

Year	Season		Total production of groundnut	Total oilseeds Production	Percentage of total production
	Kharif	Rabi			
1993-94	57.10	21.20	78.30	215.00	36.42
1994-95	60.60	20.00	80.60	213.40	37.77
1995-96	60.50	15.30	75.80	221.00	34.30
1996-97	69.40	17.00	86.40	243.80	35.44
1997-98	59.00	14.70	73.70	213.20	34.57
1998-99	69.10	20.70	89.80	247.50	36.28
1999-2000	38.00	14.50	52.50	207.10	25.35
2000-01	49.10	15.00	64.10	184.40	34.76
2001-02	56.22	14.05	70.27	206.62	34.01
2002-03	30.95	10.26	41.21	148.38	27.77
2003-04	68.60	12.67	81.27	251.86	32.27
2004-05	52.62	15.12	67.74	243.54	27.81
2005-06	62.98	16.95	79.93	279.79	28.57
2006-07	32.94	15.69	48.63	242.89	20.02
2007-08	77.70	26.04	103.74	288.25	35.99
Average	56.32	16.61	72.93	227.12	32.11

The share of groundnut production in the total oilseeds production is oscillating between 20 to 40 per cent (table 4.5). Nearly 75 per cent of total crop production was produced during rainy season while the remaining 25 per cent was production in the post-rainy season. Nearly 80 per cent of the cropped area was under rainfed condition, the fluctuations in production were very high.

Groundnut utilization pattern in India

Oil extraction – 81%, Seed purpose – 12%
Direct consumption – 6%, HPS exports – 1%

The groundnut utilization pattern in India is more of oil extraction purpose followed by seed purpose, direct consumption and HPS exports.

The popular cultivars growing under different states of India are summarized in table 4.6. The most preferred cultivars both under traditional and improved situations were categorized by state and its type (spreading or branch).

Table 4.6 Popular cultivated varieties of Groundnut

States/ Institutions	Traditional		Improved	
	Spreading	Branch	Spreading	Branch
Gujarat	Punjab-1	J-11	GAUG-10	GAUG-1
Maharashtra	Karad 4-11	AK 12-24	-	-
	Pondicherry-B	K-1 & 3, SB-XI		
Karnataka	-	Spanish Imp	S-230	S-206 Dh-3-30
Tamil Nadu	TMV-1, 3 & 4	TMV-2	-	TMV-7,9, 10
Madhya Pradesh	-	AK-12-24	-	Jyoli
Uttar Pradesh	Type-25 & 28	-	-	-
Punjab	M-145, C-501	-	M-13	-
B.A.R.C	-	-	-	TG-1, 3, 14 &17

Table 4.7 Area and Production of major groundnut producing states in India

State	2004-05		2005-06		2006-07		2007-08	
	A	P	A	P	A	P	A	P
Gujarat	1.75	0.69	1.89	2.65	2.03	1.09	1.86	3.30
A.P	1.87	2.14	1.69	1.25	1.47	0.82	1.80	2.60
T.N	0.7	1.36	0.66	1.25	0.55	0.98	0.54	1.05
Karnataka	1.06	1.08	0.85	0.59	0.84	0.55	0.91	0.73
Maharashtra	0.49	0.47	0.43	0.49	0.42	0.44	0.40	0.47
Rajasthan	0.2	0.18	0.24	0.3	0.24	0.17	0.28	0.48
Madhya Pradesh	0.21	0.23	0.22	0.24	0.19	0.12	0.20	0.19
U.P	0.12	0.1	0.11	0.09	0.07	0.05	0.10	0.06
Orissa	0.07	0.06	0.06	0.06	0.06	0.05	0.08	0.10
Others	0.09	0.11	0.09	0.11	0.08	0.09	0.12	0.20
All India	6.56	6.41	6.24	7.03	5.95	4.36	6.29	9.18

A – million ha and P – million tons

The trends in major producing states of India are presented in table (table 4.7). Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu were the major states and having significant areas under them. The production was very high in case of Gujarat followed by A.P.

STATE-WISE PRODUCTION OF GROUNDNUTS

(In Lakh Tonnes)

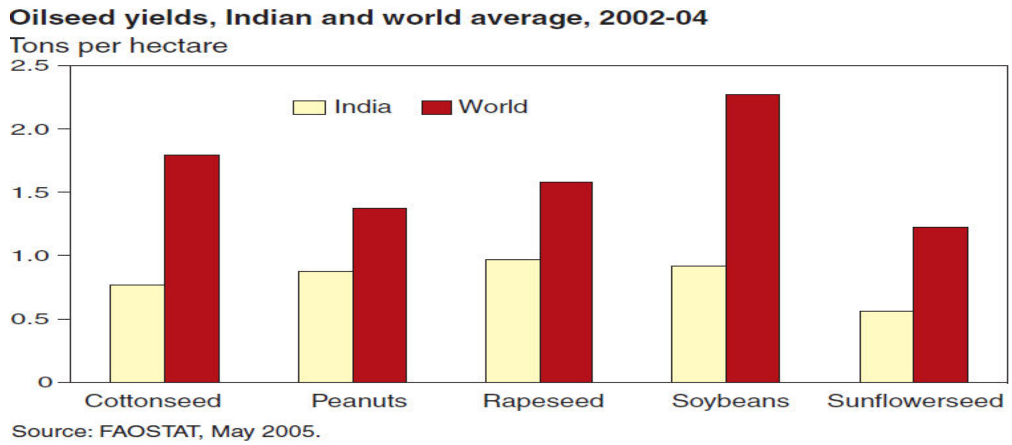
	2009-10			2008-09		
STATE	Kharif	Rabi	Total	Kharif	Rabi	Total
Gujarat	13.8	2.2	16.0	19.0	2.2	21.2
Maharashtra	1.8	0.5	2.3	2.0	1.0	3.0
Andhra Pradesh	5.0	5.3	10.3	7.5	5.0	12.5
Tamil Nadu	1.0	4.4	5.4	2.0	3.0	5.0
Karnataka	3.0	3.3	6.3	3.5	3.0	6.5
Madhya Pradesh /C.G.	1.5	--	1.5	1.5	--	1.5
Rajasthan	5.0	--	5.0	4.5	--	4.5
Punjab/Haryana/U.P.	0.7	--	0.7	1.0	--	1.0
Orissa	1.0	2.0	3.0	0.7	2.3	3.0
Others	0.1	0.6	0.7	0.5	0.5	1.0
Total	32.9	18.3	51.2	42.2	17.0	59.2

Source: IOPEPC, 2010

The recent crop production data of Groundnut also reveals that Gujarat state alone contributing nearly 40 per cent of total production in India.

Groundnut productivity in India and World

India's average yields for major oilseeds are 40-60 percent below world averages and, with the exception of the 1980s, have been growing at a substantially lower rate. Most oilseeds are grown by small-scale, limited-resource farmers in areas that are dependent on erratic monsoon rainfall, with only about 24 percent of oilseed area irrigated. Faced with considerable weather-related risk, oilseed producers invest little in improved seeds, fertilizer, and pesticides. Oilseed farmers also face considerable price risk because the minimum support prices set for oilseeds are typically either too low to influence market prices or are not adequately defended by Government purchases. Government initiatives to extend credit and technology to oilseed producers, including the 1988-94 Technology Mission on Oilseeds, have had very fleeting impact.



The Indian oilseed processing sector is characterized by a large number of relatively small-scale, low-technology plants and substantial excess capacity. The structure of the industry has been heavily influenced by Government policies that have: regulated plant scale, capital intensity, and oilseed/product marketing; provided incentives for building new capacity; and prevented imports of oilseeds for processing. Also shaping the industry has been a domestic demand preference for crude traditional oils, weak effective demand for quality feed protein, and diverse and erratic supplies of domestic oilseeds for processing.

Table 4.8 Productivity trends in across different states (kg/ha)

State	2004-05	2005-06	2006-07	2007-08
Gujarat	395	1402	539	1777
A.P	1144	739	558	1451
T.N	1942	1885	1784	1957
Karnataka	1017	685	648	807
Maharashtra	959	1146	1041	1168
Rajasthan	924	1227	687	1728
Madhya Pradesh	1059	1121	635	940
U.P	835	839	662	598
Orissa	794	985	870	1219
All India	977	1127	733	1459

The trends in productivity in India and major states were summarized in table 4.8. The mean productivity at all India was increased significantly from 977 to 1459 kg per ha during the period 2004-05 to 2007-08. But, the average productivity levels at state exhibited very fluctuations across different states except in case of Tamil Nadu.

Among all states, Tamil Nadu showed highest productivity followed by Gujarat and Rajasthan in 2007-08.

Total factor productivity (TFP) in Groundnut production

The total factor productivity attempts to measure the amount of increase in total output, which is not accounted for by increase in total inputs. There is a large residual, measured by total factor productivity, which is contribution of improvement technology/knowledge, infrastructure development, human capital improvement and policy interventions. Chandel (2007) estimated total factor productivity in groundnut in six states of India for the period 1980-81 to 1999-2000. The summary of results is presented in table 4.9.

Table 4.9 State wise growth rate in TFP

States (1)	Output index (2)	Input index (3)	TFP index (4)
Andhra Pradesh	4.73	3.66	1.07
Gujarat	1.18	1.32	-0.14
Karnataka	2.36	3.80	-1.44
Tamil Nadu	4.46	4.42	0.04
Orissa	-12.02	-11.32	-0.70
Maharashtra	2.05	0.43	1.62
Overall	2.95	2.56	0.39

The combined overall growth rate during last two decades was observed to be less than one (0.39%) and was found statistically not significantly different than zero. Among the states, TFP is significant both in A.P and Maharashtra states while it was just equivalent to zero in Tamil Nadu. The decline in TFP in Gujarat though was non-significant but it could be a major area of concern to the researchers.

World Groundnut export market

Over half of the groundnut harvested worldwide is crushed for oil and a substantial quantity of groundnut produced in developing countries is traded in domestic markets. International trade of groundnuts is mainly in the form of in shell (pods), shelled (kernels) and meal (cake). A large trade of confectionery groundnut is also booming in the international market. The major country export groundnut in shell and shelled is shown in the following table 4.10.

Developed countries like UK, Holland, Germany, France, Canada and Japan account for 65 percent of world groundnut demand. However, the major suppliers of groundnut are the United States of America, China and Argentina. The international price of groundnuts is generally decided by the crop size and quality in United States of America. The fortunes for the Indian groundnut (shelled) export are bright and it may likely to emerge as a major supplier of raw and processed groundnut mainly because of its large production base. The production price of groundnut in India is competitive globally. The market price is only 16 percent above the producer price. Except for India and United States of America the price ratio is above 40 percent in the leading exporting countries. Though India is the largest producer of groundnut in the world, its share in the worldwide edible groundnut market is insignificant.

Table 4.10 Trends in groundnut (with shell) export market (qty - tons)

Country	2001	2002	2003	2004	2005	2006	2007	CGR	C.V
China	85598	91597	90183	77684	90653	89929	87312	0.10	5.51
India	44657	23475	39780	64704	58382	61256	29853	3.98	34.87
USA	14065	17510	17064	16683	16406	13215	9771	-5.87	18.66
Israel	8824	8359	8624	8284	9744	8284	9020	0.61	6.04
Germany	822	N.A	N.A	N.A	2948	6224	7746	-	-
Vietnam	N.A	2179	3714	2595	4398	1479	5560	-	-
World	204485	214706	210847	214936	232249	213243	179766	-	-

Source: FAOSTAT, 2010

Table 4.11 Unit prices of groundnut (with shell) exports ($/ton)

Country	2001	2002	2003	2004	2005	2006	2007	CGR	C.V
China	462	450	546	645	619	651	808	9.50	20.81
India	481	506	596	619	604	705	911	9.70	22.77
USA	844	813	952	1007	972	980	1105	4.39	10.37
Israel	1567	1555	1638	1730	1700	1915	2133	5.05	11.93
Germany	838	N.A	N.A	N.A	998	1134	1217	-	-
Vietnam	N.A	430	397	422	372	678	473	-	-
World	578	590	684	727	705	763	929	-	-

Source: FAOSTAT, 2010

The recent trends in groundnut export and their unit prices are presented in tables 4.10 and 4.11 respectively for the period 2001 to 2007. India achieved 3.98 per cent growth rate in quantity exported where China showed only 0.10 per cent during the same period. But, the coefficient of variation for India was very high when compared USA and China for the study period. The United States exhibited negative growth rate of 5.87 per cent per annum for the same period. The growth rate in unit prices as well as coefficient of variation for India and China were on par between the study period 2001 and 2007. However, the unit prices were much higher in case of Israel followed by Germany and Israel in 2007.

Table 4.12 Trends in groundnut (shelled) export market (qty - tons)

Country	2002	2003	2004	2005	2006	2007	CGR	C.V
India	44415	136330	112411	131672	190172	239735	31.51	46.99
China	429092	399988	325315	363435	234362	204398	-13.81	27.66
Argentina	118504	107166	70490	117266	181586	185958	13.21	34.61
USA	201757	114092	155895	124668	156789	174915	0.05	20.81
World	1134517	1063473	1009829	1130587	1069591	1164696	-	-

Source: FAOSTAT, 2010

Table 4.13 Unit prices of groundnut (shelled) exports ($/ton)

Country	2002	2003	2004	2005	2006	2007	CGR	C.V
India	558	684	631	617	700	952	8.08	19.97
China	519	672	764	725	791	1030	11.67	22.33
Argentina	564	680	764	619	657	923	6.33	18.17
USA	786	879	933	922	842	946	2.27	6.98
World	578	706	780	718	744	942	-	-

Source: FAOSTAT, 2010

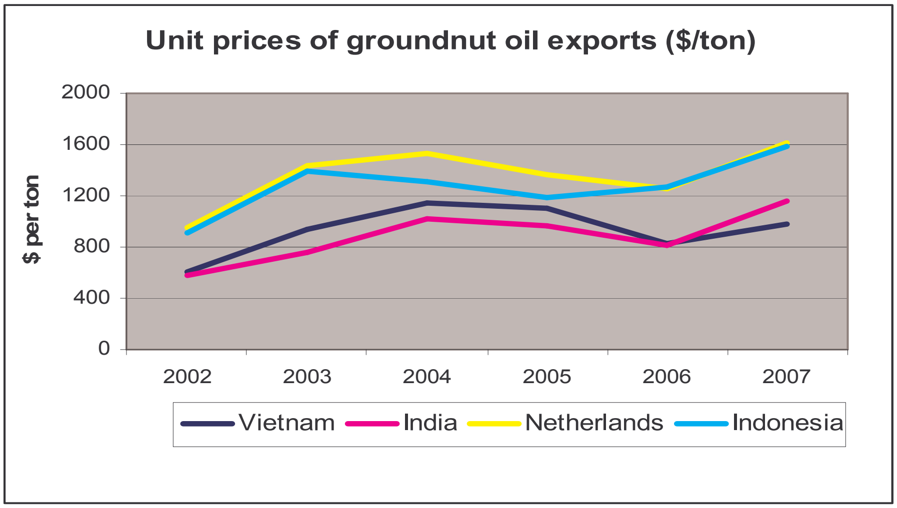
The details of groundnut export (shelled) from India are presented in table 4.12. India is on the top of the list and exhibited 31.51 per cent growth rate during 2002-07. But, the high coefficient of variation was the main concern. The rate of growth in unit prices were reasonable but less when compared with China (table 4.13) and higher than Argentina and USA. The coefficient of variation in the unit prices were higher for china followed by India and Argentina.

Table 4.14 Trends in groundnut oil export market (qty - tons)

Country	2002	2003	2004	2005	2006	2007	CGR	C.V
Vietnam	83226	38953	22700	23673	63827	68675	1.62	50.45
India	74227	47721	40278	55064	82292	43672	-1.99	30.11
Brazil	N.A	20710	40324	1515	N.A	30356	-	-
Netherlands	22032	19746	19673	21610	22293	20937	0.58	5.39
Indonesia	15640	20151	19302	18067	11776	13520	-6.64	20.31
World	275741	252273	208905	205484	251175	232112	-	-

Source: FAOSTAT, 2010

The details of trends in ground oil export market are presented in table 4.14. Vietnam is the major exporter in the international market followed by India. Brazil and Netherlands are also major players in the international market. However, the growth performance of India showed negative during the study period 2002-07. The coefficient of variation was also expressed very high.



Netherlands realized more unit prices when compared to all major players in the world. But, there is a slump in the international market during 2006. India's price realization in the international market was the lowest among global players during the study period.

World Groundnut import market

Indonesia, Germany, Italy were the major importers of groundnut (with shell) in the international market (table 4.15).

Table 4.15 Trends in groundnut (with shell) import market (qty - tons)

Country	2001	2002	2003	2004	2005	2006	2007	CGR	C.V
Indonesia	20276	5913	18049	18914	39839	121820	69832	45.77	97.14
Germany	10614	14199	17537	13674	16271	18642	22701	10.32	24.07
Italy	21094	19656	20113	20772	22115	18136	20290	-0.65	6.12
Mexico	17709	18755	20241	21812	22329	20253	19061	1.70	8.28
Spain	13102	13130	12553	13542	12004	12503	12437	-1.06	4.11
UK	12602	10754	12078	17150	16291	14757	11672	2.54	18.07
Canada	6492	7468	7364	5848	8059	7219	10037	4.86	17.72
World	199568	191043	212158	210087	251271	322283	262649	-	-

Source: FAOSTAT, 2010

The details of unit price realization of groundnut (with shell) imports are summarized in table 4.16. Italy import prices were very high followed by Germany and UK.

Table 4.16 Unit prices of groundnut (with shell) imports ($/ton)

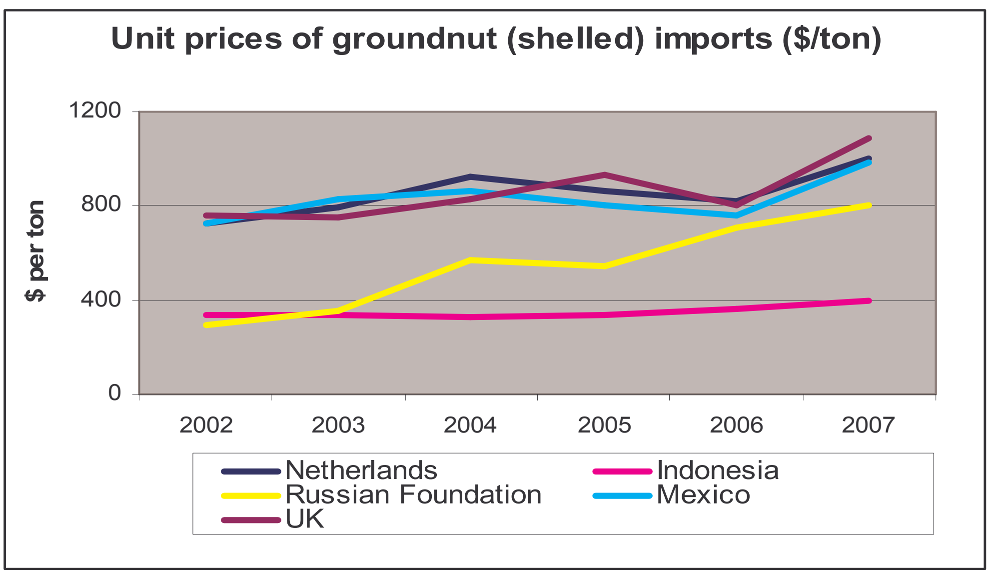
Country	2001	2002	2003	2004	2005	2006	2007	CGR	C.V
Indonesia	339	370	322	307	301	254	304	-4.01	11.45
Germany	793	749	804	1057	1056	1054	1199	8.16	18.13
Italy	993	951	1056	1264	1291	1374	1565	8.57	18.43
Mexico	640	573	722	782	717	742	917	5.84	14.93
Spain	696	634	742	911	840	856	1013	6.83	16.11
UK	603	553	826	860	933	914	1175	11.82	25.11
Canada	676	664	746	959	894	890	1045	7.69	17.43
World	650	639	711	806	768	634	862	-	-

Source: FAOSTAT, 2010

Table 4.17 Trends in groundnut (shelled) import market (qty - tons)

Country	2002	2003	2004	2005	2006	2007	CGR	C.V
Netherlands	222070	207481	225640	259048	262146	266888	5.15	10.45
Indonesia	119496	101824	71017	81765	63596	103527	-5.52	23.87
Russian Foundation	81088	76008	84932	91271	94946	96560	4.72	9.31
Mexico	73659	56822	76803	79064	82609	95096	7.19	16.16
UK	80495	92812	85188	102745	80170	88087	0.57	9.69
World	1296104	1222612	1258564	1376038	1337217	1463222	-	-

Source: FAOSTAT, 2010

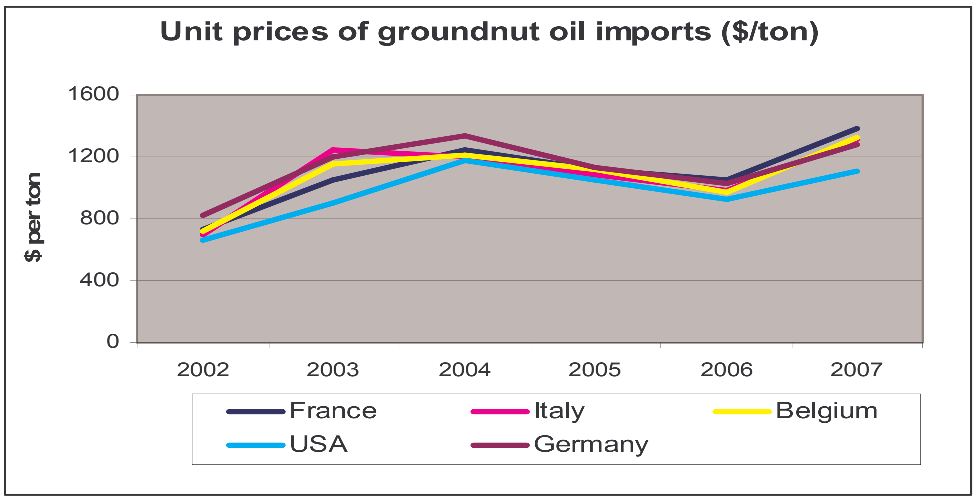


The details of groundnut (shelled) imports of major global players are summarized in table 4.17. Netherlands was top (nearly 20 per cent share in the total imports quantity) on the list of importers followed by Indonesia and Russian foundation. The unit prices of groundnut (shelled) imports were the highest for UK and the lowest for Indonesia (details in fig above).

Table 4.18 Trends in groundnut oil import market (qty - tons)

Country	2002	2003	2004	2005	2006	2007	CGR	C.V
France	64046	76135	46837	54964	42697	46155	-8.77	23.29
Italy	46926	34305	36029	37441	43712	42244	0.69	12.29
Belgium	25178	20067	23634	24605	36536	25707	5.71	21.42
USA	31108	6835	66394	15599	58120	15577	4.42	76.37
Germany	16625	15185	8703	11093	18291	14272	0.11	25.36
World	254160	233812	241193	225847	255287	209150	-	-

Source: FAOSTAT, 2010



The details of trends in groundnut oil imports by various players in the world are presented in table 4.18. France is the major importer in the world followed by Italy and Belgium. USA and Germany also imports groundnut oil in minor quantities. The unit prices were more or less similar in all the importing countries for the study period.

The details of country wise groundnut exports from India for the period 2007-10 are presented in table 4.19. The countries like Indonesia, Malaysia, Philippines and Pakistan were the major importers from India. The total imports of these countries account nearly 75-80 per cent of total India's exports. The performance of exports was consistent during the study period.

Table 4.19 India's Groundnut exports, 2007-2010

					Qty in Mt.	Value in Rs. lacs
	2007-2008		2008-2009		2009-2010	
Country	Qty	Value	Qty	Value	Qty	Value
INDONESIA	120,423.99	45,838.75	146,105.74	61,084.84	136,282.02	56,035.19
MALAYSIA	36,020.37	13,886.77	41,405.64	16,927.49	63,837.63	26,936.71
PHILIPPINES	41,616.50	16,572.23	33,940.05	14,264.02	61,619.92	26,597.87
PAKISTAN	879.22	312.94	2,707.20	1,014.77	17,291.34	6,432.89
UNITED ARAB EMIRATES	7,183.18	2,919.44	8,882.28	3,446.04	9,066.43	3,898.03
THAILAND	1,592.50	646.42	9,857.21	4,128.82	8,512.95	3,818.22
UKRAINE	11,368.99	5,179.60	4,284.67	2,002.68	7,852.26	3,601.85
SINGAPORE	5,770.72	2,230.66	5,752.03	2,221.42	5,121.45	2,185.09
UNITED KINGDOM	10,159.07	4,089.88	9,416.80	3,959.43	3,551.59	1,891.35
CHINA P RP	2,885.00	1,206.57	4,762.18	2,101.27	3,400.56	1,569.11
YEMEN REPUBLC	2,861.76	1,276.29	3,912.60	1,686.88	2,951.72	1,270.81
SRI LANKA	2,147.48	276.31	2,503.49	496.5	4,256.36	1,233.72
SAUDI ARABIA	2,121.96	852.46	1,188.40	543.94	2,084.31	951.14
NEPAL	1,624.49	450.32	2,658.41	724.14	2,549.70	817.44
IRAN	1,139.00	473.94	515	202.09	1,698.02	732.6
TAIWAN	2,872.95	1,216.81	1,944.32	586.67	1,555.94	732.55
UNSPECIFIED	180.95	64.99	20	9.28	1,609.00	696.1
VIETNAM SOCIAL REPUBLIC	1,031.55	422.52	149.5	46.65	1,204.78	593.4
GERMANY	1,160.60	469.88	1,760.29	773.19	1,110.95	430.27
CANADA	1,304.80	571.8	1,602.00	732.42	546.5	280.15
NETHERLAND	1,252.18	487.31	1,910.00	925.67	417	212.78
ALGERIA	4,377.24	2,020.30	2,461.00	1,175.55	0	0
MEXICO	2,850.00	1,203.94	4,531.00	2,049.47	0	0
Total	269,587.6	105,407.7	297,890.3	123,900.9	340,246.3	142,593.2
Source: DGCIS Annual Export						

Cost of production

The unit costs of production among the three major global players are present in the fig 4.2. India's cost of production was low during 1991 and this trend has gone down till further up to 1999. Then, the unit price has started increasing slowly up till 2009. However, the unit cost of production of India was lower than USA and China. The China's unit cost of production was the lowest in 1991 while this trend gone reserve in 2009.

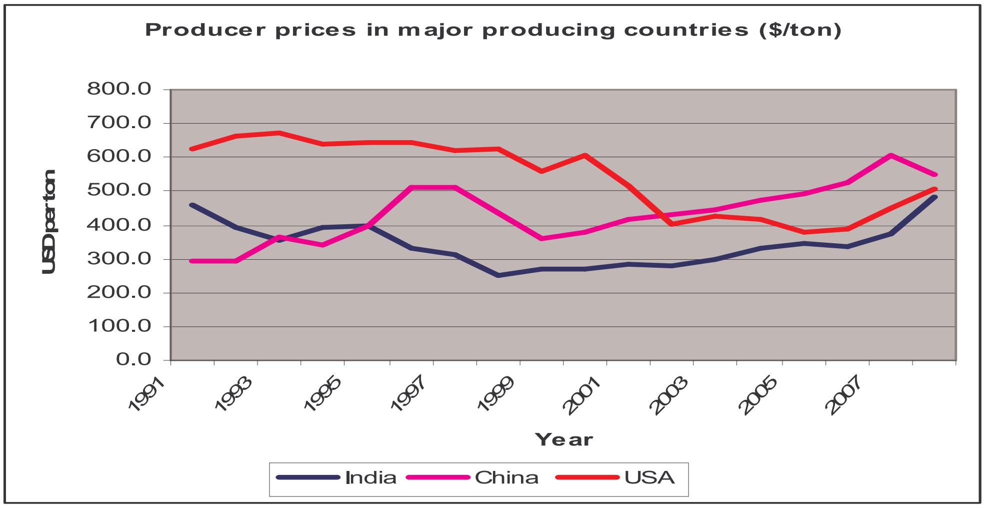


Fig 4.2 Cost of production among global players

Table 4.20 Cost production in major producing states (Rs per ha)

Cost item	Gujarat		Andhra Pradesh	
	02-03	03-04	02-03	03-04
Human labor	3717.7	4554.4	3308.2	4161.0
Bullock labor	2080.0	1842.9	774.4	1015.5
Machine labor	958.1	1344.0	422.6	545.1
Seeds	2679.22	3267.1	2674.8	3025.8
Fertilizers	1510.4	1460.8	823.0	1339.0
Insecticides	254.7	199.5	76.8	100.6
Irrigation charges	442.5	305.4	525.5	811.9
Interest on working capital & Miscellaneous	291.5	317.1	229.5	294.7
Total operational cost	**11934.4**	**13291.5**	**8835.3**	**11293.9**
Rental value of owned land	2891.9	5686.7	2833.1	4726.1
Rent paid for leased-in land	19.11	17.5	866.4	58.69
Land revenues cesses and taxes	10.57	9.6	2.44	3.78
Depreciation on implements and farm buildings	211.9	161.3	280.0	369.5
Interest on fixed capital	921.8	646.0	1010.7	1326.7
Total fixed cost	**4055.3**	**6521.2**	**4992.8**	**6485.0**
Total cost per ha	**15989.8**	**19812.8**	**13828.1**	**17778.9**
Yield per ha (qtl)	**8.75**	**17.90**	**7.11**	**9.64**
Value of main-product per ha (Rs)	14499.0	29439.1	11126.9	14748.8
Value of by-product per ha (Rs)	3150.8	4958.5	873.0	1381.2
COP per qtl	**1827.40**	**1160.86**	**1944.88**	**1844.29**

Source: CACP Report, 2006-07

The major input cost components in groundnut cultivation in Gujarat and Andhra Pradesh were seeds and labour costs during 2002-2004. In general, seed is the major item of input cost varying from 35 to 45% for irrigated crop and 27 to 37 % for rainfed crop. Human labour occupied the second place in the cost structure which varied from 23 to 25%. Bullock labour cost was another important item costing about 15-20%. The total labour cost varies any where between 44-50% in South India (table 4.20). The total cost per ha has gone up both in Gujarat as well as Andhra Pradesh states from 2002-03 to 2003-04. But, the productivity levels have increased significantly in both the states. The cost per qtl has gone down significantly in Gujarat when compared to Andhra Pradesh during the same period.

Factors involved in high cost of production

- The seed rate used in India is more than twice the seed rate used in other major groundnut-growing countries.
- Better methods of drying and storage of seed-pods, better pod and seed selections and seed treatment with fungicides may lead to reduction in seed rate per hectare.
- If farmer use their own seed from previous crop they can avoid purchasing seed at exuberant cost in the current season.
- Use of power-operated shellers will reduce the cost of shelling considerably.
- Line sowing with seed-drills helps to regulate seed rate and coverage of large areas within a short time, reducing the cost of seeding.
- Line sowing also facilitates inter cultivation with bullock-drawn implements and reduces cost on manual labour for weeding.
- Groundnut diggers operated with bullocks or tractors have to be popularized to reduce the harvesting costs.
- The investment on labour costs may thus be reduced considerably by using mechanical equipment available for carrying out various operations from sowing to harvest and grading of groundnut pods.
- The investment on fertilizers and plant protection has to be increased so that higher productivity is achieved and the cost of production of a unit of pods is reduced.

- Farmers are reluctant to invest on fertilizers and pesticides because of the risks involved in raising rainfed groundnut crop due to uncertainity in receipt and distribution of rainfall during the crop period leading to instability in production and productivity and widely fluctuating price pattern due to intense speculative trade in groundnut.
- If price support is offered to the farmers, they may invest on inputs like fertilizers and pesticides and increase productivity.
- Shelling of seed-pods by manual labour is a costly operation.
- The sowing period is short and the market price of seed is very high at sowing time.
- Harvesting by pulling our plants is another operation requiring considerable manual labour.
- The large number of labourers engaged in stripping of groundnut pods may considerably reduced using mechanical strippers.

India's production and export prices

India's per unit production and export prices of groundnut were calculated and depicted in the fig 4.3 for the period 1966 to 2009. The difference between them was meagre for the period 1966 to 1984. India has gained substantial margin between those two prices beginning from 1985 to 2009.

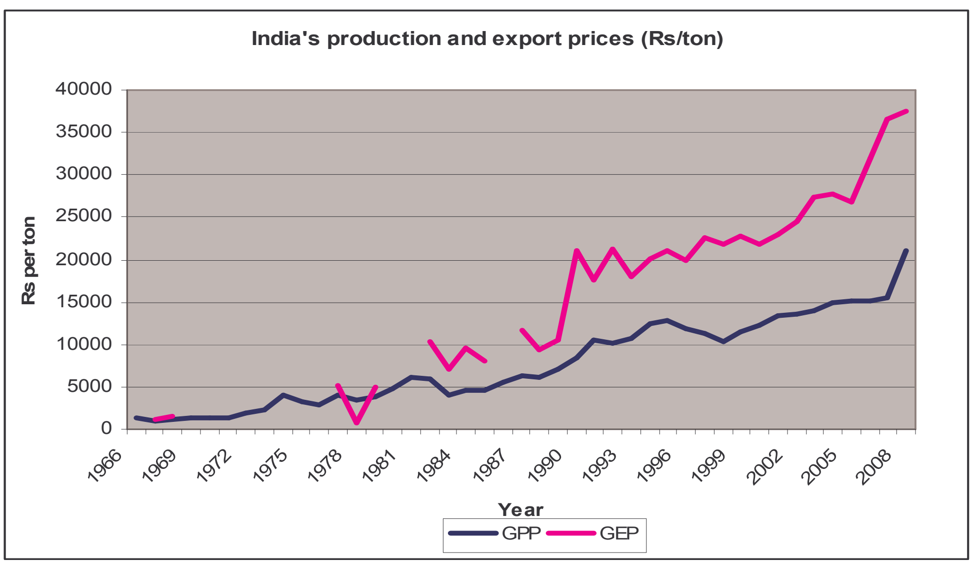


Fig 4.3 India's cost of production and export prices

Impact of trade liberalization on Groundnut trade

Groundnut products are of central economic importance to millions of smallholder farmers in Africa, India and Southern China. The products generate 60 percent of rural cash income and account for about 70 percent of the rural labor force in Senegal and Gambia. Groundnut trade remains, however, heavily distorted, and this has affected the competitive position of various players in world markets. The trade liberalization in groundnut markets has a strong South-South dimension with policies in India, and to a lesser extent China, heavily depressing the world prices of groundnuts at the expense of smaller developing countries mainly located in Africa (Ndiame et al., 2004). Under free trade, African exporters would gain because they are net sellers of groundnut products. In India, consumers would be better off with lower consumer prices resulting from the removal of prohibitive tariffs and large imports of groundnut products. The cost of adjustment would fall on Indian farmers and crushers. In China, crush margins would improve because of the large terms of trade effects in the oil market relative to the seed market. China's groundnut product exports would expand dramatically. Net buyers of groundnut products in OECD countries would be worse off.

The role of trade in India's oilseed economy is determined primarily by trade policy. India's recent large imports of edible oil have been the result of reduced border protection beginning in 1994. Oilseed imports, though no longer restricted by quantitative measures, are prevented by prohibitive tariffs and sanitary regulations. Exports of oil meals have been aided both by traditionally weak domestic feed demand and by the implicit support that the protected oil market affords to domestic oilseed processors.

Bound and applied tariffs in India's oilseed sector

Commodity	Bound rate	Applied rate[1]
	Percent, ad valorem	
Oilseeds	30	30
Oils		
Crude		
Soybean	45	45
Palm oil	300	80
Peanut	300	75
Sunflower[2]	300	50/75
Rapeseed	75	75
Refined		
Soybean	45	45
Palm oil	300	90
Peanut	300	85
Sunflower	300	85
Rapeseed[3]	75	45/85
Oilmeals	100	30

[1] Applied sales as of March 2006.
[2] Applied rate of 50 percent within 150,000-ton quota; 85 percent above quota.
[3] Applied rate of 45 percent within 150,000-ton quota; 75 percent above quota.
Source: Ministry of Commerce and Industry, Government of India; USDA/Foreign Agricultural Service attache reports.

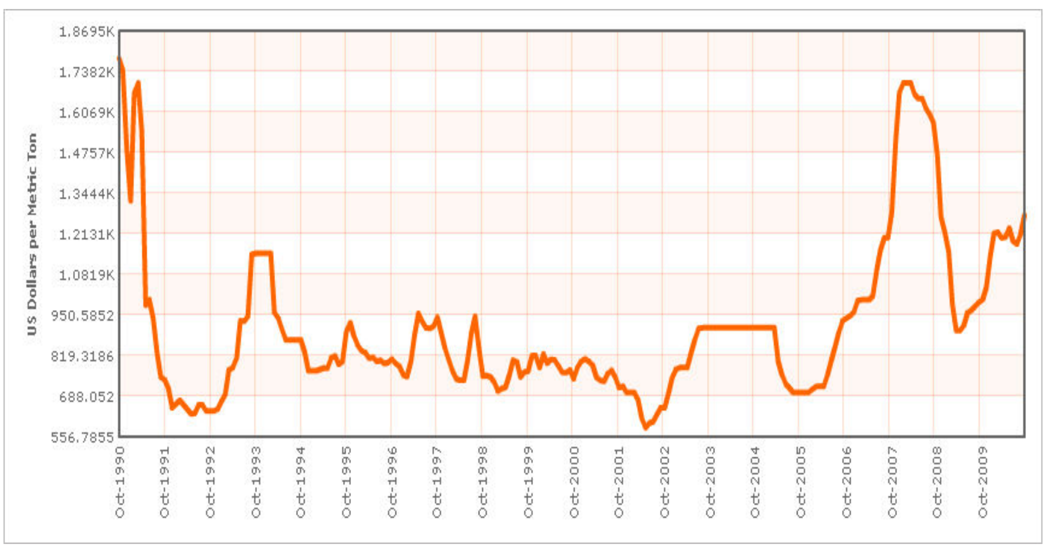
India's applied tariffs for different oilseed products—as well as other oilseeds and products—are high by global standards. For peanuts, for example, India's seed, meal, and oil tariffs are all sharply higher than for any of the world's major producing and consuming countries. The principal reason for India's high tariffs is to protect the welfare of oilseed producers, most of whom are small-scale, limited resource farmers operating under conditions of erratic rainfall. Imports were particularly restricted during 1989-94, a period corresponding with the Technology Mission on Oilseeds, a government initiative to boost self-sufficiency in edible oils. Since 1994, when India began conforming to WTO rules and replacing quantitative trade restrictions with tariffs, oil imports have been placed under Open General License (OGL), allowing unlimited imports by private traders subject to applied tariffs (Suresh and Landes, 2006).

India produces a broad range of oilseeds, ranking among the world's largest producers of peanut, rapeseed, soybean, cottonseed, and a number of minor oilseeds. Oilseed yields, however, remain well below world averages, with limited success in sustaining productivity growth. Government policy gives priority to protecting oilseed producers by placing quantitative restrictions or high tariffs on imports of oilseeds and products.

Integration of groundnut markets

Badiane et al., (2010) analyzed the spatial price transmission and market integration in Senegal’s groundnut markets. They found that world market prices are higher than those that have currently prevailed in the market since privatization of SONACOS (parastatal for groundnut markets). By keeping groundnut prices fixed after privatization, the government is actually implicitly subsidizing its new private owners to the disadvantage of groundnut farmers. Therefore, they suggested that the liberalization of prices alone would not yield much benefit, unless the tightly controlled marketing systems are also reformed to allow competition.

The CIF prices of groundnut prevailing at Argentina market was depicted in the fig 4.4 for the period 1990 to 2009. The trend exhibited huge fluctuations during the study period. Overall, there was decline in the unit prices for groundnut in the International market. Nearly 40 per cent of the international price was declined for the study period 19 years. Between the time period 2007 and 2009, there was a significant decline in the CIF prices.



** Grade: (40/50 count per ounce)*

Fig 4.4 Groundnut c.i.f Argentina prices (US$ / ton), 1990-2009*

Relationship between producer, import and export prices

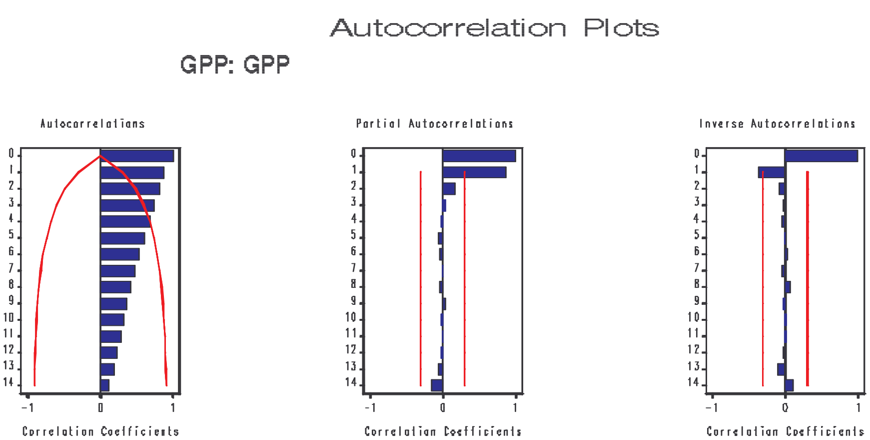
Table 4.21 Tests for stationarity

Market	ADF test#	
	I (0)	I (1)
Producer prices	1.05	-3.81*
Export prices	0.02	-3.79*
Import prices	N.A	N.A

based on single mean type estimation
* Significant at 1 percent level

If t (cal) > ADF critical value => not reject the null hypothesis, i.e., unit root exists in data variable
If t (cal) < ADF critical value => reject the null hypothesis, i.e., unit root does not exist in data variable

The stationarity tests were conducted on groundnut producer prices and export prices for the period of 43 years (1966-2008). The import prices of commodity were not available for the study period. The results of ADF test indicated that the first differences showed significant estimates at 1 per cent level. This meant that data were stationary in first differences with order of integration being I (1) for groundnut. As the two price series were found to be qualified for the pair-wise cointegration tests (table 4.21).



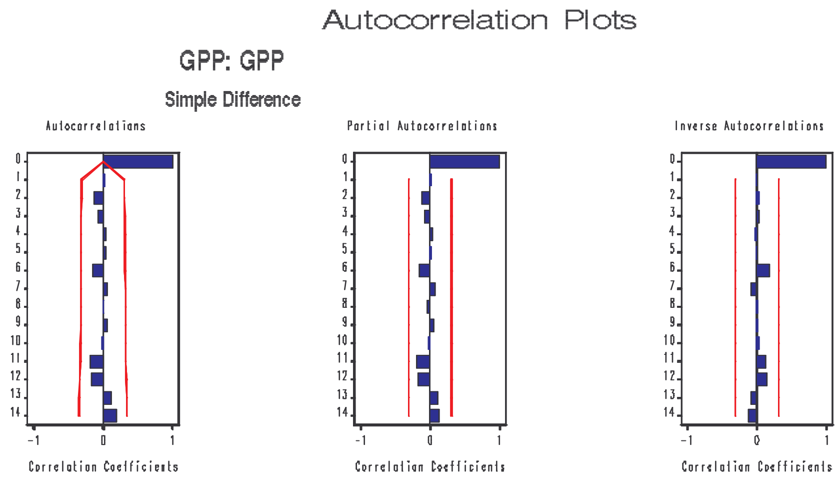


Fig 4.5 Producer prices before and after differencing

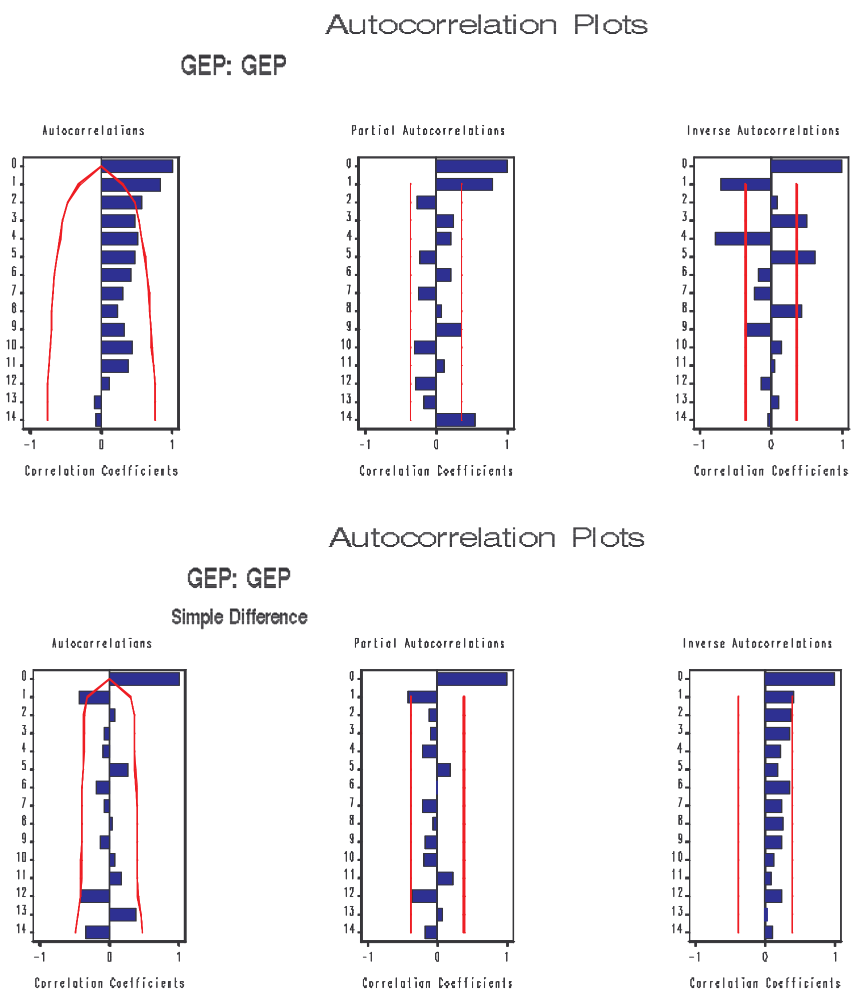


Fig 4.6 Export prices before and after differencing

Table 4.22 Testing Cointegration between producer and export price series

(ranking using trace method)

Series	H0: Rank=r	H1: Rank>r	Eigen Value	Trace	5% Critical Value
Producer and Export Prices	0	0	0.4127	23.9468	15.34
	1	1	0.0506	2.1283	3.84

Drift in ECM: Constant; Drift in process: Linear

The order of integration was tested for different combination of prices in order to find out the relationship between those prices. Maximum eigen value and significant trace indicated that producer price and export price were integrated at order I (1) while the other combinations of prices were not (Table 4.22).

Table 4.23 Granger-Causality Wald Test for long term integration

Dependant	Independent	Chi-Square	Pr > ChiSq
Producer Price	Export Price	17.13	0.0002
Export Price	Producer Price	2.12	0.3468

Results of Granger Causality Wald tests presented in table 4.23 indicate the direction of relationship (uni or bidirectional) between prices. Producer and export prices were influencing each other, while the influence of export price on producer price was found high. Export price was found to influence producer price a little while the vice-versa was not significant. For detailed VECM (long run and short run relationships) please see Appendix table A14 to A18.

Relationship between International and domestic markets

Table 4.24 Tests for stationarity

Market	ADF test#	
	I (0)	I (1)
International price	-1.50	-4.52*
APMC, Junagadh	-1.15	-3.22**
APMC, Rajkot	-0.68	-3.34**
APMC, Gondel	-0.45	-4.04*

based on single mean type estimation
* Significant at 1 percent level
** Significant at 5 percent level

If t (cal) > ADF critical value => not reject the null hypothesis, i.e., unit root exists in data variable

If t (cal) < ADF critical value => reject the null hypothesis, i.e., unit root does not exist in data variable

The stationarity tests were conducted for groundnut International price with three major domestic APMC markets for the period 1990 to 2010 month wise data (table 4.24). The results of ADF test indicated that the first differences showed significant estimates at 1 per cent level. This meant that data were stationary in first differences with order of integration being I (1) for groundnut. As the four price series were found to be qualified for the pair-wise cointegration tests.

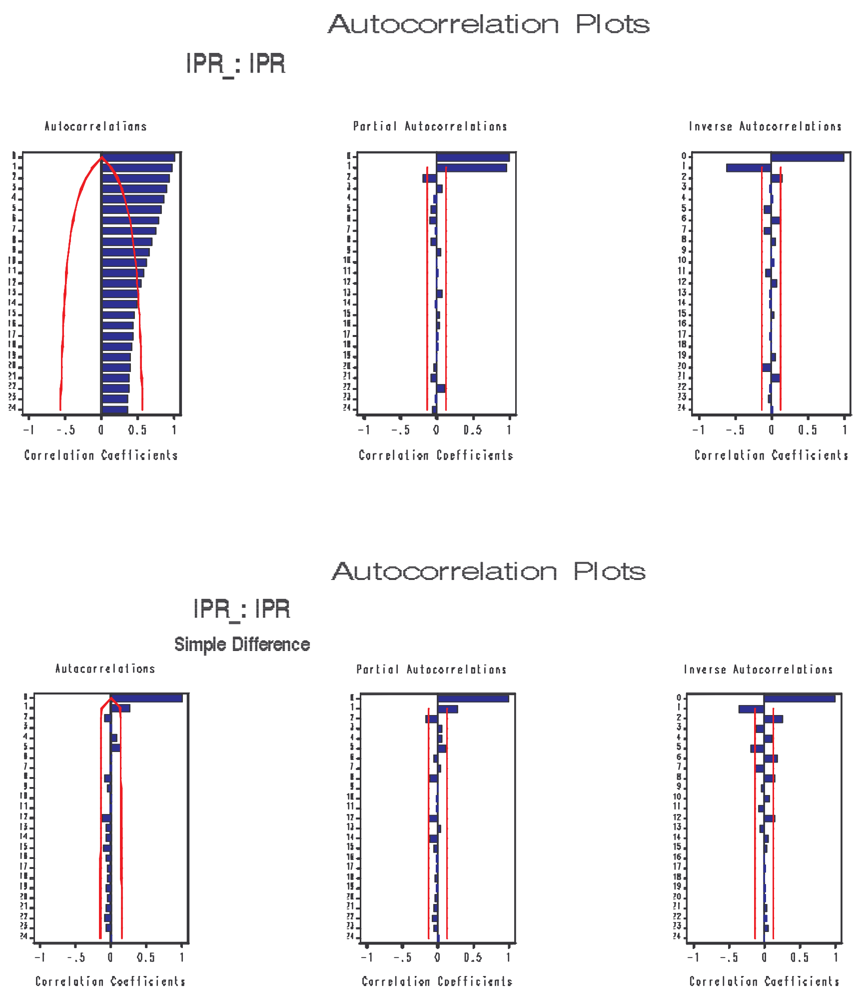
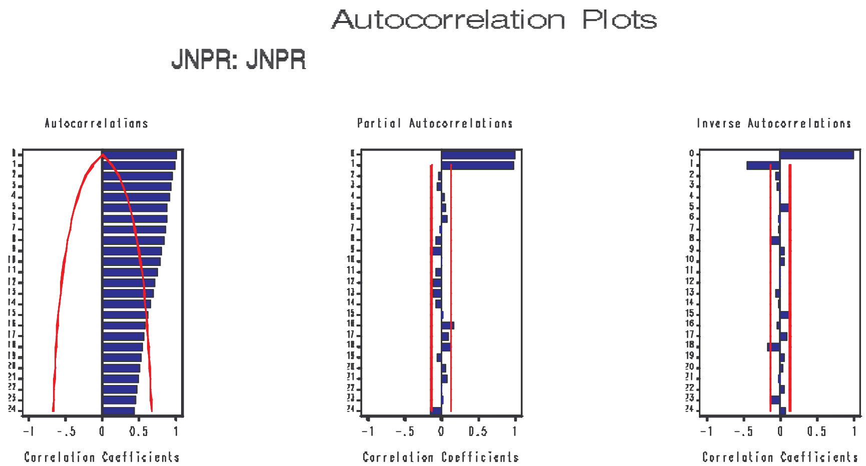


Fig 4.7 International price before and after differencing



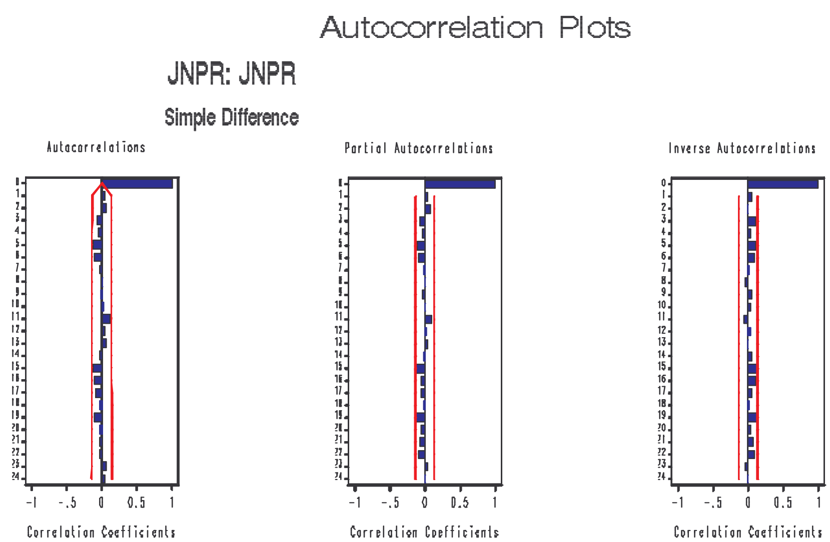


Fig 4.8 Junagadh wholesale price before and after differencing

Table 4.25 Testing Cointegration between different price series

(ranking using trace method)

Series	H0: Rank=r	H1: Rank>r	Eigen Value	Trace	5% Critical Value
International price and Junagadh price	0	0	0.0755	19.0280	15.34
	1	1	0.0015	0.3502	3.84
International price and Gondel price	0	0	0.0982	25.0993	15.34
	1	1	0.0021	0.4894	3.84
International price and Rajkot price	0	0	0.0942	23.6740	15.34
	1	1	0.0006	0.1384	3.84
Junagadh price and Gondel price	0	0	0.1389	36.0954	15.34
	1	1	0.0021	0.5019	3.84
Junagadh price and Rajkot price	0	0	0.1331	34.4073	15.34
	1	1	0.0017	0.4160	3.84
Gondel price and Rajkot price	0	0	0.1819	48.0634	15.34
	1	1	0.0012	0.2911	3.8

Drift in ECM: Constant; Drift in process: Linear

The order of integration was tested for different combination of prices in order to find out the relationship between those prices (table 4.25). Maximum eigen value and significant trace indicated that international price and three domestic markets (Junagadh, Gondel and Rajkot) prices were integrated at order I (1) while the other combinations of prices were not (Table 4.25). Similarly, Junagadh market has integrated with Gondel and Rajkot markets. Gondel market also highly integrated with Rajkot market but vice-versa did not integrate.

Results of Granger Causality Wald tests presented in table 4.26 indicate the direction of relationship (uni or bidirectional) between prices. Three domestic markets (Junagadh, Gondel and Rajkot) were influencing international prices, while the influence of international market on domestic markets was found low. Similarly, Gondel APMC market was able influence Junagadh market while the vice-versa was not significant. But, Rajkot and Junagadh markets are interdependent and influencing each other. Gondel and Rajkot markets are also found to be interdependent in nature. For all detailed VECM (long run and short run relationships) please see Appendix tables A14 to A18.

Table 4.26 Granger-Causality Wald Test for international and domestic prices

Dependant	Independent	Chi-Square	Pr > ChiSq
International price	Junagadh price	16.07	0.0003
Junagadh price	International price	4.35	0.1135
International price	Gondel price	28.76	<0.0001
Gondel price	International price	1.41	0.4951
International price	Rajkot price	19.93	<0.0001
Rajkot price	International price	0.36	0.8365
Junagadh price	Gondel price	24.06	<0.0001
Gondel price	Junagadh price	0.75	0.6884
Junagadh price	Rajkot price	30.27	<0.0001
Rajkot price	Junagadh price	21.59	<0.0001
Gondel price	Rajkot price	17.80	0.0001
Rajkot price	Gondel price	49.36	<0.0001

Competitiveness

Oilseeds in India seem to have comparative advantage because of the following issues. One, as irrigation water is becoming more and scarcer and oilseeds are less water intensive, cultivation of oilseeds represents more efficient use of water. Two, oilseeds in the cropping pattern in some areas have increased the intensity of cropping i.e., more efficient use of land – another scarce resource. Three, improvement in yield of oilseed crops has made them more remunerative than the competing crops. Therefore, more area was brought under oilseeds even in the absence of increase in prices. Nevertheless, their comparative advantage can be clearly established on the basis of domestic resource cost ratios for different regions.

Naik *et al.,* (2004) analyzed the competitiveness of various oilseeds and edible oils for the period 1988-89 to 1998-99 under importable hypothesis. The summary of the findings presented in the table below. Because of no protection to oilseeds in India domestic prices adjusted to international prices. As a result, NPC was pushed up marginally above unity. However, further fall in prices that continued in 1999-2000 must have made Indian oilseeds less remunerative to farmers. The NPC for oilseeds may be less than unity but the returns from the activity in the major producing states are low. A fall in international prices would have also effected the production of oilseeds if left unprotected.

NPC value of major oilseeds

Years	Rape-mustard	Groundnut	Soybean	Sunflower
1988-89	1.56	1.08	0.88	0.89
1989-90	1.06	1.17	0.95	1.36
1990-91	1.58	1.17	1.0	1.39
1991-92	1.28	1.08	1.01	1.26
1992-93	1.08	0.79	0.77	0.90
1993-94	1.06	0.65	0.72	0.93
1994-95	0.95	0.72	0.93	1.16
1995-96	1.02	0.8	0.93	0.92
1996-97	0.94	0.82	0.85	0.98
1997-98	1.2	0.77	0.7	0.71
1998-99	1.15	0.81	0.76	0.76

Source: a) Up to 1994-95: Pursell, Gary and Anju Gupta, Trade policies and Incentives in Indian Agriculture, Background statistics and Protection and Incentive Indicators, 1965-95, Background paper (1-6), World Bank, Mimeo

b) Naik *et al*., (2004)

NPC value of major edible oils

Years	Rape-mustard	Groundnut	Soybean	Sunflower
1988-89	2.34	1.69	2.20	2.22
1989-90	2.0	1.49	2.41	2.27
1990-91	2.69	1.53	2.76	2.61
1991-92	2.26	1.83	2.47	2.16
1992-93	1.75	1.27	1.62	1.66
1993-94	1.35	0.99	1.42	1.39
1994-95	1.35	1.08	1.51	-
1995-96	1.26	1.13	1.4	1.37
1996-97	1.17	0.99	1.4	1.38
1997-98	1.21	1.09	1.3	1.3
1998-99	1.19	1.11	1.21	1.21

Source: a) Up to 1994-95: Pursell, Gary and Anju Gupta, Trade policies and Incentives in Indian Agriculture, Background statistics and Protection and Incentive Indicators, 1965-95, Background paper (1-6), World Bank, Mimeo

b) Naik *et al*., (2004)

The nominal protection coefficient for the four edible oils has been consistently above unity. Though the fall in NPC to approach unity suggests that the Indian oil prices are adjusting to international prices there are still inefficiencies. The higher NPC of oil than NPC of oilseeds indicate that there are inefficiencies beyond farm gate in activities such as processing, transport, marketing etc. The inefficiencies need to be addressed in order to make them competitive.

The coefficients bring in some social perspective and measure the competiveness of commodity from point of view of producers/producer-cum-traders. DRCR computes the value of domestic primary and non-tradable resources to earn or save a unit of foreign exchange through production or exchange of commodity. The DRCR values is consistently less than unity and its value in general is lower. It is especially lower for groundnut in all the three states included in the analysis. Thus, from social welfare point of view production of these oilseeds in India is beneficial /desirable.

DRCR values of groundnut

Groundnut state	1996-97	1997-98	1998-99
Andhra Pradesh	0.32	0.32	0.39
Gujarat	0.26	0.28	0.29
Maharashtra	0.27	0.21	0.30

Table 4.27 Trade Competitiveness (under exportable hypothesis)

			Gnut-03-04*	Gnut-02-03*	Gnut-09-10@
Domestic Prices	Domestic price of Tradable output$	A	16130.0	12000.0	36927.0
	Domestic price of Non-Tradable output	B	4032.5	2640.0	7703.6
	Domestic price of Tradable input	C	10100.5	7756.1	21180.0
	Domestic price of Non-Tradable input	D	7678.5	6072.1	7225.0
Economic Prices	Border price of Tradable output#	E	30988.0	16049.3	36825.0
	Opportunity cost of Non-Tradable output	F	4032.0	2640.0	7703.6
	Border price of Tradable input	G	10100.5	7756.1	21180.0
	Opportunity cost of Non-Tradable input	H	9000.0	7923.3	8245.6
Surplus	Private Profit under Autarky (PPA)	(A+B)-(C+D)	2383.5	811.8	16225.6
	Private Profit under Free Trade (PPFT)	(E+B)-(C+D)	17241.5	4861.1	16123.6
	Social Profit under Free Trade (SPFT)	(E+F)-(G+H)	15919.5	3009.9	15103.0
	Total Policy Transfer (TPT)	(PPA-SPFT)	-13536.0	-2198.1	1122.6
Competitiveness Measure	Nominal Protection Coefficient (NPC)	(A/E)	0.52	0.75	1.00
	Effective Protection Coefficient (EPC)	(A-C)/(E-G)	0.29	0.51	1.01
	Effective Subsidy Coefficient (ESC)	[(A-C)+(H-D)]/(E-G)	0.35	0.73	1.07
	Domestic Resource Cost Ratio (DRCR)	(H-F)/(E-G)	0.24	0.64	0.03

* from CACP Report, 2007 @ Author's own analysis
$ - Whole market price prevailing at Junagadh after adjusting with transport costs;
# The U.S port prices at Rottardam after adjusting with transport costs

Trade competitiveness of groundnut crop at three data points were analyzed under exportable hypothesis and presented them in table 4.28. The results clearly indicate that over the period of time, groundnut loosing its competitiveness in the international market. But, the DRCR values indicate that we have high comparative advantage in production of groundnut. Surplus measures like PPA, PPFT, SPFT and TPT were positive during 2009-10. The results lend support to the earlier findings derived by Naik *et al.,* (2004) for groundnut crop.

Future strategy

The import of cheap oils at low tariff has brought down the domestic prices of edible oils and oilseeds as well. This has adversely affected the economics of oilseed crops relative to the competing crops. When imports of oilseeds take place, domestic prices of oilseeds will further go down making their cost of cultivation less profitable. In short-run, tariff rates may be raised to restrict import of oils. The domestic prices of oilseeds have already fallen to non-remunerative level and production is adversely affected. Import of proven oilseed crop technologies to enhance productivity should be another component of short-term strategy. In long-run, the strategy should be to evolve new varieties/hybrids with high yield/ high oil content, short duration, resistant to pests and diseases and adaptability to different agro-climatic conditions. Improvement in transport, processing and marketing is need of the hour for enhancing the competitiveness. Similarly, the part of gains due to increased efficiency could be passed on to the farmers to make the returns from oilseeds production more attractive.

4.2 Castor

India is the largest producer of castor seed in the world and produces on an average 8.0 to 8.5 lakh tones of castor seed. India's exports of castor oil and derivatives are estimated at over Rs.800 crores. The global castor derivatives market is estimated to be over US $ 500 million. Castor crop production in India (2009) was around 10.9 lakh tones and the export earnings from castor oil, derivatives and castor meal was nearly Rs.1000 crores (SEA Annual Report, 2009). In India, Gujarat, Rajasthan and Andhra Pradesh are the leading states in this field. Gujarat dominates with more than 65% share of the castor seed production and earns over Rs.600 crores per annum by way of export of castor and castor meal.

Castor oil is not a new industry in the country. At the same time, the industry has been operating in traditional manner over a period of years. The industry has always been subjected to fluctuations in the production of castor seed and more significantly in the prices of the seed and particularly castor oil. While India dominates the international trade of the castor oil with more than 70% share, apparently not much of value addition is taking place. In fact, the value addition takes place outside India. The global castor derivatives market is dependent on India for its requirement of castor oil. At the same time, India does not have much control over international castor oil prices. There are also related issues of availability of appropriate and cost effective technology to produce first, second and third generation derivatives.

However, India's future place in the international castor oil market cannot be taken for granted for two reasons. First, India faces stiff competition from exporting countries, primarily from Brazil and China. For example as of now, Brazil is trying to maintain its market leadership, despite declining international castor bean production by allowing large imports of castor beans from China and Thailand and then re-exporting the value-added product castor oil in the international market. India's policy of allowing bean imports for value-added exports has turned out to be successful, primarily owing to insufficient profit margins to traders. Second, the competition has been intensified from the buyers' side, in particular because of political and economic changes that have and are taking place in Eastern Europe and in USSR states.

World Production

The details of world area, production and productivity of castor are presented in table 4.28. The area has increased from 1233 thousand ha in 1961 to 1473 thousand ha by 2009. The compound growth rate in area was negative at 0.29 per cent per annum. The production has increased at 0.21 per cent per annum for the same period. However, the rate of growth in the productivity was 1.61 per cent per annum. The production exhibited a high coefficient of variation when compared to cropped area and yield.

Table 4.28 World area, production and yield of castor
(A – 1000 ha, Production – 1000 MT and Yield – kg/ha)

Year	Area	Production	Yield
1961	1233	580	470
1965	1466	801	546
1970	1497	843	563
1975	1377	786	571
1980	1540	776	503
1985	1733	1224	706
1986	1708	1032	604
1987	1348	842	625
1988	1534	1059	690
1989	1589	1117	703
1990	1657	1357	819
1991	1464	1198	818
1992	1257	11131	900
1993	1251	1094	875
1994	1342	1314	979
1995	1231	1089	885
1996	1257	1232	981
1997	1215	1250	1029
1998	1097	1178	1074
1999	1519	1159	763
2000	1832	1574	859
2001	1292	1093	846
2002	1111	938	844
2003	1260	1220	968
2004	1355	1258	928
2005	1475	1488	1009
2006	1264	1140	902
2007	1490	1438	965
2008	1542	1603	1039
2009	1473	1499	1017
CGR#	-0.29	0.21	1.61
C.V#	13.5	124.0	14.8

Source: FAOSTAT database
for the period 1986-2009

Table 4.29 Major producers in the World
(A – 1000 ha, Production – 1000 MT and Yield – kg/ha)

Country		2001	2002	2003	2004	2005	2006	2007	2008	2009
Brazil	Area	172	136	134	173	231	138	163	157	159
	Production	100	171	84	139	169	92	98	122	90
	Yield	582	1256	625	803	731	671	601	774	567
China	Area	270	270	267	260	260	250	210	220	210
	Production	260	265	258	250	250	240	170	190	190
	Yield	963	981	966	962	962	960	809	863	904
India	Area	717	583	732	800	860	750	860	900	840
	Production	653	428	801	793	991	730	1053	1171	1098
	Yield	911	734	1094	991	1152	973	1224	1301	1307
Africa+	Area	158	173	183	188	193	193	209	210	210
	Production	55	60	65	69	73	74	80	79	79
	Yield	349	346	356	368	380	384	383	374	374
America+	Area	191	151	151	187	246	165	177	173	175
	Production	119	184	100	154	185	109	112	139	107
	Yield	619	1218	659	821	749	660	633	802	613
Asia+	Area	1030	889	1028	1041	1139	902	1102	1157	1087
	Production	937	717	1080	1069	1238	983	1245	1385	1312
	Yield	910	807	1049	1025	1083	1089	1129	1196	1207
World+	Area	1292	1111	1260	1355	1475	1264	1490	1542	1473
	Production	1093	938	1220	1258	1488	1140	1438	1603	1499
	Yield	846	844	968	928	1009	902	965	1039	1017

Source: DOR, Hyderabad

India, China and Brazil are the major global player in case of castor crop (table 4.29). The area, production and productivity were much higher in India when compared with global competitors. India is continuing its dominance in the international castor market since 1990s. India is contributing nearly 75 per cent of the total production in the world. The productivity levels in India were much higher than the world productivity levels. The area, production and productivity growth were consistent in India during the study period.

India’s production

The annual compound growth rate of castor area since 1986 was 17.9 per cent (table 4.30). The rates of growth in production and productivity were 34.1 and 26.7 per cent respectively. The production registered high growth when compared with area and yield. There is significant improvement in yields since 1996 perhaps may be due to introduction of hybrids and improved package of practices in the cultivation. The high coefficient of variation was observed in case of production when compared with area and yield.

Table 4.30 India area, production and yield of castor
(A – 1000 ha, Production – 1000 MT and Yield – kg/ha)

Year	Area	Production	Yield
1961	486	109	224
1965	405	79	197
1970	439	136	310
1975	375	143	381
1980	498	204	411
1985	637	308	484
1986	578	230	399
1987	480	195	407
1988	631	415	658
1989	702	517	736
1990	810	716	884
1991	712	577	811
1992	660	623	944
1993	685	635	926
1994	779	845	1084
1995	789	780	988
1996	740	902	1218
1997	641	829	1292
1998	982	840	1231
1999	782	765	978
2000	1079	883	817
2001	716	653	911
2002	583	428	734
2003	717	797	1111
2004	743	793	1068
2005	864	991	1146
2006	639	762	1192
2007	860	1053	1224
2008	900	1171	1301
2009	840	1098	1307
CGR#	1.25	4.64	3.36
C.V#	17.9	34.1	26.7

Source: FAOSTAT database
for the period 1986-2009

Global castor oil seed export market

The details of major castor oil seed exporters in the world and their unit values are presented in tables 4.31 and 4.32. The major exporters are Indonesia, Myanmar, Pakistan and India. Even though, India is a major producer but not a major exporter. This may be due to high domestic consumption for different purposes. The export price realization was much higher in case of India when compared with other competing countries. The performance of India is consistent over a period of time.

Table 4.31 Major castor oil seed exporters in the World (tons)

Country	2002	2003	2004	2005	2006	2007	C.V
Indonesia	N.A	73	N.A	N.A	288	22405	240.3
Myanmar	685	3452	3300	5400	7559	10200	66.6
Pakistan	2332	885	6620	2529	571	3813	79.4
India	2779	1917	1339	844	117	309	83.1
Kenya	142	45	121	20	N.A	78	83.2
Paraguay	285	8803	9456	8964	6284	N.A	78.0
USA	11	56	100	2818	3285	N.A	149.4
World	8428	16571	24139	22895	20713	36908	-

Table 4.32 Unit prices castor oil seed exports ($/ton)

Country	2002	2003	2004	2005	2006	2007	C.V
Indonesia	N.A	178	N.A	N.A	128	346	128.1
Myanmar	102	86	109	81	102	245	51.1
Pakistan	263	375	345	368	434	432	17.1
India	574	534	526	552	684	854	20.6
Kenya	211	200	248	200	N.A	205	50.0
Paraguay	140	249	300	286	218	N.A	56.8
USA	364	268	560	841	599	N.A	66.8
World	354	272	328	337	364	331	

Global castor oil seed import market

The details of major importing countries and their unit prices are presented in tables 4.33 and 4.34. China, Brazil, Thailand and Germany are the major importers of castor beans. The unit price realization was higher in case of Thailand when compared with other importing countries. India was also importing castor beans during the period of drought in the country or shortage of crop production.

Table 4.33 Major castor oil seed importers in the World (tons)

Country	2002	2003	2004	2005	2006	2007	C.V
China	214	3049	4942	6017	8405	11	88.1
Brazil	3620	9332	9644	7533	6416	N.A	60.8
Thailand	4615	2395	8009	1989	1953	N.A	88.4
Germany	8123	6000	53	151	133	N.A	152.1
India	N.A	917	N.A	N.A	N.A	N.A	-
World	17786	22815	23367	16859	17819	688	

Table 4.34 Unit prices castor oil seed imports ($/ton)

Country	2002	2003	2004	2005	2006	2007	C.V
China	89	82	198	130	144	909	124.2
Brazil	108	248	299	245	221	N.A	59.6
Thailand	259	298	328	348	344	N.A	50.6
Germany	352	2469	2472	252	278	N.A	120.3
India	N.A	358	N.A	N.A	N.A	N.A	-
World	289	279	292	226	209	1279	

Castor oil seed production in India

Castor (Ricinus communis L.; Euphorbiaceous) seed is cultivated for the commercial importance of its oil. India is the world leader in Castor seed and oil production. In castor every plant part in addition to seed and its products is highly useful at the industrial as well as household level. The Indian variety of castor has 48 per cent oil content out of which 42 per cent can be extracted (table 4.35). The cake retains the rest. Castor is a kharif crop. Castor production in India usually fluctuates between 6 to 9 lakh tones per year. In 2006-07, India's castor production was 7.83 lakh tones.

Table 4.35 Castor seed composition

Constituent	Composition (%)
Hull	25-30
Kernel	70-75
Seed oil	40-55
Kernel oil	64-71
Protein	18-23
Soluble sugars	5
Crude fibre	25
Ash	2

Common varieties grown in India

State	Varieties
Gujarat	Sagamoti, Maharaja, G-2, G-4, Avani, G-4 + G-2, Mixed (G-4 + Avani)
Rajasthan	Nandi, Avani, Avani-9, G-7, Sagar Shakti, Mico
A.P	Gujarathi, Aruna, Kranti, Nava Bharath, Nagarjuna, Rear, GCH-4

Gujarat ranks No.1 in production of Castor seeds in India. Castor is extensively grown in India and in a few places the World. Castor crop grow under tropical conditions. It loves heat and humidity does best in regions where both are ample. India gifted with an ideal climatic condition, has recorded a produce of close to 10.5 lakh tons of castor seed. Gujarat produces 80 per cent of the total castor seeds in India followed by A.P and Rajasthan. Mehsana and Banaskantha districts are the largest castor producing districts in Gujarat. Castor is produced in lesser extent in Karnataka, T.N, Maharashtra and Orissa. There is a potential to produce castor in M.P, Bihar. C.G and Haryana states in India. Castor is planted during July and August and harvested around December to January.

The details of castor bean production in different states of India are presented in table 4.36. Gujarat, A.P, Rajasthan and Maharashtra are the major castor growing states in India. Gujarat is having the highest area, production and productivity among all states of India. Even the productivity levels in Gujarat were much higher than average of all India. The trend in area under castor crop was going down in case of A.P while the same was increasing in case of Gujarat. However, Rajasthan is showing consistent growth but very slowly.

Table 4.36 Area, Production and Yield of Castor seed, 2003-04 to 2007-08
(A – 1000 ha, Production – 1000 MT and Yield – kg/ha)

Country		03-04	04-05	05-06	06-07	07-08
A.P	Area	291	271	345	202	199
	Production	132	105	140	87	129
	Yield	454	387	406	431	648
Gujarat	Area	290	326	342	288	358
	Production	541	563	665	533	708
	Yield	1864	1730	1944	1851	1978
Rajasthan	Area	64	92	106	79	110
	Production	90	86	135	104	159
	Yield	1412	936	1273	1330	1451
Maharashtra	Area	26	12	16	12	12
	Production	5	3	6	4	4
	Yield	192	250	375	333	333
Karnataka	Area	17	20	25	20	23
	Production	15	22	27	16	16
	Yield	895	1100	1080	800	696
All India	Area	717	743	864	628	787
	Production	797	793	991	762	1054
	Yield	1111	1068	1146	1213	1339

Source: MoA, GoI

STATE-WISE PRODUCTION OF CASTOR SEED

(In Lakh Tonnes)

	2009-10			2008-09		
STATE	**Kharif**	**Rabi**	**Total**	**Kharif**	**Rabi**	**Total**
Gujarat	6.5	--	6.5	7.3	--	7.3
Rajasthan	1.2	--	1.2	1.4	--	1.4
Andhra Pradesh	0.7	--	0.7	0.7	--	0.7
Maharashtra	0.1	--	0.1	0.1	--	0.1
Punjab & Others	0.3	--	0.3	0.3	--	0.3
Total	8.8	--	8.8	9.8	--	9.8

Source: IOPEPC, 2010

In India, Gujarat, Rajasthan and A.P are three leading states producing almost 95 per cent of the Indian castor seed. As per castor crop survey carried out by M/s. AG Nielsen for Solvent Extractors Association (SEA) for the year 2009-10, following are the observations:

Table 4.37 District wise area, yield and production of castor seeds in Gujarat

District	Estimated Area ('000' ha)			Estimated production ('000' tons)			Estimated yield (Kg/ha)		
	08-09	09-10	%	08-09	09-10	%	08-09	09-10	%
Ahmedabad	12.0	14.26	19	19.8	24.6	24	1657	1725	4
Banaskantha	102.4	97.9	-4	180.7	178.2	-1	1765	1820	3
Bharuch	7.2	6.8	-5	11.1	9.6	-14	1547	1409	-9
Gandhinagar	30.4	29.2	-4	53.6	55.2	3	1764	1890	7
Jamnagar	12.4	10.4	-16	21.6	17.7	-18	1748	1716	-2
Kachchh	67.8	52.2	-23	73.2	61.2	-16	1078	1172	9
Kheda	13.1	10.8	-17	20.3	17.0	-16	1554	1574	1
Mahesana	53.4	52.1	-2	93.3	98.2	5	1748	1886	8
Panchmahal	2.3	1.9	-17	3.5	2.7	-21	1494	1414	-5
Patan	37.5	41.2	10	62.9	72.7	16	1678	1765	5
Rajkot	12.8	15.2	19	19.8	23.6	19	1546	1552	-
Sabarkantha	54.8	54.3	-1	94.9	102.3	8	1733	1884	9
Surendranagar	29.1	34.8	20	46.6	43.0	-8	1602	1235	-23
Vadodara	11.0	11.4	4	15.7	20.0	28	1426	1754	23
Others	4.8	4.6	-3	7.8	7.8	-	1597	1679	5
Total	**451.1**	**437.4**	**-3**	**725.1**	**734.2**	**1**	**1608**	**1679**	**4**

Source: SEA castor crop surveys (2009-10)

The data concludes that total area under castor crop in Gujarat for the year 2009-10 is 4.37 lakh ha. It has decreased by 3 per cent as compared to previous year (table 4.37). Area under Castor crop has increased in all the major castor growing district except Ahmedabad, Patan, Rajkot, Surendranagar and Vadodara. The estimated total production of Castor seeds is 7.34 lakh tons. It has increased by merely 1 per cent as compared to previous year. However, this growth is mainly in the districts such as Vododara (28%), Ahmedabad (24%), Rajkot (19%), Patan (16%) districts and Sabarkantha (8%). The average yield for the year 2009-10 is 1679 kg per ha as against 1608 kg per ha during 2008-09.

Table 4.38 District wise area, yield and production of castor seeds in Rajasthan

District	Estimated Area ('000' ha)			Estimated production ('000' tons)			Estimated yield (Kg/ha)		
	08-09	09-10	%	08-09	09-10	%	08-09	09-10	%
Barmer	6.0	5.9	-1	6.3	6.6	4	1053	1104	5
Hanumangarh	17.9	10.1	-43	13.6	6.1	-66	758	597	-21
Jalore	49.1	48.8	-1	56.8	58.1	2	1157	1190	3
Jodhpur	15.8	15.9	1	16.8	17.7	5	1062	1108	4
Pali	3.6	3.9	10	3.6	4.1	13	1021	1052	3
Sirohi	27.9	26.9	-4	32.4	26.5	-18	1160	983	-15
Others	7.3	6.6	-7	7.8	7.1	-9	1076	1065	-1
Total	**127.7**	**118.5**	**-7**	**137.4**	**126.2**	**-8**	**1076**	**1065**	**-1**

Source: SEA castor crop surveys (2009-10), Nielsen India estimates

Total area under Castor crop in Rajasthan for the year 2009-10 is 1.18 lakh ha. It has decreased by 7 per cent as compared to previous year (Table 4.38). The area under Castor crop has mainly decreased in Hanumangarh (43%) and other major district is Sirohi (4%). But, the area in Pali district increased by 10 per cent. The estimated total production for the year 2009-10 is 1.26 lakh tons. It has decreased by 8 per cent over previous year. The production in Hanumangarh and Sirohi districts has decreased by 66 per cent and 18 per cent respectively as compared to 2008-09. The average yield is 1065 kg per ha which is 1 per cent lower than from previous year. The yields have decreased significantly in Hanumangarh and Sirohi districts.

Total area under Castor crop in A.P for the year 2009-10 is 1.35 lakh ha. It has decreased by 30 per cent as compared to previous year (table 4.39). Area under Castor crop has decreased in all other districts of A.P except in Kurnool. Similarly trends were observed over last two years in A.P. The estimated production of Castor seed is 0.44 lakh tons. It has declined 38 per cent over the last year. The average yield 2009-10 is 325 kg per ha which is 12 per cent lower than 2008-09.

Table 4.39 District wise area, yield and production of castor seeds in A.P

District	Estimated Area ('000' ha)			Estimated production ('000' tons)			Estimated yield (Kg/ha)		
	08-09	09-10	%	08-09	09-10	%	08-09	09-10	%
Kurnool	14.8	18.5	25	6.6	6.2	-6	444	333	-25
Mahabubnagar	118.3	79.2	-33	41.2	24.5	-40	348	310	-11
Nalgonda	33.0	18.4	-44	13.5	6.8	-49	409	372	-9
Ranga Reddy	5.5	4.2	-21	1.9	1.6	-20	363	367	1
Others	20.2	14.1	-30	7.4	4.6	-38	369	326	-12
Total	**191.7**	**134.5**	**-30**	**70.7**	**43.7**	**-38**	**369**	**325**	**-12**

Source: SEA castor crop surveys (2009-10), Nielsen India estimates

Table 4.40 India's Castor seed trade

Sr. No.	State	Trade Estimate					
		2009-10 Season			2008-09 Season		
		Kharif®	**Rabi**	**Total**	Kharif	Rabi	Total
1.	Gujarat	**7.3**	--	**7.3**	7.3	--	7.3
2.	Rajasthan	**1.3**	--	**1.3**	1.4	--	1.4
3.	Andhra Pradesh	**0.4**	--	**0.4**	0.7	--	0.7
4.	Maharashtra	**0.3**	--	**0.3**	0.1	--	0.1
5.	Punjab & Others	--	--	--	0.3	--	0.3
	Total	**9.3**	--	**9.3**	9.8	--	9.8
Retained for sowing & export		--	--	--	--	--	--
Marketable surplus for crushing		**9.3**	--	**9.3**	9.8	--	9.8

Fro 2009-10 Maharashtra, Punjab & Others are combined
Source: SEA handbook, 2009

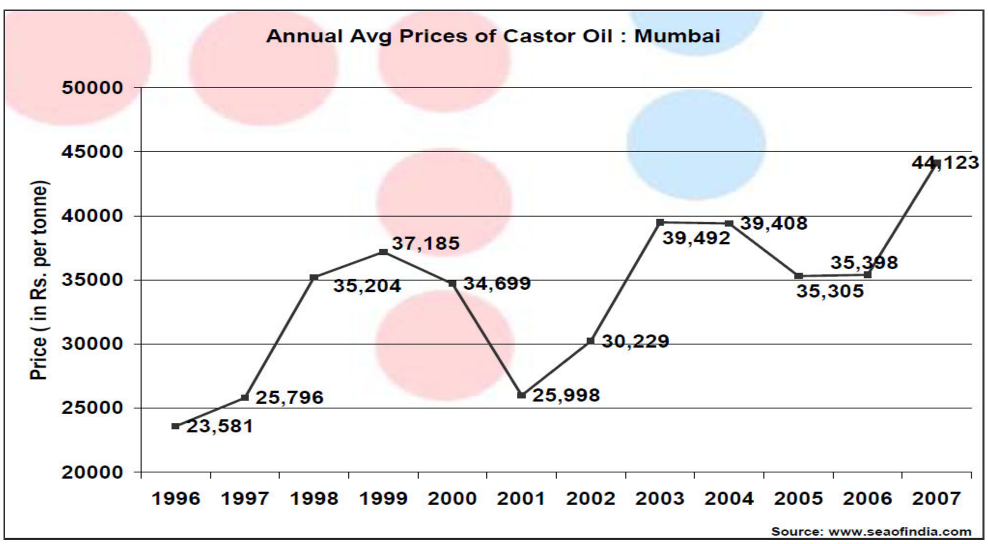
The details of India's castor seed trade is summarized in table 4.40. More than 60 per cent of total trade is happening in Gujarat alone followed Rajasthan and A.P. Maharashtra and Punjab showing very negligible shares in the total.

The details of production of castor seed and castor oil from India are presented in table 4.41 for the period 1990-91 to 2007-08. India is contributing nearly 68 per cent of the total castor oil production in the world. In the world total exports of castor oil, India is contributing around 57 per cent and earning 7573 million rupees of foreign exchange.

Table 4.41 India's production of Castor seed/oil and export of castor oil (qty in '000' MT)

Years	Castor seed		Castor oil		Export of castor oil		
	India	World	India	World (Nov-Oct)	World (Qty)	India (Qty)	FOB value (Rs.Million)
1990-91	716	1326	237.4	482.9	171.4	97.2	1661.0
1991-92	484	1093	223.5	456.5	152.2	94.0	1647.0
1992-93	568	1174	243.5	449.1	200.3	84.0	1443.0
1993-94	690	1113	255.1	435.3	173.8	153.0	2970.0
1994-95	850	1230	319.1	479.0	264.5	158.0	3750.0
1995-96	930	1218	353.6	482.4	301.9	302.6	7178.2
1996-97	770	1117	288.4	454.5	224.5	188.3	4692.3
1997-98	800	1191	296.0	456.4	255.9	183.8	4777.6
1998-99	840	1168	298.2	438.2	220.3	193.9	5959.8
1999-00	910	1261	307.4	478.7	264.3	234.8	8975.6
2000-01	867	1353	322.0	521.3	269.9	227.0	8060.7
2001-02	610	1043	263.2	450.8	208.8	204.9	5562.2
2002-03	650	1055	247.1	425.2	208.8	163.9	5208.5
2003-04	720	1154	289.2	475.4	251.2	161.6	6032.7
2004-05	870	1350	340.4	539.4	314.0	208.2	7885.6
2005-06	920	1407	339.4	518.0	283.0	182.1	6274.3
2006-07	810	1208	359.8	518.2	329.4	186.6	6530.5
2007-08	900	1314	362.0	538.9	310.5	176.2	7572.8

Source: Oil World, 2008



The annual average prices of castor oil at Mumbai market is depicted in figure above for the period 1996 to 2007. The castor oil price showed a growth of 87 per cent during the study period. The data exhibited that there were fluctuations in the prices over a period of time.

Table 4.42 India's Castor oil exports (qty – MT, Value in Rs. Lakh)

	2007-2008		2008-2009		2009-2010	
Country	**Qty**	**Value**	**Qty**	**Value**	**Qty**	**Value**
CHINA P RP	52,476.74	23,155.46	82,585.68	46,170.56	147,588.44	79,874.44
NETHERLAND	58,895.91	26,741.92	66,547.50	39,831.85	70,618.37	37,324.74
U S A	31,480.52	14,020.93	38,304.27	22,998.18	46,033.61	24,631.68
FRANCE	51,944.89	21,637.82	76,898.00	45,057.37	41,890.70	22,101.37
JAPAN	22,752.31	10,499.48	19,874.67	12,301.48	14,502.38	8,535.46
THAILAND	9,560.81	4,460.67	13,045.41	8,200.10	15,646.00	8,371.72
BRAZIL	4,030.22	1,819.15	2,757.12	1,615.93	8,145.13	4,263.63
U K	6,820.31	3,253.50	6,402.14	4,062.74	6,348.80	3,578.33
BELGIUM	1,940.21	960.05	2,800.01	2,032.19	5,351.12	3,206.50
KOREA RP	5,026.42	2,429.44	9,499.59	4,338.09	5,255.07	3,145.08
ITALY	3,295.06	1,736.41	2,718.00	1,922.91	3,615.43	2,411.76
TURKEY	3,331.22	1,632.42	3,978.31	2,729.88	3,125.35	1,892.12
SOUTH AFRICA	2,104.22	1,069.34	3,142.43	2,102.16	2,468.92	1,590.28
UNSPECIFIED	0	0	171.04	121.26	2,885.15	1,529.40
GERMANY	5,436.18	2,588.24	4,934.44	3,296.73	2,314.52	1,471.74
U ARAB EMTS	1,640.01	881.97	2,447.50	1,726.91	2,051.72	1,280.56
TAIWAN	2,441.03	1,216.55	2,037.70	1,331.86	1,991.48	1,222.55
RUSSIA	2,311.62	1,163.41	2,567.00	1,794.47	1,777.67	1,098.33
MALAYSIA	1,062.09	546.78	821.83	553.51	1,304.46	1,046.13
SPAIN	2,498.08	1,192.21	2,866.00	1,821.49	1,602.27	929.21
MEXICO	789.98	389.4	464.9	310.12	1,477.75	919.72
AUSTRALIA	1,613.40	812.92	1,652.33	1,121.60	1,302.89	849.53
SAUDI ARAB	1,372.28	639.59	983.93	659.6	1,195.67	773.01
SINGAPORE	898.76	459.46	751.13	561.04	1,037.34	669.17
IRAN	914.05	427.24	1,098.80	759.31	837.97	527.44
SWEDEN	14	6.97	30.1	24.45	804	402.99
EGYPT A RP	386.84	193.02	518	398.1	640.16	390.24
SYRIA	126.05	67.65	225.09	146.21	545.5	327.01
UKRAINE	895	445.48	771	515	441	277.92
IRAQ	321	158.95	229	152.3	412.6	261.01
Total	**281,987.71**	**127,458.48**	**356,441.37**	**212,273.37**	**397,698.01**	**217,756.64**

Source: DGCIS Annual Export

The details exports of castor oil from India to different destinations points are summarized in table 4.42 for the years 2007-08 to 2009-10. China, Netherlands and USA were the top three major importers from India. The performance of total exports was consistent during the study period.

Table 4.43 Castor cake processing, production and export, 1989-90 to 2008-09

Year	Processed MT	Production of SE castor oil MT	Production of Extraction MT	Export of Extraction		
				Qty MT	FOB value Rs.crores	Unit value Rs/MT
89-90	47390	2881	43713	5471	0.81	1488
90-91	61816	3679	57889	7649	1.25	1636
91-92	53980	3470	50218	11180	1.73	1543
92-93	46931	2775	44035	3816	0.89	2335
93-94	96640	5706	90643	9105	2.45	2690
94-95	127203	8179	118847	20784	4.24	2040
95-96	258254	21563	236475	24752	4.23	1710
96-97	229479	19477	209226	43695	8.02	1835
97-98	177976	14820	162395	41213	9.23	2239
98-99	189922	15366	173968	41855	7.85	1877
99-00	234903	19883	213675	72040	14.77	2050
00-01	193084	17025	176703	70240	14.73	2098
01-02	167223	15316	152657	69063	13.57	1966
02-03	197156	21368	179177	82495	17.66	2141
03-04	227487	37347	190253	85945	23.33	2714
04-05	313173	44835	269160	101885	27.73	2726
05-06	363232	52128	273740	201150	52.51	2855
06-07	451292	114185	338331	202175	58.65	2900
07-08	484539	52295	358072	330475	146.00	4420
08-09	444106	49720	320923	203915	103.50	5075

Source: SEA Databank, 2008

The details of castor cake processing, production and export from India over the period of 89-90 to 08-09 are summarized in table 4.43. Over the period time, the performance was consistent and significantly contributing to Indian agricultural exports.

Cost of production

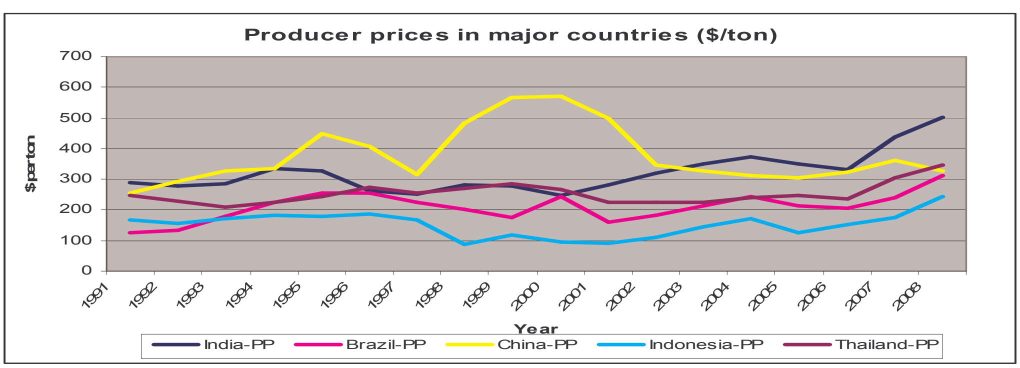


Fig 4.9 Producer prices in different major producing countries

Among the different global producers, the cost of production was very high in case of China followed by India (fig. 4.9). The lowest COP was observed in case of Indonesia. Brazil and Thailand were showing in between these two groups. In 2008, the cost of production is the highest in case of India followed by China.

Table 4.44 Economics of Castor cultivation (Gujarat)

Treatment	Seed yield (kg/ha)	Income (Rs/ha)	COC (Rs/ha)	Net (Rs/ha)	BCR
Full package (FP)	3259	61921	15775	46146	2.93
FP – Fertilizers	2427	46113	13890	32223	2.32
FP – PP	3056	58064	14775	43289	2.93
FP- Weeding	2792	53048	13975	39073	2.80
FP – (F+PP)	2170	41230	12890	28340	2.2
FP- (F+W)	1812	34428	12090	22338	1.85
FP- (PP+W)	2561	48659	12975	35684	2.75
FP – (F+PP+W)	1798	34162	11090	23072	2.08

Source: GITCO survey & SDAU, Dantiwada, Gujarat, 2009

The summary of cost of production of castor bean in Gujarat state is presented in table 4.44. The farmers were making reasonable good margins in castor cultivation in the state. It has also given various scenarios and their impact on yield and net returns in castor cultivation in the state.

Table 4.45 Economics of Castor cultivation (Rajasthan)

Particulars	Cost (Rs/ha)
Land preparation	1200
Seed	800
Manure + Fert	1500+1070+670+160+146
Bonding with tractor	296
Sowing	296
Irrigations	6000
Weeding	1800
Plant protection	410
Harvesting	1750
Threshing	1650
Others	252
Total	18000

Source: GITCO & ARS, Jodhpur, 2009

The summary break-up of average cost of cultivation of castor in Rajasthan is presented in table 4.45. The data indicates that the cost of cultivation in Rajasthan is little bit higher when compared with Gujarat state.

Castor oil seed pricing

Pricing of castor seed and oil is one of the most important and sensitive aspect. Castor seed availability in the marketplace and its numerous uses in turn affect the oil prices also. The castor seed prices have shown fluctuation over a period of years affecting the farmers as also the processors. Stable pricing scenario is being advocated by all the concerned but has not resulted in a consistent manner. To illustrate, the prices of castor seed in three major states in India in last ten years is presented in table 4.46.

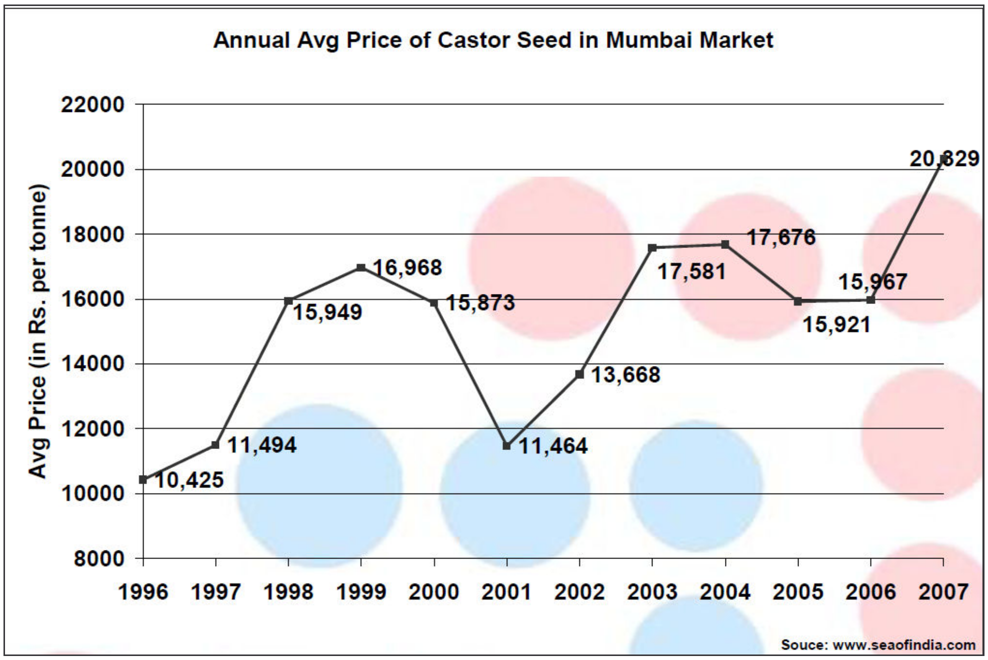
The prices of castor seed is influenced by climatic conditions, prices of castor oil in the world trade, production in India and Rotterdam prices in Europe. Also the large number of down-stream products makes consumption demand of this oil price inelastic. In the international market, castor oil is one of the most expensive vegetable oil. Despite India's dominant position in the global castor market, in the exports markets the Indian castor produce does not drive the prices.

Table 4.46 Farm harvest prices of Castor seed in three major states in India (Rs/qtl)

Year	A.P	Gujarat	Rajasthan
1996-97	1022	1030	943
1997-98	1072	1195	937
1998-99	1320	1455	1136
1999-2000	1206	1382	1604
2000-01	1028	1259	1091
2001-02	942	1233	1151
2002-03	1285	1538	1641
2003-04	1373	1583	1544
2004-05	1505	1537	1593
2005-06	1252	N.A	1458
2006-07	1524	1034	1800
2007-08	1825	2188	2633

Source: DOR, Hyderabad

The details of average Farm harvest prices of castor in the three major growing states have summarized in table 4.46. The prices were much higher in Rajasthan than the remaining two states during the period 2007-08. But, Rajasthan state showed lower prices when compared to Gujarat and A.P during 1996-97. The current prices (2007-08) in A.P were much lower when compared other competing states.



Need and the action

There is a big gap between the productivity of research farm and the average yield of the state or nation. In demonstrations also, the yield productivity is many more times than average yield. There are many reasons responsible for low yield of castor in which mainly castor crop grown in rainfed conditions in marginal soils and under low inputs. Mono-cropping which cause a great loss due to drying of plant to wild and root rot. Not availability of pure seed is also a responsible factor for low yield.

This necessitates several research based measures for increasing the castor productivity. Some innovative ways are:

1. Wilt and root rot resistant high yielding hybrids
2. increasing irrigation facilities through micro-irrigation technologies

3. Rabi castor- a innovative ways to increase the castor production
4. development high yielding hybrids with high oil content and ricinoleic acid
5. price forecasting and price stability
6. development of hybrids/varieties against drought and problematic soils

SWOT Analysis

India's exports are largely dependent on the overseas consumers/buyers and prices are mostly determined by few selected large consumers/buyers. Due to low technology – the castor oil importers from Europe/USA/Japan and China are making several value added derivations and re-exporting them to world, including to india. To come out from this bottle neck, it's vital to develop new range of derivations from castor oil and have higher investment in technology to get higher returns from such high level products. SWOT analysis of castor industry are as follows:

Strengths

- In last 15 years period India has emerged as World's largest castor seed producer, processor and exporter of castor oils of different grades in global market. Export of co-product castor cake has also developed in last five years period
- Castor seeds can be cultivated in wide range of agro-climatic conditions, without much yield variation. It can be cultivated successfully in arid and semi-arid climates and wide range of soils.
- Main castor seed producing areas in the country, Gujarat and Rajasthan has favourable agro-climatic conditions for getting highest yield of castor seeds in India and in World. Castor seed yield in other areas like Andhra Pradesh and Maharashtra have also improved substantially.
- Castor seed crop is generally not affected by plant diseases, which may affect adversely the crop yield.
- Unlike other oilseeds, properly harvested castor seed can be stored without any deterioration in oil content or quality for nearly two years period.
- Use of appropriate agronomic practices like hybrid seeds, fertilizer and improved farm practices by hard working farmers of main castor cultivation

area have continuously made it possible to get consistently high castor seed yield, resulting in castor oil recovery in the range of 45 to 50 per cent.

- Enterprising people in main castor seed cultivation areas and favourable industrial policies of state and central government have encouraged highest castor seed processing in the area.
- Main castor seed producing / processing areas have easy availability of basic industrial infrastructure like water, electricity, road and rail and all sea port linkages for easy transportation and export of castor oil and its co-product.
- Easy and cheap availability of technical and managerial manpower in main Castor seed processing areas has provided the edge in global market, with lower production cost for Castor oil and derivatives.
- Castor oil and almost all its derivatives are bio-degradable, eco-friendly and renewable. Castor cake a bi-product of castor oil industry is organic manure in many Asian countries. It is rich source of input material for organic cultivation.

Weaknesses

- Castor industry is fragmented in India and due to this it has remained under developed so far. Lower investment and lower technology has resulted in stiff competition within country and given lower margins to small and medium processors.
- Lower margins in Castor industry so far has also prevented them in investing for developing technology for higher value products from castor oil. This has again made them dependent on international buyers and that resulted in tighter margins.
- Though India is the largest producer and processor of Castor seeds in the World and lack of unity amongst major players and lack of unified business strategy, Indian Castor industry is unable to fetch best price of their valuable produce.
- There is lack of clarity on availability of ready and cost effective technology for second and third generation derivatives
- The mind set, to an extent, of a commodity player

Opportunities

- Castor seed cultivation area and yield will further improve with improved irrigation facilities available in main castor seed producing areas of Gujarat and Rajasthan. Further the research by different Agricultural Universities would help in increasing the yield.
- India has so far developed only primary and secondary level derivatives, and there is vast scope of development of many high value industrial and consumer products, which will have both domestic and export markets.
- Due to high advantage available for castor seed processors, many Chinese companies are interested to invest and collaborate with Indian castor seed processors.
- Castor cake is excellent source of natural protein (equal to Soya meal protein) but due to "Ricinin Content" it cannot be used as cattle feed. A technology has already been developed and approved by an UN agency and this has opened an opportunity of its use as animal, poultry and fish feed. India being one of the largest exporters of several de-oiled cakes for cattle feed purpose; it can have synergy in development of this technology on a large scale.

Threats

- Due to availability of higher farm returns in competitive crops like Bt cotton, rapeseeds etc than in main castor seed cultivation, there is likelihood of crop shift from castor seed in coming period, and this may reduce overall castor seed supply for processors.
- China and Brazil have much lower castor seed production as compared to India, due to various reasons. Increase in castor seed yield and production will pose serious competition for Indian castor oil industry.
- Castor is the costliest vegetable oil in the world at present and hence there is always a threat of its substitution by other minor oilseeds oils or animal fats.

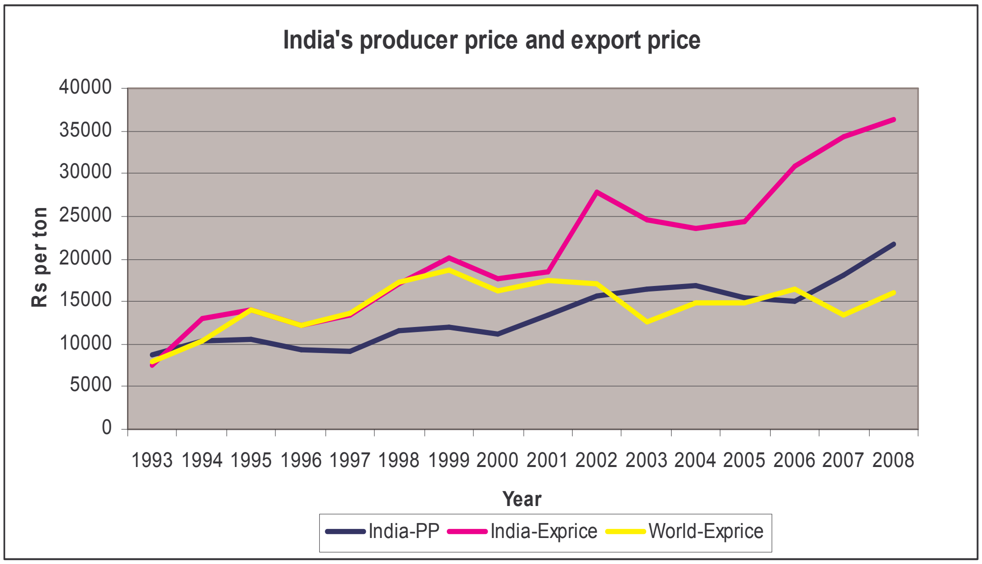
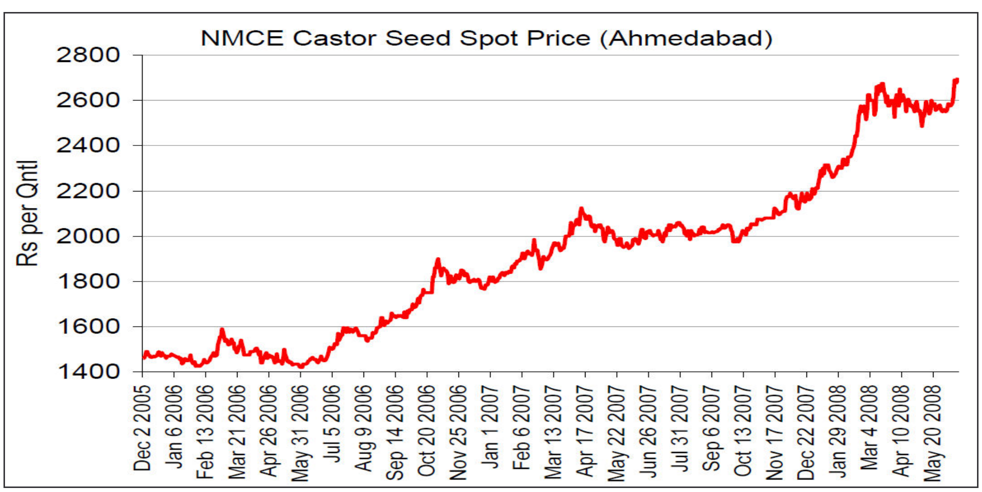


Fig 4.10 India's producer price Vs export price

The trends in India's producer price and export price are depicted in fig 4.10. There is huge margin in between the producer price and export price. This is good sign for traders, exporters and castor growers. India is realizing much higher export prices than even the world average prices. There is a wide gap in between in world export price and India's export price. The National Multi-Commodity Exchange (NMCE) derivate prices for castor seed at Ahmedabad are summarized in the fig. below from 2005 to 2008. This illustrates the clear trend and demand for the castor seed spot prices at Ahmedabad. The unit price has increased nearly 85 per cent in the span of three years time period.



Market integration

Relation between producer and export prices

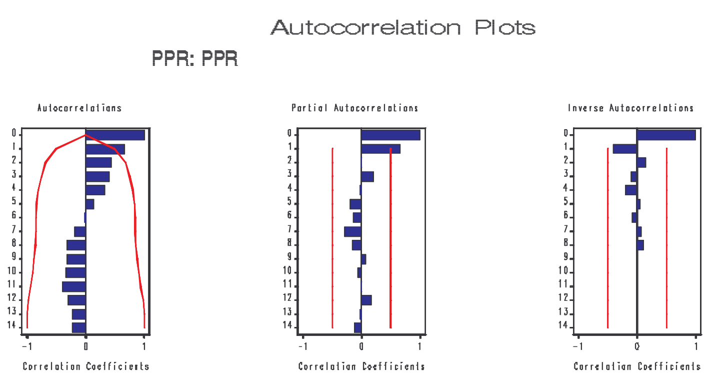
Table 4.47 Tests for stationarity

Market	ADF test#	
	I (0)	I (1)
Producer prices	0.26	-4.14*
Export prices	0.11	-4.59*
Import prices	N.A	N.A

based on single mean type estimation
* Significant at 1 percent level

If t (cal) > ADF critical value => not reject the null hypothesis, i.e., unit root exists in data variable
If t (cal) < ADF critical value => reject the null hypothesis, i.e., unit root does not exist in data variable

The stationarity tests were conducted on castor producer prices and export prices for the period of 16 years (1993-2008) (table 4.47). The castor import prices were not available during the study period. The results of ADF test indicated that the first differences showed significant estimates at 1 per cent level. This meant that data were stationary in first differences with order of integration being I (1) for Castor. As the two price series were found to be qualified for the pair-wise cointegration tests.



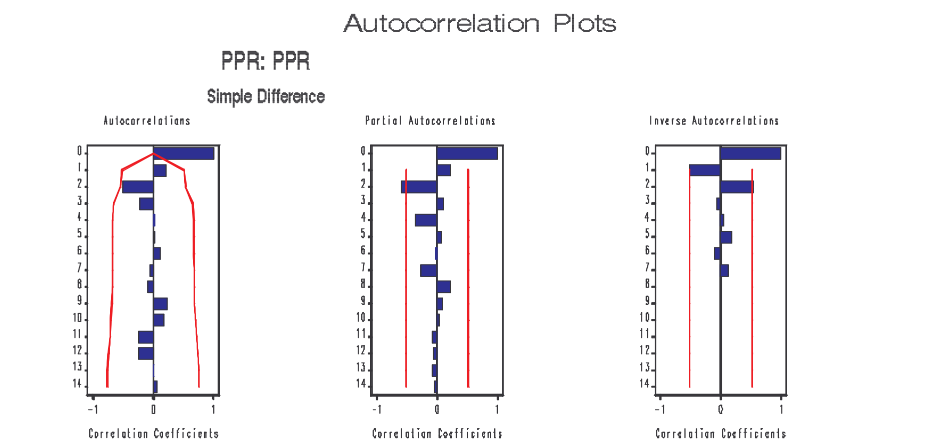


Fig 4.11 Producer price before and after differencing

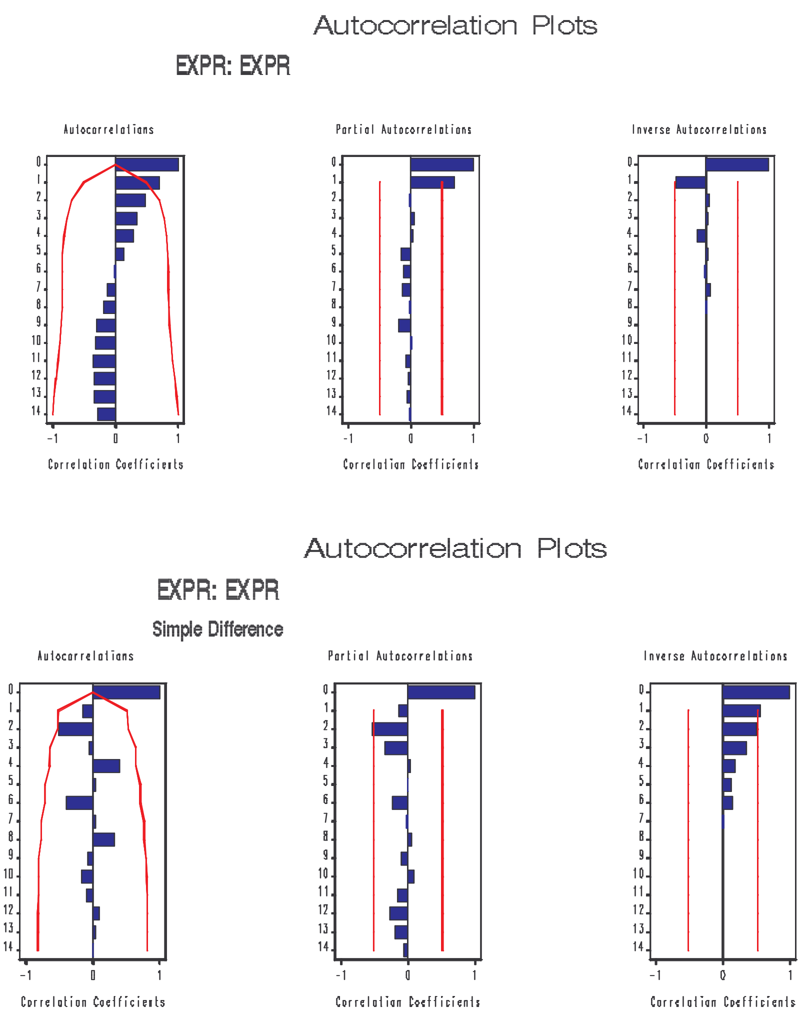


Fig 4.12 Export price before and after differencing

Table 4.48 Testing Cointegration between producer and export price series
(ranking using trace method)

Series	H0: Rank=r	H1: Rank>r	Eigen Value	Trace	5% Critical Value
Producer and export prices	0	0	0.7284	18.2579	15.34
	1	1	0.0006	0.0082	3.84

Drift in ECM: Constant; Drift in process: Linear

The order of integration was tested for different combination of prices in order to find out the relationship between those prices. Maximum eigen value and significant trace indicated that producer price and export price were integrated at order I (1) while the other combinations of prices were not (Table 4.48).

Table 4.49 Granger-Causality Wald Test for long term integration

Dependant	Independent	Chi-Square	Pr > ChiSq
Producer Price	Export Price	13.64	0.0011
Export Price	Producer Price	0.02	0.9900

Results of Granger Causality Wald tests presented in table 4.49 indicate the direction of relationship (uni or bidirectional) between prices. Producer and export prices were influencing each other, while the influence of export price on producer price was found high. Export price was found to influence producer price a little while the vice-versa was not significant. For detailed VECM analysis (long run and short run relationships) please see Appendix table A19 to A21.

Relationship between international prices and domestic markets

Table 4.50 Tests for stationarity

Market	ADF test#	
	I (0)	I (1)
International prices	-1.50	-3.21*
Mumbai market	-0.86	-5.25*
Junagadh market	-0.50	-3.68*
Rajkot market	-0.66	-3.18*
Gondel market	-0.67	-5.02*
Unjha market	-0.30	-4.11*

based on single mean type estimation
* Significant at 1 percent level

If t (cal) > ADF critical value => not reject the null hypothesis, i.e., unit root exists in data variable

If t (cal) < ADF critical value => reject the null hypothesis, i.e., unit root does not exist in data variable

The stationarity tests were conducted on Castor international market price and five domestic markets (Mumbai, Junagadh, Rajkot, Gondel and Unjha) for the period 19 years data (1990 to 2009) (table 4.50). The results of ADF test indicated that the first differences showed significant estimates at 1 per cent level. This meant that data were stationary in first differences with order of integration being I (1) for Castor. As the two price series were found to be qualified for the pair-wise cointegration tests.

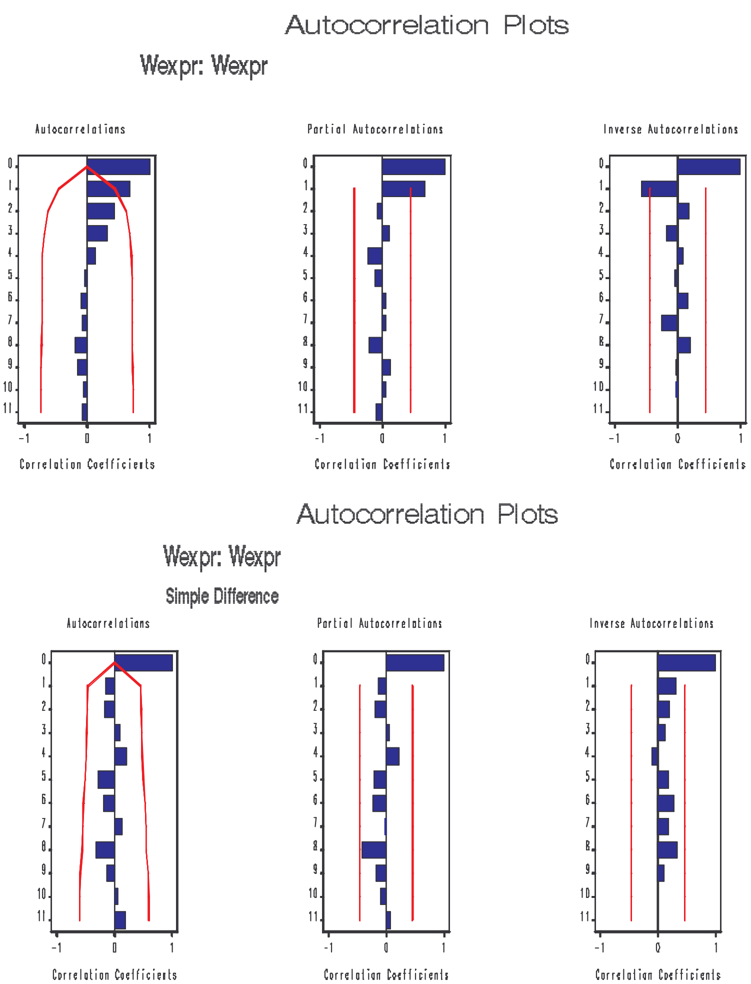


Fig 4.13 International prices before and after differencing

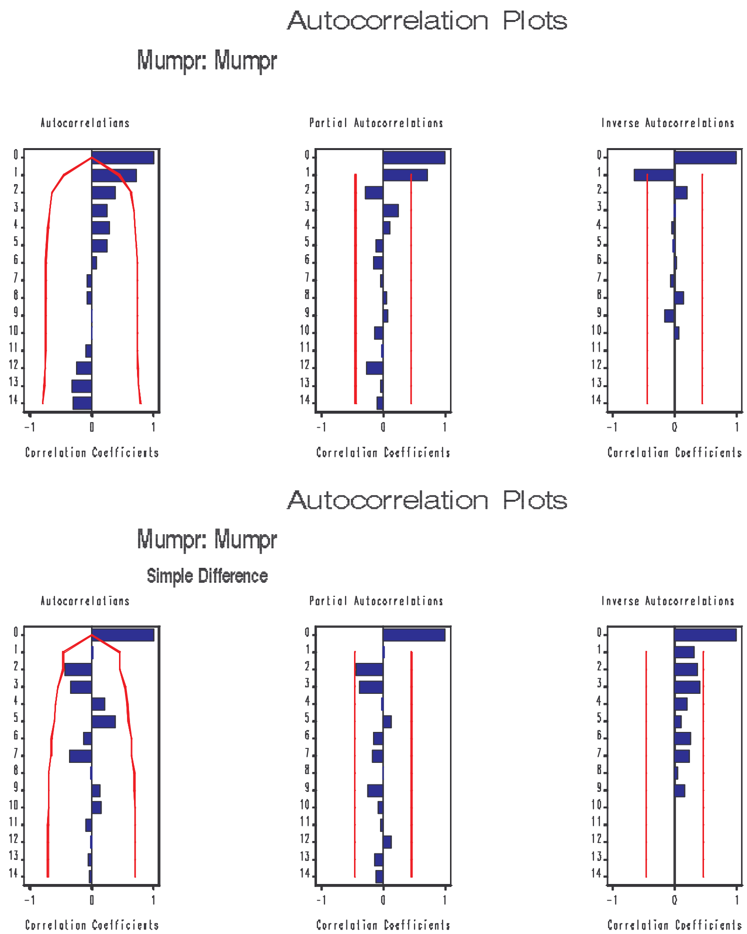


Fig 4.14 Mumbai market prices before and after differencing

The order of integration was tested for different combination of prices in order to find out the relationship between those prices (table 4.51). Maximum eigen value and significant trace indicated that Mumbai and Gondel market prices were integrated at order I (1) while the other combinations of prices were not (except Mumbai and Unjha markets are integrated).

Table 4.51 Testing Cointegration between international prices and domestic prices

(ranking using trace method)

Series	H0: Rank=r	H1: Rank>r	Eigen Value	Trace	5% Critical Value
International prices and Mumbai market	0	0	0.3645	9.0412	15.34
	1	1	0.0478	0.8813	3.84
International prices and Junagadh market	0	0	0.4037	9.5541	15.34
	1	1	0.0137	0.2479	3.84
International prices and Rajkot market	0	0	0.4113	9.7358	15.34
	1	1	0.0111	0.2002	3.84
International prices and Gondel market	0	0	0.3951	9.6533	15.34
	1	1	0.0330	0.6043	3.84
International prices and Unjha market	0	0	0.4058	9.6031	15.34
	1	1	0.0128	0.2325	3.84
Junagadh market and Mumbai market	0	0	0.5260	13.4624	15.34
	1	1	0.0013	0.0242	3.84
Junagadh market and Rajkot market	0	0	0.4026	9.9632	15.34
	1	1	0.0376	0.6890	3.84
Junagadh market and Gondel market	0	0	0.4286	10.6793	15.34
	1	1	0.0331	0.6062	3.84
Junagadh market and Unjha market	0	0	0.3318	7.2576	15.34
	1	1	0.0000	0.0003	3.84
Rajkot market and Mumbai market	0	0	0.5208	13.2973	15.34
	1	1	0.0030	0.0541	3.84
Rajkot market and Gondel market	0	0	0.4858	12.1286	15.34
	1	1	0.0086	0.1557	3.84
Rajkot market and Unjha market	0	0	0.4784	11.7343	15.34
	1	1	0.0010	0.0185	3.84
Gondel market and Mumbai market	0	0	0.6247	17.7207	15.34
	1	1	0.0044	0.0787	3.84
Gondel market and Unjha market	0	0	0.3166	6.8537	15.34
	1	1	0.0000	0.0005	3.84
Unjha market and Mumbai market	0	0	0.6506	18.9931	15.34
	1	1	0.0037	0.0660	3.84

Drift in ECM: Constant; Drift in process: Linear

Table 4.52 Granger-Causality Wald Test for long term integration

Dependant	Independent	Chi-Square	Pr > ChiSq
International price	Mumbai market	5.88	0.0530
Mumbai market	International price	1.19	0.5524
International price	Junagadh market	3.48	0.1752
Junagadh market	International price	0.19	0.9112
International price	Rajkot market	6.53	0.0382
Rajkor market	International price	2.64	0.2676
International price	Gondel market	3.94	0.1391
Gondel market	International price	0.94	0.6264
International price	Unjha market	5.10	0.0783
Unjha market	International price	2.31	0.3145
Junagadh market	Mumbai market	2.79	0.2480
Mumbai market	Junagadh market	4.79	0.0913
Junagadh mar6ket	Rajkot market	7.57	0.0227
Rajkot market	Junagadh market	1.99	0.3688
Junagadh market	Gondel market	3.60	0.1653
Gondel market	Junagadh market	0.30	0.8588
Junagadh market	Unjha market	6.80	0.0333
Unjha market	Junagadh market	1.48	0.4767
Rajkot market	Mumbai market	2.65	0.2653
Mumbai market	Rajkot market	10.41	0.0055
Rajkot market	Gondel market	1.27	0.5291
Gondel market	Rajkot market	6.84	0.0327
Rajkot market	Unjha market	1.14	0.5651
Unjha market	Rajkot market	5.16	0.0757
Gondel market	Mumbai market	2.39	0.3020
Mumbai market	Gondel market	10.94	0.0042
Gondel market	Unjha market	3.61	0.1643
Unjha market	Gondel market	2.54	0.2811
Unjha market	Mumbai market	2.32	0.3141
Mumbai market	Unjha market	15.86	0.0004

Results of Granger Causality Wald tests presented in table 4.52 indicate the direction of relationship (uni or bidirectional) between prices. Mumbai, Rajkot and Unjha markets were able to influence the international market a little. Similarly, Mumbai market was also influenced by Rajkot, Gondel, Junagadh and Unjha markets. The vice-versa was not significant. For detailed VECM analysis (long run and short run relationships) please see Appendix table A19 to A21.

Table 4.53 Trade Competitiveness
(under exportable hypothesis)

			Cas-09-10@
Domestic Prices	Domestic price of Tradable output#	A	111644
	Domestic price of Non-Tradable output	B	2234
	Domestic price of Tradable input	C	30707
	Domestic price of Non-Tradable input	D	6607
Economic Prices	Border price of Tradable output$	E	100156
	Opportunity cost of Non-Tradable output	F	2234
	Border price of Tradable input	G	32000
	Opportunity cost of Non-Tradable input	H	8125
Surplus	Private Profit under Autarky (PPA)	(A+B)-(C+D)	76564
	Private Profit under Free Trade (PPFT)	(E+B)-(C+D)	65076
	Social Profit under Free Trade (SPFT)	(E+F)-(G+H)	62265
	Total Policy Transfer (TPT)	(PPA-SPFT)	14299
Competitiveness Measure	Nominal Protection Coefficient (NPC)	(A/E)	1.11
	Effective Protection Coefficient (EPC)	(A-C)/(E-G)	1.19
	Effective Subsidy Coefficient (ESC)	[(A-C)+(H-D)]/(E-G)	1.21
	Domestic Resource Cost Ratio (DRCR)	(H-F)/(E-G)	0.09

@ Authors own estimates collected from Gujarat state
# The FOB prices at Mumbai port after adjusting to transport costs
$ World references prices after adjusting to transport costs

The data results proved that the castor lost its competitiveness in the international market under exportable hypothesis. The DRCR value was low indicating still India has comparative advantage in castor production when compared with global players. Other values like PPA, PPFT, SPFT and TPT were higher and positive.

Future strategy

Stagnating oilseed yields for the last two decades and an inefficient and underutilised processing sector have resulted in an uncompetitive complex India. So far, India has the technology only to extract the primary or secondary derivates from castor seed. But, there is huge untapped potential for generating the tertiary benefits from castor seeds and castor oil. The need of the hour is to upgrade our processing technology for realizing the higher per unit out prices as well as become more competitive in the international market. Even though India is the largest producer in the world but we have limited control over the international prices. India needs to develop a long term strategy mainly to capture the comparative advantage in castor production in the extremely risky environments and rainfed marginal lands.

Chapter 5

Sugar Crop: Sugarcane

The discovery of sugarcane, from which sugar is made, is derived, dates back unknown thousands of years. It is thought to have originated in New Guinea, and was spread along routes to Southeast Asia and India. The process known for creating sugar, by pressing out the juice and then boiling it into crystals, was developed in India around 500 BC. Its cultivation was not introduced into Europe until the middle-ages, when it was brought to Spain by Arabs. Columbus took the plant, dearly held, to the West Indies, where it began to thrive in a most favourable climate. India has been known as the original home of sugar and sugarcane.

India is the largest consumer of sugar and also the second largest producer in the world next to Brazil (Source: USDA Foreign Agricultural Service). India is the largest single producer of traditional sugarcane, khandsari and gur equivalent to 26 million tons raw value followed by Brazil in the second place at 18.5 million tons. Even in respect of white crystal sugar, India has ranked one in 7 out of last 10 years. In Sugar Year 2006-07 India produced 28.5 million tons and consumed 20 million tons of sugar. India has exported around 1.5 million tons of sugar after the ban on sugar exports was lifted in January, 2007. With an opening stock of 4 million tons in 2005-06, India has ended the year with stocks of more than 11 million tons.

Presently in India, about 4 million hectares of land is under sugarcane with an average yield of 70 tons per hectare. Indian sugar industry has a turnover of Rs. 500 billion per annum and it contributes almost Rs. 22.5 billion to the central and state exchequer as tax, CESS, and excise duty every year (Source: Ministry of Food, Government of India). There is a possibility that overall sugar production in the country might fall to 26 million metric tons because of low yields as farmers didn't care much about their standing crop. Earlier, most industry players and the government were expecting India's sugar production to be at least 30 million tons, 2 million tons more than last year. Though production is expected to be lower in current year, it should not affect supply as the large carryover stocks from last year will be sufficient to meet any additional demand. There are some 45 millions of sugar cane growers in India and a larger portion of rural labourers in the country largely rely upon this industry. Sugar Industry is one of the agricultural based industries. In India it is the second largest agricultural industry after textile industry.

Sugar pricing

Government of India plays a large role in determination of price of sugar as it being a necessary commodity. The Statutory Minimum Price (SMP) for sugarcane is fixed by the government according to Clause 3 of the Sugarcane Order. SMP is designed through the consent of Commission for Agricultural Coast and Prices (CACP) and respective state Governments. The following diagram (fig. 5.1) shows fluctuation of sugar price in last 15 years, taking 1994 as base year. In the last 2 years price of sugar has almost doubled and it's still increasing (table 5.1).

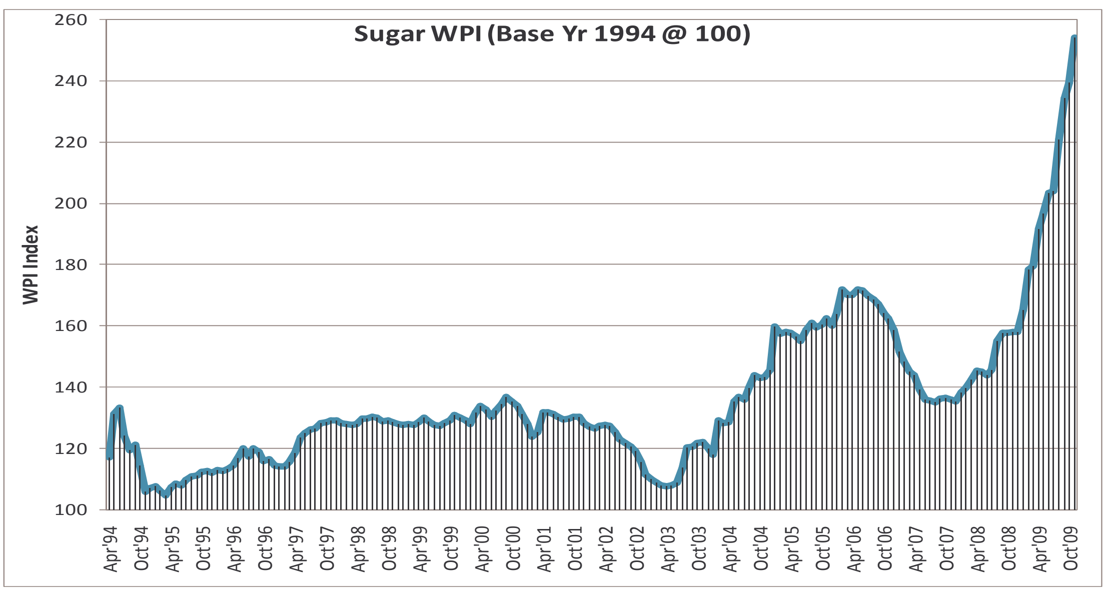


Fig 5.1 Sugar WPI

(Source: Data retrieved from www.indiastat.com)

Table 5.1 Sugarcane prices over years (Rs per Quintal)

Commodity	2005-06	2006-07	2007-08	2008-09	2009-10
Sugarcane Price	79.5	80.25	81	81	108

Source: agropedia website

Other than setting the MSP, GOI has taken some policy initiatives also for the betterment of Indian sugar industry which are the following:

- It declared the new policy on August 20, 1998 with regards to licenses for new factories saying that there will be no sugar factory in a radius of 15 km.
- It set up of Indian Institute of Sugar Technology at Kanpur to improve efficiency in the industry.
- In the year 1982, the sugar development fund was set up with a view to avail loans for modernization of the industry.

Price spirals

The following figure 5.2 depicts the movement of export and import of sugar prices. Both the prices are highly volatile and varying drastically. Most of the times, both the prices moved opposite sides.

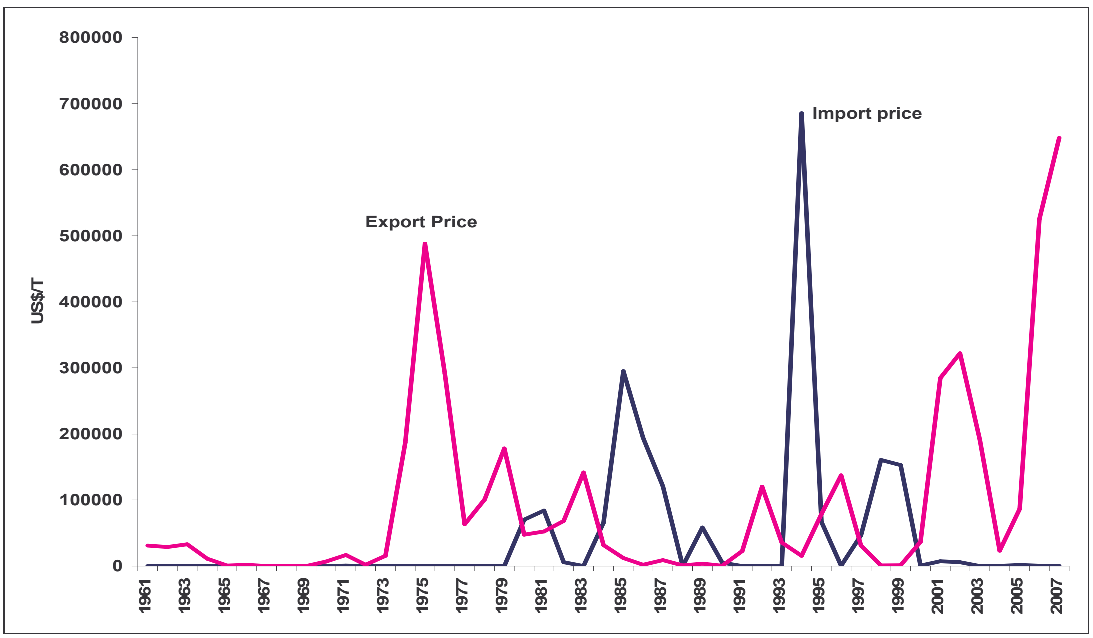


Fig.5.2 Export and import prices of refined sugar in India

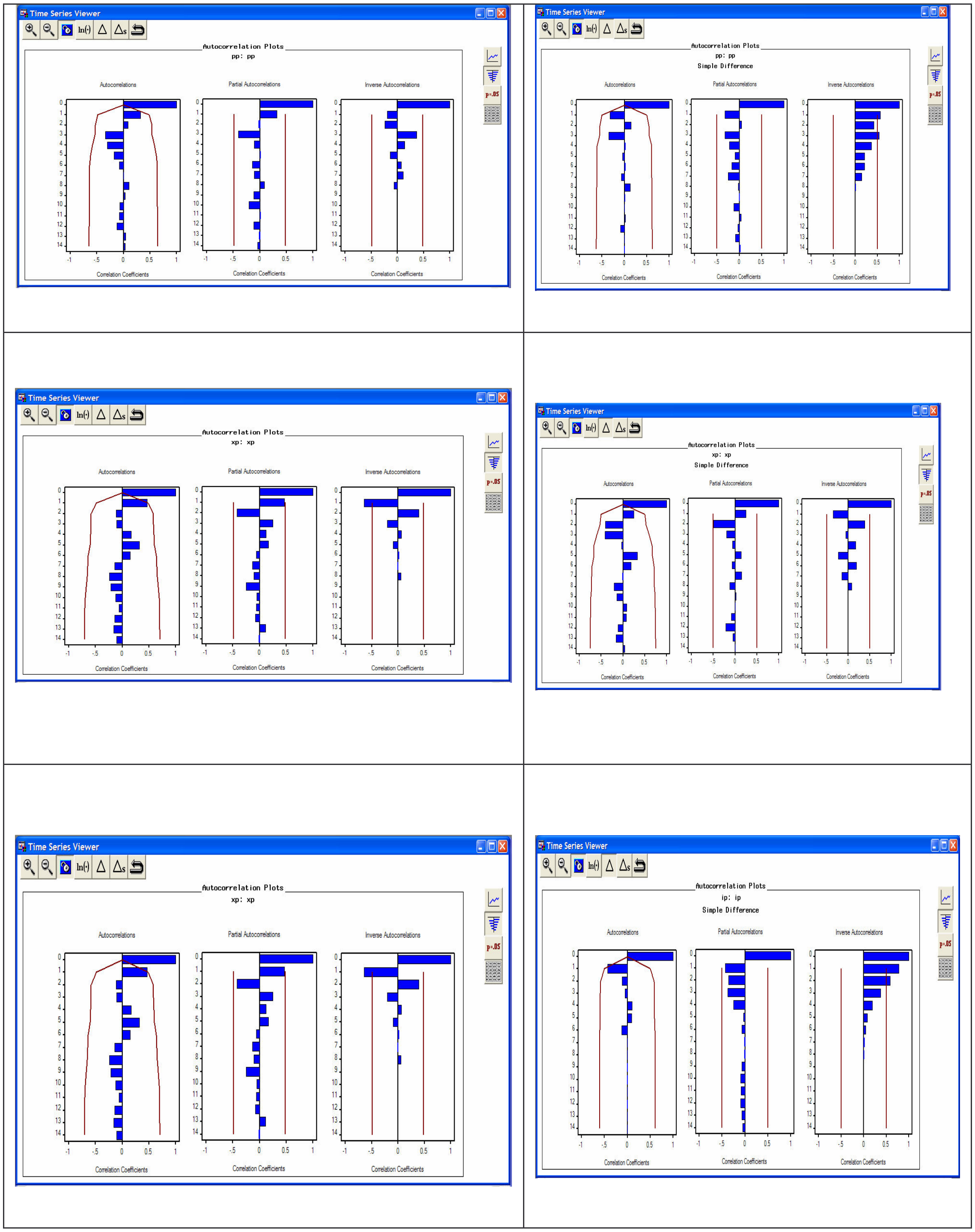


Fig 5.3 Testing Stationarity of price series

Price Integration and Transmission

Table 5.2 Testing Cointegration between different price series

Series	H0: Rank=r	H1: Rank>r	Eigen Value	Trace	5% Critical Value
Producer and Export Prices	**0**	**0**	0.3298	6.8031	15.34
	1	**1**	0.0519	0.8000	3.84
Producer and Import Prices	**0**	**0**	0.4637	13.4101	15.34
	1	**1**	0.2373	4.0632	3.84
Export and Import Prices	**0**	**0**	0.4810	14.6357	15.34
	1	**1**	0.2737	4.7972	3.84

Drift in ECM: Constant; Drift in process: Linear

Table 5.3 Granger-Causality Wald Test for long term integration

Dependant	Independent	Chi-Square	Pr > ChiSq
Producer Price	Export Price	0.67	0.7168
Export Price	Producer Price	0.64	0.7255
Producer Price	Import Price	0.18	0.9150
Import Price	Producer Price	0.39	0.8218
Export Price	Import Price	0.31	0.8553
Import Price	Export Price	1.39	0.4998

Based on the above results (table 5.2 and 5.3), it may be concluded that prices series were not integrated in the long run and not influencing each other. Export and import prices were found to be slightly integrated but influence is not significant (please see Appendix tables A.33 to A35 for VECM long and short term effects)

Varieties of Sugar:

- Granulated Sugar

  There are different types of granulated sugar, used mainly by food processors and professional bakers. They are not available in the supermarket.

- Regular Sugar, Extra Fine or Fine Sugar

  This is the type of sugar we buy at market for our home. The food processing industry describes "regular" sugar as extra fine or fine sugar.

- Fruit Sugar

  It is little finer than regular sugar and is used to make desserts and drink mixes.

- Brown Sugar- Turbinado Sugar

  It is a partially processed sugar and brown in color. Brown sugar consists of sugar crystals coated in molasses syrup with natural flavor and color. Many sugar refiners produce brown sugar by boiling a special molasses syrup until brown sugar crystals form. There other various types of brown sugar, Muscovado or Barbados Sugar, Free Flowing Brown Sugars, Demerara Sugar, Liquid Sugars, Invert Sugar

Apart from these, there are many more varieties of sugar. They vary depending on the size of the crystal/ grain. India mainly produces the granulated type, which is further classified into various types based on color and grain size. According to the Indian Standards Specifications, there are around 20 grades of sugar based on the grain size and colors. The color series has four grades designated as 30,29,28 and 27, while the grain size has five grades namely A, B, C, D, E. Bulk of production in the country is of C, D and E grains, branded as large, medium and small and has color specification of 30. The D grade produced in the country is comparable to world standards.

Sugar Industry in India

India is said to have the highest consumption rate of sugar according to the stats of USDA Foreign Agricultural Service. As was mentioned earlier also, it takes rank 2 in world production of sugar followed by Brazil. Indian sugar is produced from sugarcane, thus maximum number of the companies is found in the sugarcane growing states of India including Uttar Pradesh, Maharashtra, Gujarat, Tamil Nadu, Karnataka, and Andhra Pradesh. These six states contribute more than 85% of total sugar production in the country (table 5.4). Uttar Pradesh alone accounts for 24% of the overall sugar production in the nation and Maharashtra's contributes nearly 20% share in India. Indian sugar industry is divided into two sectors that is organized and unorganized sector.

Sugar factories belong to the organized sector and those who produce traditional sweeteners fall into unorganized sector. Gur and khandsari are the traditional forms of sweeteners. There are 453 sugar mills in India. Co-operative sector has 252 mills and private sector has 134 mills. Public sector boasts of around 67 mills. In 1950-51 the government of India made serious industrial development plans and set the targets for production and consumption of sugar. It projected the license and installed capacity for the sugar industry in its Five Year Plans. State wise industries are Andhra Pradesh Sugar Industry, Bihar Sugar Industry, Gujarat Sugar Industry, Haryana Sugar Industry, Himachal Pradesh Sugar Industry, Karnataka Sugar Industry, Madhya Pradesh Sugar Industry, Maharashtra Sugar Industry, Chhattisgarh Sugar Industry, Manipur Sugar Industry, Orissa Sugar Industry, Punjab Sugar Industry, Tamil Nadu Sugar Industry, Uttaranchal Sugar Industry, Uttar Pradesh Sugar Industry and West Bengal Sugar Industry.

India's sugar industry typically follows a 5 to 7 year cycle. And the price of sugar moves counter cyclically with production behaviour. A rise in production leads to fall in price due to excess supply leading to non payment to the farmers. It results in fall of sugarcane production in the next season, as the farmers tend to switch to other crops. Again a fall in production boosts up the price and thus profit. And the farmers switch back to sugar production in full swing. And this cycle moves on.

Table 5.4 State-wise Sugar Production Directly from Cane in India

States	1994-95	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
Assam	7	5	3	-	-	-	-	-	-	-
Andhra Pradesh	874	1182	1022	1048	1210	886	982	1236	1680	1335
Bihar	394	368	288	342	408	274	254	422	451	336
Goa	16	15	16	8	13	10	8	11	19	15
Gujarat	759	1141	1073	1056	1252	1066	797	1168	1425	1366
Haryana	343	477	586	624	636	582	400	409	652	599
Kerala	12	14	7	5	1	-	-	-	-	-
Karnataka	1225	1577	1613	1550	1868	1116	1040	1943	2660	2900
Madhya Pradesh	70	103	93	71	71	93	72	94	179	174
Maharashtra	5025	6503	6705	5613	6215	3175	2217	5197	9100	9075
Nagaland	1	-	-	-	-	-	-	-	-	-
Orissa	43	53	34	25	39	41	44	40	61	63
Punjab	319	421	496	593	587	390	315	338	486	534
Pondicherry	62	48	38	39	34	20	18	28	59	50
Rajasthan	18	14	6	5	2	10	4	6	7	6
Tamil Nadu	1859	1720	1781	1839	1644	921	1108	2142	2540	2141
Uttar Pradesh	3609	4556	4394	5260	5651	4551	5037	5784	8475	7319
Uttar Pradesh East	1012	1210	1114	1462	1980	1399	1601	2093	2823	2414
Uttar Pradesh West	1142	1503	1663	1825	1845	1700	1835	1913	2744	2432
Uttar Pradesh Central	1455	1843	1617	1973	1826	1452	1601	1778	2908	2473
West Bengal	7	3	3	5	8	7	4	5	8	5
Uttaranchal	-	-	361	444	498	387	381	426	535	400
Chhattisgarh	-	-	-	-	3	17	10	18	24	38
India	**14643**	**18200**	**18519**	**18527**	**20140**	**13546**	**12691**	**19267**	**28361**	**26356**

International Sugar Trade

The import and/or export of sugar to or from India depend on the above mentioned cyclical behavior of sugar production. Whenever there is a shortage of supply export of sugar becomes banned and in extreme case it is supported by import from overseas, similarly over supply is handled by export. Due to the recent crisis, currently almost all of the sugar imported into India is raw sugar bought by the mills for processing into refined sugar under the 'Advanced Licensing Scheme (ALS, under which, mills are allowed to import raw sugar at zero duty against a future export commitment.). It is advantageous for Indian mills as domestic sugar prices are currently well above the international prices, even after accounting for processing, transportation, and distribution costs, and future export obligations. At the same time, according to the ALS they have to re-export 1.00 ton of refined sugar for every 1.05 ton of raw sugar imported within a specified period, which is currently 36 months *(Source: USDA Foreign Agricultural Service).*

Imports

Many trade sources reports notified, about 1.35 million tons of raw sugar was imported from October 2004 through March 2005, at prices ranging from $200 to $255 per ton CIF at Indian port, mostly from Brazil and South Africa. With the recent strengthening of international prices, imports are expected to slowdown as compared to the first half of the marketing year, and SY 2004/05 imports are expected to reach 2.0 million tons (table 5.5). *(Source: USDA Foreign Agricultural Service)*.

India imposes an ad valorem duty of 60 percent on the CIF value, plus a countervailing duty (CVD) of Rs. 850 ($19.50) per ton, on 'general' imports of raw and refined sugar (tariff code 1701). The CVD is in lieu of the local taxes and fees on the domestic sugar (central excise tax of Rs. 340 ($7.80) per ton, additional excise duty of Rs. 370 ($8.50) per ton and cess of Rs. 140 ($3.22) per ton. The imported sugar is also subject to non tariff barriers like the 'levy sugar obligation', the market quota release system, and other local regulations applicable to domestic sugar. The high import duties and other non tariff barriers preclude imports of refined sugar by traders. *(Source: USDA Foreign Agricultural Service)*

Table 5.5 Import of Sugar by India

(Qty. : In Ton; Value : Rs. in Crore)		
Financial Year (April to March)	Import	
	Quantity	Value
1990-91	-	-
1991-92	-	-
1992-93	-	-
1993-94	-	-
1994-95	1765440	2245.85
1995-96	150630	215.89
1996-97	2131	3.18
1997-98	346905	470.25
1998-99	900471	1111.22
1999-00	1181183	1110.80
2000-01	30404	31.11
2001-02	26578	32.60
2002-03	41430	32.83
2003-04	74400	62.70
2004-05	932740	976.18
2005-06	558770	651.80
2006-07	0.010$	3.48
2007-08	0.005$	2.29
2008-09 (up to Dec., 08)	0.713*$	128.85*

Source: Ministry of Consumer Affairs, Department of Food & Public Distribution, Govt. of India.

Exports

India has never been a consistent exporter of sugar in the past as mentioned because of the cyclic movement (table 5.6). The sugar industries undertake exports on their own competing directly in the international market. Exports from a mill do not form part of the quota under the market quota release system. In the last five years we had exported 4.07 MMT sugar. In the last few years, India had an average exportable surplus of 6.23 million tons every year. On an average, the sugar exported was only 0.81 MMT or 7.69% of the total exportable surplus. Interestingly, the domestic prices have remained higher than international prices.

Table 5.6 Export of Sugar from India

(Qty. : In Ton; Value : Rs. in Crore)		
Financial Year (April to March)	Export	
	Quantity	Value
1990-91	2000	0.91
1991-92	82000	55.8
1992-93	365000	316.73
1993-94	119000	111.33
1994-95	39350	48.88
1995-96	434320	597.34
1996-97	667274	860.8
1997-98	173282	244.44
1998-99	12735	17.36
1999-00	12990	18.14
2000-01	338691	430.98
2001-02	1456448	1728.29
2002-03	1662370	1769.49
2003-04	1200600	1216.59
2004-05	108690	149.53
2005-06	316850	557.1
2006-07	16.36$	3055.45
2007-08	46.41$	5404.18
2008-09 (Apr.-Sept.)	31.41$	4084.36
2008-09 (Oct.-Mar.)	1.82$	308.15*

Source: Ministry of Consumer Affairs, Department of Food & Public Distribution, Govt. of India.

World Market for Sugar

Table 5.7 World Sugar Balance

	2009-10	2008-09	Change	
	(million ton, raw value)		in million ton	in %
Production	159.887	152.976	6.911	4.52
Consumption	167.134	164.316	2.818	1.71
Surplus / Deficit	-7.247	-11.340		
Import demand	52.072	48.180	3.892	8.08
Export availability	52.079	48.250	3.829	7.94
End Stocks	53.471	60.725	-7.254	-11.95
Stocks/Consumption ratio in%	31.99	36.96		

Source: ISO quarterly market outlook, November 2009

The world consumption of sugar is expected to grow at a rate significantly lower than the long term 10 year average (1.71% and 2.66%, respectively). The current lower growth of world production of sugar is attributed to impacts of the 2008-09 global recessions. Global use of sugar is expected to reach 167.134 million ton (table 5.7). The growth in global production is far too small to cover sugar consumption and the world statistical deficit is expected to reach 7.247 million ton as against 8.404 million ton projected in September, 2009.

World Scenario of Sugar Production (country wise)

Brazil: Brazil's cumulative sugar production to 15th November, 09 reached 26.181 million ton, which is up 9.82% year-on-year (UNICA). Ethanol production during the same period amounted to 20.412 billion litres, down 5.46% on the year-ago level. A much higher proportion of cane has been allocated to sugar compared to last year. Brazilian sugar exports in Nov'09 reached 2.478 million ton. A total of 1.85 million ton was exported as raw and 0.63 million ton as whites.

China: The domestic sugar production in the season 2008-09 has been 12.43 million ton and it is expected to rise by 3% in the next season. As said by China Sugar Association now sugar consumption is 13.9 million ton, up.

Australia: According to the Queensland Cane Growers Organization Ltd, which represents most of Australia's cane-growers, sugar production could rise 10% next year as farmers plant more area in response to a doubling in world sugar prices this year. Commonwealth Bank of Australia Ltd expects national production to rise 6.5% next year due to a projected 5-7% increase in cane area.

Russia: Russia is expecting imports of sugar in the year 2009-10 due to shortage of stock. In the new season, consumption is expected to exceed domestic output by 2.825 million ton. At present, the ISO forecasts the new season's overall import demand (including imports of about 200,000 ton of white sugar from the neighbouring FSU countries) at 2.650 million ton.

Recycling Sugar Industry by-products & Municipal bio-solids on cane lands:
Sugar mill by-products such as mill mud and boiler ash as well as municipal bio-solids are increasingly being utilized as value added products. A large nutrient resource of N and P are available in abundance as it gets concentrated from all the nutrients absorbed from the crop during processing of sugarcane to sugar. Various

chemicals like Sulphur Dioxide Gas, Hydrogen Sulphide and many phosphate based chemicals make these products rich in valuable plant nutrients such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg). Sugar by-products such as mill mud and boiler ash have traditionally been applied to local lands as alternatives or supplements to commercial fertilizers and/or as soil ameliorants.

Sugar industry is well placed to utilize bio-solids for fertilizer substitution because of its relatively close proximity to major bio-solid producers, and because it's major food product undergoes extensive treatment before consumption. Today, there are increasing pressures on the industry to ensure its recycling process sustainable, both from an environmental viewpoint, as well as a nutrient and economic management ones.

Reuse of these by-products has been of mutual benefit to the farming and milling sectors as well as supporting the Industry's endeavours by maintaining the environmental values. The most useful components in filter cake and bio-solids are nutrients and organic matter. However, these potential benefits can be offset if excessive applications occur, or if soil contamination results from heavy metals, pesticides, pathogens and/or weed seeds that may be relocated by these materials.

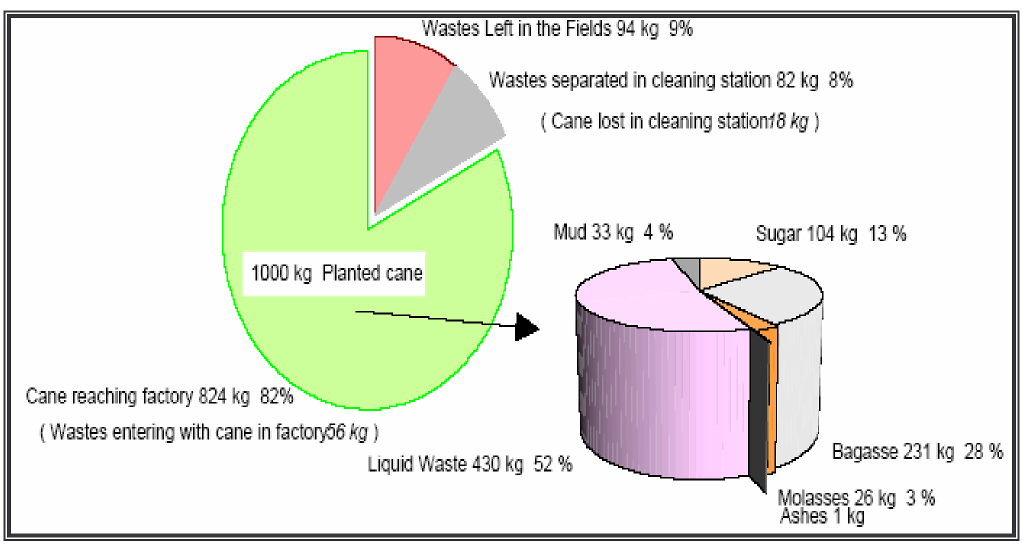


Fig 5.4 Balance of cane products and by-products of harvest and industry

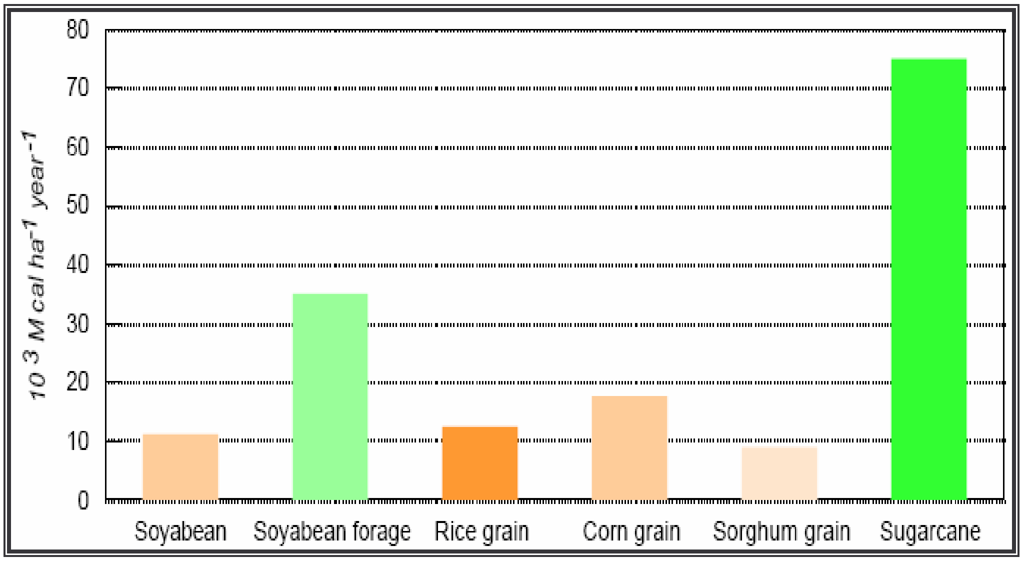


Fig 5.5 Potential calorific value produced by different crops for animal feeding

Case Study on India's Sugar Cooperative

(Model Tatyasaheb Kore Warana Sahakari Sakhar Karkhana Ltd., Warananagar, Dist. Kolhapur)

Once upon a time, a commission agent active in Kolhapur understood the market dynamics as: "Price of Jaggery fluctuates but not the price of sugar"**.** With this understanding, visionary Tatya Saheb Kore came up with the solution that to hedge against market risk, farmers will have to upgrade their marketing potential from sugar cane to sugar and gave the birth to Warna Sugar Cooperative.

Warna is traditionally known for the sugar cane cultivation and conversion of sugar cane to Jaggery and selling it in to the nearby developed market of Kolhapur. In 1950s, Jaggery price crashed badly and caused huge loss to the producers and also affected the sugarcane growers. The impact was such that farmers couldn't even recover the cost of production. In dejection farmers burnt their standing sugar cane in the farms. Tatya Saheb Kore took it as a challenge. In 1953, he started collecting money from the farmer's on equity basis and tried to raise the debt from other sources. He was successful to get the agricultural loan from Kolhapur Bank but not from ministry of finance, Maharashtra. He was supported by Vikhe Patil and Ratnappa Kumbhar. Under the mentorship of Y. B. Chavan, commissioned the plant and inspired educated people to join him. To put the quality upfront imported machineries from Buck Wolf Co.

This new avenues pumped in lot of enthusiasm to farmers in the nearby region. Huge employment was created in the sugar factory, which further improved the social economy of Warna. Tatya Saheb Kore could understand that sugar factory cannot stand alone; it should be supplemented by other allied activities. He took advantage of market linkages. He established poultry and dairy cooperatives. To complete the chain of development and promote saving, Warna Bank was established. Warna Co-operative Complex is one of the finest examples of successful integrated rural development resulting from co-operative movement through people’s participation. It links 25 co-operative societies, having a turnover more than Rs. 600 crores. The sugar factory and people of the cooperative keep the belief in empowering and raising awareness of the farmers. It keeps on holding seminars and workshops for the farmers of the nearby region. Tatya Saheb Kore Warna Co-operative sugar factory has got Union Commerce and Industry Ministry's "Star export house grade". Warna sugar factory is the first in the country to earn such an honor. The factory exported sugar about 12 lakhs and 11 lakhs quintal in the current and previous years respectively. Since last two years, the factory has done export business of about Rs 250 crore after abiding all criteria of excise and customs departments. Warna factory earlier won the awards of the national federation of co-operative sugar factory at Delhi.

In the current days, Warna is a vibrant economy with all possible infrastructures available. Moreover, Warna Sugar Factory got hands on experience in turning out loss making regional sugar mills and continuously helping out other factories in their performance improvement activities.

Warna Sugar Cooperative – Sugar Cane Production

Tatya Saheb Kore Sakhar Karkhana Ltd at Warna Nagar has under it 69 villages of operation area 10,800 Ha of land under producing sugarcane, in the year 2009-2010. Various cane development schemes are implemented by the sugar factory to increase the yield of sugar cane with minimum input.

Sugar factory supply and helps farmers with:

1. Chemical Fertilizers: Distributed at MRP on credit basis
2. Pesticides: Distributed at 60% subsidy on credit basis
3. Micro Nutrients: Distributed at 25% subsidy on credit basis
4. Herbicides: Distributed at 15% subsidy on credit basis
5. Spray Pump: Distributed at subsidy of Rs. 300.00 on credit basis
6. Sugar Cane Seed: Warna Sugar Cooperative has implemented three tire nursery programs to provide quality sugar cane seed to farmers. They purchase foundation seed from the breeder seed farms of “Vasantdada Sugar Institute, Pune” and “Central Sugar Cane Research Centre Padegaon”. These seeds then reared at the farm of progressive farmer selectively and then distributed to the farmers on credit basis.

   Currently the major varieties of sugar those are produced in this region are:

   - CO86032, COC 671 and COM 265

   And the minor varieties are:

   - CO8014, COVSI9505 and CO7527
7. Seedling Schemes: Sugar cane plant seedlings are done in plastic bag and sold in large scale. In the last two years, about 10 lakhs sugar cane plant seedling is distributed through the plant nursery, which is less then the actual demand. The benefits are improved yield, reduced transportation cost and it also created job for woman in villages.
8. Press Mud Cake: Bio Earth compost prepared by using press mud cake, cane yard waste, Bagasse, Ash, Spent wash etc, and fermented by using which is enriched with Bio-fertilizer like Azotobactor PSB Culture and Decomposing Culture. Also, Vermi compost, distributed to the farmers at the rate of production cost
9. Green Mannering: Sun Hemp and Dhencha Seeds distributed at 50% subsidy on credit basis to improve the health of the soil.
10. Bio Fertilizers: Sugar cooperative have bio fertilizer laboratory and is producing bio fertilizers like Acetobactor, Azotobactors, PSB Culture, Decomposing Culture Tricoderma and EM solution. Bio fertilizers are important for the health of soil as sugar cane is high nutrients exhausting crop. Use of Bio-Fertilizers leads to biological nitrogen fixation, mobilization of

phosphorus and sulphur etc. Sugar cooperative gives 15% subsidy to promote its usage by farmers.

11. Irrigation Schemes: There are 11 big irrigation schemes (for more then 200 Ha area) and 38 small irrigation schemes (for more then 50 Ha area) in the area of operation under the management of sugar factory.

    Drip Irrigation:

    Due to high temperature in surroundings and irregularity of rainfall, water level is going down. To increase the efficiency in water utilization, improved techniques of water management are required and in this line “Drip Irrigation” is the best alternative technique adopted by the progressive farmers. It helps to apply minimum quantity of water which is sufficient for healthy growth of plant and easy way to apply fertilizers at the root of the cane, which in turns increase the efficiency.

    As per available data of 2009, 300 Ha are under the drip irrigation system. To promote its usage, a subsidy of Rs. 4,000 to cooperative members and Rs. 3,000 to non members is given by sugar factory.

12. Soil testing laboratory and technical guidance: Sugar Cooperative owns soil testing laboratory and checked more then 2000 soil samples free of cost. Soil testing results are incorporated in technical guidance for the proper and balanced fertilizer usage. It helps farmers in two ways, first saves the cost of chemical fertilizers, might have been used in excess and secondly, maintains the soil productivity and high yield of sugar cane brings more returns to the farmers. Technical support team also arranges seminar’s lecture of scientists to provide additional information about recent research regarding sugar cane cultivation.

13. Warna Wired Village Project: Its first of its type in Asia, which helps farmers to access information at the village centre offices for tonnage of cane supplied, cane bill and credit balance of fertilizers etc.

Payment Structure

Warna Factory has always been named for its payments. It has almost throughout being paying more than that is decided by the GOI as MSP. The SMP is decided on the basis of recovery. According to the GOI rule, 10% of the recovery has to be sold as levied sugar. In the year 2009-10 SMP was removed and FRP (Fair Reasonable

Price) was introduced. It's like, for the first 10% of recovery, Rs 1289.40 PMT and then for each percentage Rs. 136 PMT. The farmers are mainly paid in instalments. Although price has been fluctuating a lot in every year due to fluctuating production cycle, the factory has mostly managed to pay an amount above the MSP suggested by the GOI (fig. 5.6).

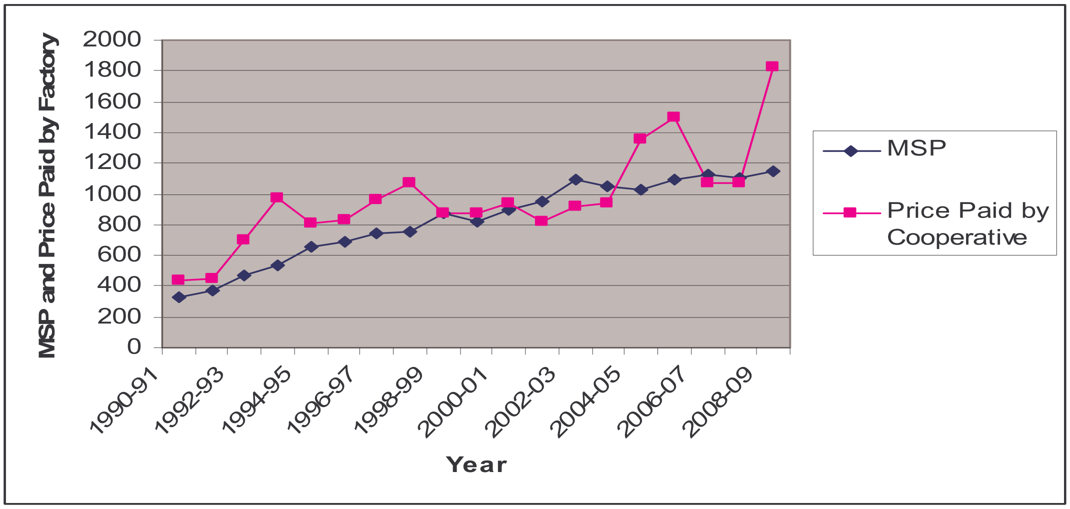


Fig. 5.6 MSP and Price paid by the factories over the years

The sugar mills also get subsidies from both the Central and the State Govt. on export of sugar. It gets and amount of Rs. 135 PMT from the Center and Rs. 100 PMT from the State. In the current year our country banned sugar export and at the same time it had to import sugar, but no duty was charged on such import. The sugar mills are supposed to keep some sugar unsold as buffer stock. They get the buffer maintenance cost from the govt. and also the cost of insurance. Import and export of sugar varies according to sugar production and is decided by the GOI.

Per acre cost of cultivation of Sugarcane

The approximate cost of cultivation of sugar cane is calculated with the average data from the interview of few progressive farmers at Warna Nagar (see table 5.8).

Table 5.8 Cost of cultivation of sugarcane

S. No.	Operation	UoM	Unit	Unit Rate	Cost per Acre
1	Field Preparation and Cleaning	Hrs	4	1400	5,600
2	Seeds	tonne	4	2500	10,000
3	Fertilizer				
3.a.	Urea	Bags	10	250	2,500
3.b.	DAP	Bags	8	495	3,960
3.c.	Potash	Bags	4	231	924
3.d.	Micronutrients	Bags	2	300	600
4	Pesticides		1	400	400
5	FYM		1	4000	4,000
6	Irrigation		1	5000	5,000
7	Rental Value of Land	Rs	10%	500,000	50,000
8	Family Labor	Hrs	200	100	20,000
					102,984

Here the rental value of land is calculated on the opportunity cost of selling the land at the rate of 5 lakhs per acre and keeping that money in the bank for the annual return of 10% per annum. Also, the family labor is considered 200 labor hours per acre of the land per cultivation. Based on the above cost of cultivation per acre and the possible average yield, cost of sugar cane cultivation per tonnage is calculated in the table 5.9.

Table 5.9 COC of sugarcane (based on yield per acre)

Average yield per acre	Cost of Cultivation per tonne
Tonne	Rs/Tonne
100	1,030
95	1,084
90	1,144
85	1,212
80	1,287
75	1,373
70	1,471
65	1,584
60	1,716
55	1,872
50	2,060
45	2,289
40	2,575

If we compare the current year actual price paid to the farmers at the rate of Rs 2,300 per ton is nearly about at the yield of 44.8 ton per acre. Whereas, average yield recorded is about 60 tons per acre and hence the profit margin of Rs. 584 (=2300-1716) per ton i.e. about 34% of the profit margin. It is market driven and a perfect example of distribution of market benefit to the farmers. The price to the farmers paid in various stages (4-5) and it assures that all benefit that is realized at the end of the year gets distributed to the farmers through bonus or festival gifts. We summarize the farmers' willingness and perspective to grow sugar cane in the SWOT analysis.

Farmer's perspective: Why to grow Sugar Cane?

To understand this SWOT analysis of sugar farming was attempted with the perspective growers. The summary of that is presented below:

<table>
<tr>
<td>Strength

1. Developed cooperative structure

2. Assured benefit of market and Price confirmation, whereas growing vegetable and floriculture is risky because of lacking infrastructure and problem of moral hazards of externalities in lieu of cooperative setup

3. Larger land holder get economy of scale on sugar, as it require less maintenance and the crop is for the long duration

4. Harvesting and other facilities provided by Sugar Factory acts as a guiding factor and allow remote farming as well</td>
<td>Weakness

1. On repetitive production of sugarcane soil productivity goes downward. Crop rotation is the solution of this problem

2. Future adaptability is difficult for labor intensive farming as farmer get lazy because of the very less requirement of labor to produce sugar cane</td>
</tr>
<tr>
<td>Opportunity

1. Dairy business got the forward linkages with sugar cane top as fodder

2. Intercropping benefits – Soya bean, Ground nut, sunflower and other dwarf varieties can be included in farming for land conservation and productivity enhancement

3. Technical influence and decision making may bring more returns to the farmer

4. Tetra-pack may bring excellent marketing opportunities, if success</td>
<td>Threats

1. Price Discovery: Similar to other Agri Commodities, price discovery and suitable action is very difficult because of its long cultivation period and it adversely effect farmers

2. Pest attack: In the past attack of White mil bungs and white grub has completely destroyed the crops</td>
</tr>
</table>

It is evident from the SWOT analysis that backward and forward linkages of the sugar co-operative make it most profitable venture for the farmer but for its sustainability, a change is required to explore the opportunities identified and to take proactive majors for the threats found.

Tatya Saheb Kore Warna Co-operative sugar factory at Warnanagar in the district has got Union Commerce and Industry Ministry's **"Star export house grade"**. Sugar factory chairman Shobhatai Kore mentioned that the factory achieved this ranking due to its remarkable works and progress in export sector in last few years. Warna sugar factory is the first in the country to earn such an honour, she said. The factory exported about 12 lakh and 11 lakh quintals of sugar in the current and previous years respectively. Since last two years, the factory has done export business of about Rs 250 crore after abiding all criteria of excise and customs departments. According to Miss Kore the factory should get a three star grade next year. Warna factory earlier won the awards of the national federation of co-operative sugar factory at Delhi.

Sugar manufacturing process

WARNA sugar factory has the capacity of 4500MT per year of raw sugar and also used to produce other products from sugar cane. Factory is made up of a range of industrial plant such as boilers, storage and processing vessels, crushing and hammer factory and a large range of maintenance equipment. Factory operates in two distinct modes, crushing and non-crushing, both of which introduce a range of specific and general hazards to employers, workers and others. In essence, a sugar mill can be broken into the following processes (see fig. 5.7).

a. **Cane handling:** Canes are transported by either tractor or bullock cart to the factory premises. In the premises using gravity Weighment system, Weighment is done and unloaded at the feeding section. By the usage of lifting mechanism, it get loaded on the millers.

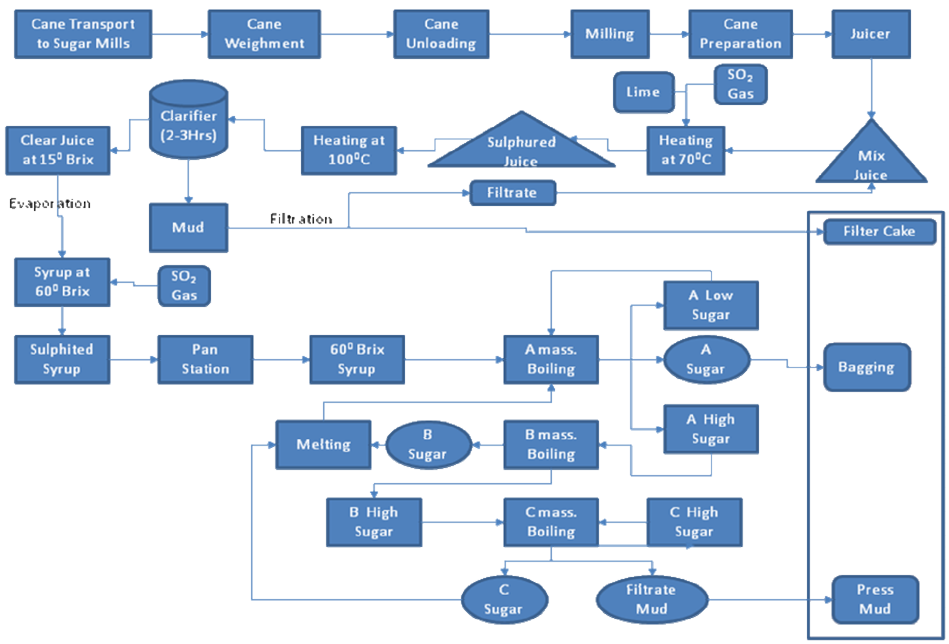


Fig. 5.7 Sugar Manufacturing Process

b. **Milling:** The milling process involves the initial breaking of cane into its primary fibers by a large hammer mill (shredder). Shredders consist of a number of large hammers attached to a rotor by swing rods which are then driven at around 1200 revolutions per minute (rpm). The canes are shredded by smashing them between the hammers and the grid bar (a hard set of plates on one side of the shredder) breaking them into individual strands of fiber. This fiber is then processed through a series of crushing factory to extract juice. Mill rollers exert huge forces on the shredded cane which is fed through them via a vertical chute. The pressure between the rollers is large enough to break down the cell structure of the fibers so that the sucrose can be extracted from juice. Juice contains a large amount of water which is removed or reduced in subsequent processes. The remaining fiber is then burned in a boiler to produce steam which drives most mill processes.

Extraction of as much of the sucrose as possible is a key element in milling. Factory uses a number of methods to aid sugar extraction which includes the application of hot water (around 95˚C) to the fiber within the mill set, a series of crushing mill sets (the milling train) and reapplication of mixed juice and water (maceration) throughout the milling process.

c. **Clarification/evaporation:** The clarification/evaporation stage executes a number of functions such as:

I. Mixed juice incubation

II. Adjusting PH by addition of lime

III. Heating

IV. Addition of Lime and flocculant (Sulphur Dioxide): Lime and flocculant are usually added to the juice as slurry. A subsider then removes heavy contaminants from the juice. Subsiding, the process of allowing heavy materials to sink or fall to the bottom, usually removes the majority of dirt and the chemical mud formed from the reaction between the phosphate in the juice and the added lime from juice. The mud is then spread across a moving filter (a rotary drum filter) and 'washed' to leech out any remaining sucrose before removal from the factory. Mill mud is a nutrient rich product which is normally returned to the field.

V. Addition of anti-scale chemicals

VI. Removal of mud and heavy contaminants

VII. Reduction of water levels in the juice.

VIII. Heating

The effect stage consists of a number of evaporators (large kettles) in series that boil the juice to reduce the water content. Effects are constructed in a particular pattern using multiple effect evaporation. Vapor produced from each vessel is used to boil the juice in the subsequent vessel at a lower pressure making maximum use of the energy initially put into the first vessel as low pressure steam. The latter effects in the set are operated at a vacuum in order to reduce the boiling point. The final product from the effect stage is usually known as 'liquor' or 'syrup' and is a dark gold colored liquid.

Dependent on juice properties heating surfaces within the effects and contact heaters are prone to contaminant build up (scale) which reduces heating efficiencies and after a period needs to be removed.

d. **The pan stage:** The pan stage is a similar process. In this a pan boils off additional water. The main function of the pan stage is to produce sugar crystal from the liquor. In order to increase the speed of this process the pan stage operates in a manner which utilizes 'seed crystal' and a combination of products with varying levels of sugar content to produce a range of crystal sizes and hence qualities. The pan stage has many storage tanks such as receivers (tanks which receive product from the pans), crystallizers (a series of tanks and stirrers which cool the product from the pan stage resulting in additional crystal growth before fugaling) and large transfer pipes and valves.

e. **The fugal stage:** A fugal is a large electric centrifuge which spins up to 1200 revolutions per minute (rpm) dependent on its function and stage of operation (while filling batch fugals only turn at around 50 rpm). There are two types of centrifuge in use within sugar factory, high grade centrifuges (usually batch, but sometimes continuous) and low grade centrifuges which are continuous. Continuous fugals maintain a constant flow of product through them while batch fugals fill, operate and then discharge the final product. The fugal stage removes the remaining liquid product which surrounds the crystal, washes the crystal and delivers it into the final sugar system through a series of conveyors and a drier. The material removed during the centrifuge process is known as molasses and transferred to Distillery Unit for Alcohol and other product manufacturing.

f. **Final sugar:** Finally, the sugar crystal is dried and moved to large storage bins awaiting transport to sugar terminals or other areas (such as refineries). Driers are large cylinders which are fluted and rotate to pass the crystal through at an even rate whilst dry air is applied via ducted fans or large air conditioners. Moisture levels and sucrose purity are important measures for sugar quality.

By products

Molasses, press mud and Bagasse are the three important by-products of the sugar industry. For every 100 lakhs ton of sugar produced, by products produced are:

- Molasses - 45 lakhs ton
- Press Mud - 32.1 lakhs ton
- Bagasse - 333 lakhs ton

Waste water and fly ash are also produced during the manufacture of sugar. As Bagasse, molasses and press mud are gainfully utilized; they do not cause much environmental pollution though they are potential pollutants unless disposed off.

Competitiveness

India is the world's largest producer of sugar and sugarcane. About 350 lakh farmers are engaged in the cultivation of sugarcane. India has about 4 million ha of land under sugarcane but the average yield is only 70 tonnes per ha. At present the per capita consumption of sugarcane based sweeteners in India is about 24 kg per person per annum. Of these sugar accounts for 15 kg and gur and khandasari 9 kg. The production of sugar in India follows a three-year cycle with the output peaking in one year and declining in the next two years.

Table 5.10 Comparative advantage and competitiveness of Indian sugar

A. NPC of sugar for major states in India under importable and exportable hypothesis

states	1990 Importable	1994 Exportable	1995 Importable	1990 Exportable	1994 Importable	1995 Exportable
India	1.052	1.42	1.251	1.73	0.985	1.28
A.P	1.055	1.42	1.264	1.76	0.993	1.30
Gujarat	1.05	1.44	1.24	1.75	0.964	1.27
K.A	1.052	1.42	1.237	1.68	0.974	1.25
Maha	1.058	1.41	1.247	1.71	0.983	1.27
T.N	1.056	1.42	1.253	1.73	0.985	1.28
U.P	1.051	1.44	1.261	1.78	0.995	1.32

B. Domestic Resource Cost Ratio of sugar for India and major states

states	1990 Importable	1994 Exportable	1995 Importable	1990 Exportable	1994 Importable	1995 Exportable
India	0.783	1.144	0.68	1.019	0.59	0.807
A.P	0.801	1.177	0.841	1.263	0.601	0.821
Gujarat	0.774	1.141	0.487	0.745	0.495	0.691
K.A	0.549	0.757	0.611	0.868	0.536	0.706
Maha	10.997	1.420	0.587	0.864	0.455	0.617
T.N	0.679	0.983	0.691	1.014	0.569	0.765
U.P	0.798	1.192	0.834	1.277	0.695	0.966

Nominal Protection Coefficients calculated by Gupta (1999) for the years 1990, 1994 and 1995 suggests that none of the major producing states was competitive in sugar under exportable hypothesis (table 5.10 A & B). Even under importable hypothesis the states were very marginally import competitive only during 1995. However, considering wide fluctuations in the market such marginal competitiveness may not be adequate. Under importable hypothesis DRCR did indicate that states such as Gujarat and Karnataka are import competitive in producing sugar. The NPCs computed using data for 1998 for firms processing the by-products of sugar suggests that under exportable hypothesis none of the unit is competitive. Under importable hypothesis also NPC showed a marginal competitiveness for most of the firms.

Chapter 6

Spices: Cumin (Jeera)

Cumin seed is native of Egypt which is now mainly grown in India, Middle east (Iran, Turkey, Syria), China, North Africa (Morocco) and Latin America (Chile, Mexico). It is widely used as spice and for medicinal purpose all over the world. There is also black cumin mainly found in Iran but its availability is limited and more costly than regular cumin and known for its medicinal use. India is the largest producer, exporter and consumer of cumin seed with Syria, Turkey and Iran being main competitors. Being a rabi crop sowing period is from October and continues till the first week of December and the crop is harvested from February onwards and main arrivals in market are during March-April. Generally cumin crop gets matured in 110-115 days. In Syria the harvesting period is June-July whereas for Turkey it is July-September and Iran June-August so India remains the major supplier to the world market till the crop of its competitors arrives. India consumes 90% of its total output whereas Middle-East producers exports around 85-90% of their cumin production. The estimated world production is around 300000 mt with India contributing bulk of it in the region of 200000 to 220000 tons.

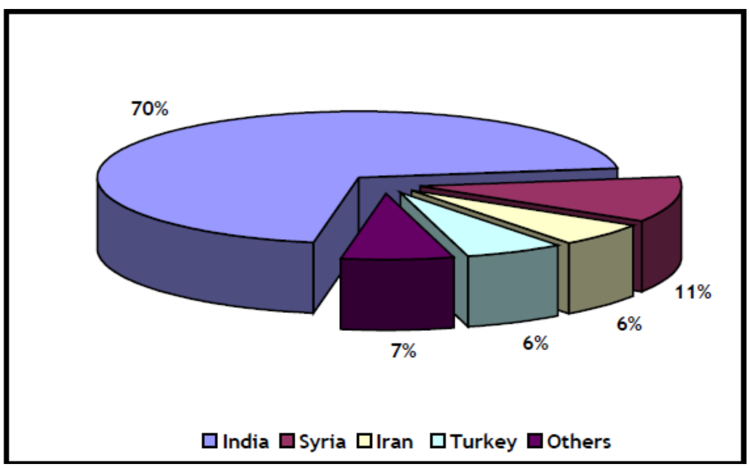


Fig 6.1 World major producers and their shares

India contributes about 70% of world production followed by Syria 11%, Iran and Turkey 6% respectively (fig 6.1 & 6.2). The major consumers of jeera are China, Indonesia, UAE, UK, US, Singapore, Malaysia, Bangladesh and Nepal besides India. The global consumption of jeera seeds is quite low, except in India and Middle East.

Consumption in the rest of the world (excluding India) is low at below 60,000 tons. Jeera essential oil is also becoming popular in the western hemisphere.

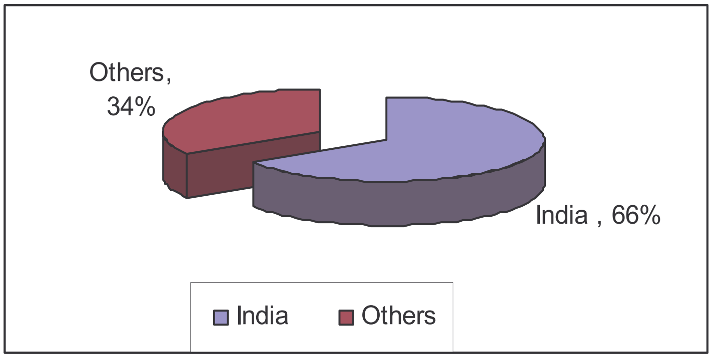


Fig 6.2 India's share in global consumption

Cumin seed India scenario

Table 6.1 Area, Production and Yield of Cumin in India

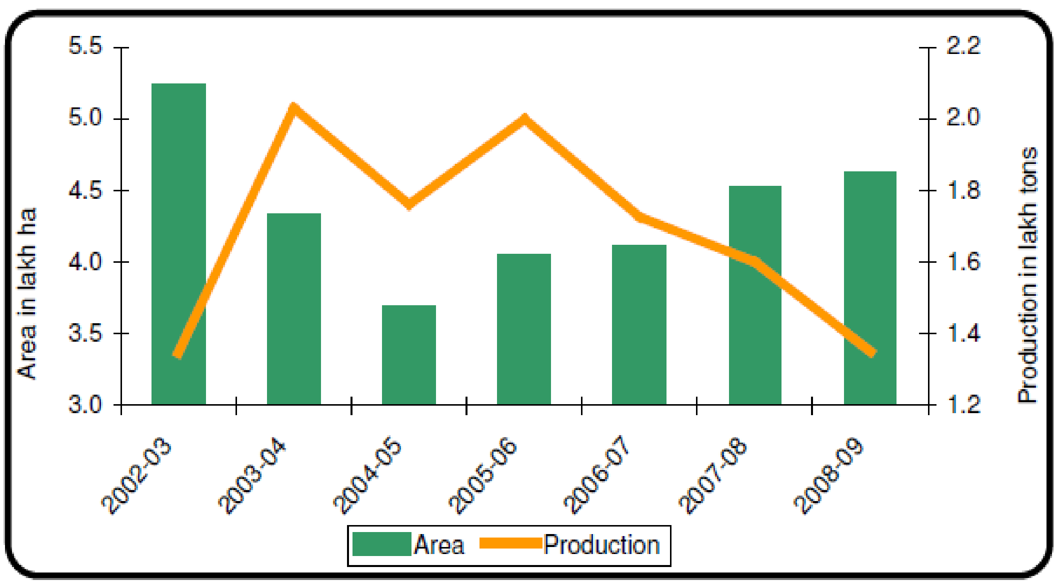
Year	Area (Hect.)	Production (Tonne)	Yield (Kg/Hect)
1975-76	86880	28170	324
1976-77	128426	48798	380
1977-78	158009	84727	536
1978-79	180549	79116	438
1979-80	165887	78376	472
1980-81	165305	89155	539
1981-82	80867	43177	534
1982-83	135576	62740	463
1983-84	149917	88315	589
1984-85	102400	54213	529
1985-86	73629	35475	482
1986-87	80743	41606	515
1987-88	110013	49745	452
1988-89	223493	114440	512
1989-90	150493	46874	311
1990-91	131720	71780	545
1991-92	163575	64884	397
1992-93	313895	135189	431
1993-94	420755	166524	396
1994-95	282027	118877	422
1995-96	220343	75250	342
1996-97	307046	117122	381
1997-98	288832	115344	399
1998-99	264018	107858	409
1999-00	247431	70809	286
2000-01	315781	139356	441
2001-02	526634	206410	392
2002-03	521250	134753	259

Source: Indiastat, 2010

Gujarat and Rajasthan are the major jeera producing states in India (table 6.1). Uttar Pradesh and Madhya Pradesh produce small quantity of jeera. In the country, about 15 to 20% of the total output is exported and rest is consumed internally. Jeera is the fourth largest spice exported from India after chilli, pepper and turmeric. In terms of quality and value, it accounts about 7% and 6% respectively. It has been exported in the form of jeera seed, powder and oleoresin. The details of area, production and yield of cumin from 1975-76 to 2002-03 is presented in table 6.1.

Recent production trends

The area under jeera is about 4.3 lakh ha. per annum (fig 6.3). The output is about 1.5 lakh tons of jeera seed annually. The output is not consistence and subject to area under the crop (which is subject to prices) and yield (which is vulnerable for weather conditions). Rain, dew or rise in temperature can play spoilsport for the crops. In addition to this, pests and diseases have an influence on the production. The crop normally arrives into the market in February and March.



Source: Spice Board of India, 2010

Fig 6.3 Area and production of Cumin seeds

Jeera varieties

Improved varieties like S-404, MC-43. Gujarat Jeera-1 (GC-1), GC-2, GC-3, RS-1, UC-198, RZ-19, etc., evolved by Agricultural Universities of Gujarat and Rajasthan having higher yield potential are useful for cultivation. The maturity varies between 110 and 115 days depending on the variety.

Jeera crop calendar

Country	Sown	Harvest
India	Oct-Dec	Feb-Apr
Syria	Mar-May	June-Sep
Turkey	Mar-May	July-Sep
Iran	Mar-May	July-Sep

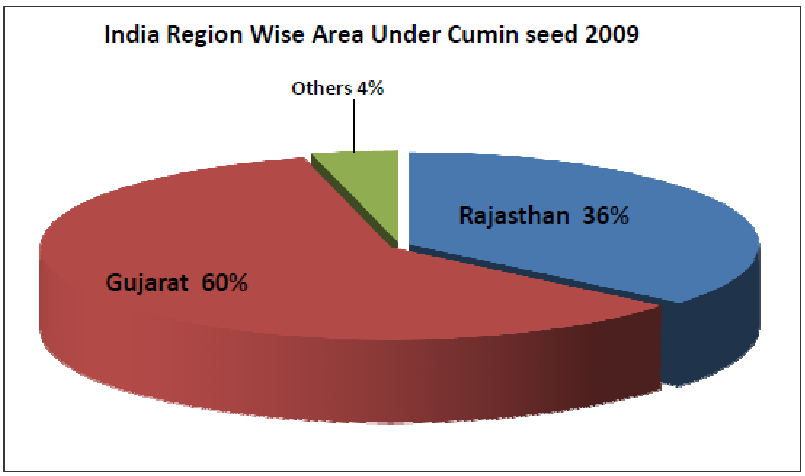
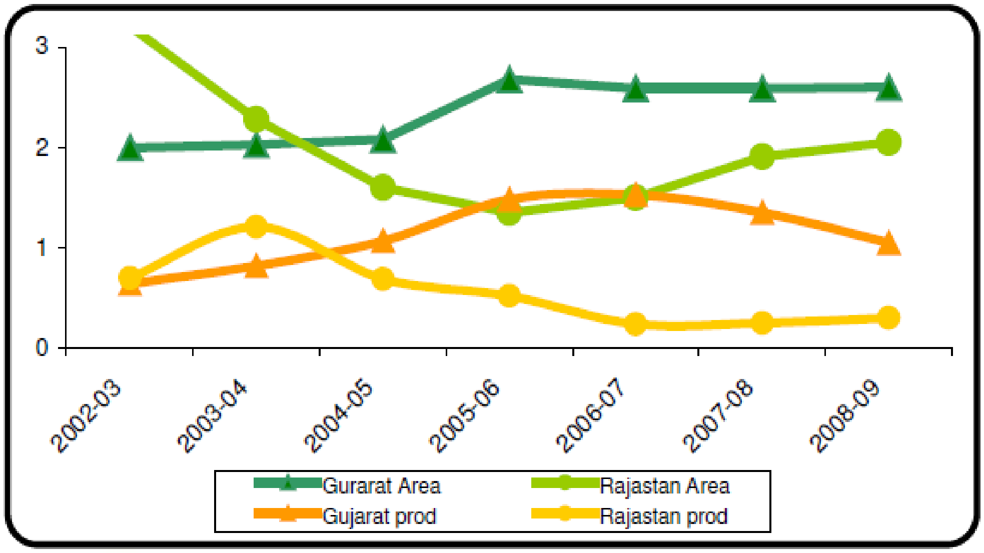


Fig 6.4 State-wise area, production of Cumin seed production

Area under jeera is persistently declining in Rajasthan since 2002-03 onwards, as the crop is highly vulnerable to weather condition in the state and the yield is less (fig.6.4). With this, the output has also taken a hit and ruled at 0.3 tons in 2008-09 compared to higher output in 2003-04 of about 1.2 tons. On the other hand, Gujarat state has witnessed continuous increase in acreage and output. The state has average area and output of about 2.36 lakh ha. and 1.13 tons respectively during the period between 2002-03 and 2008-09.



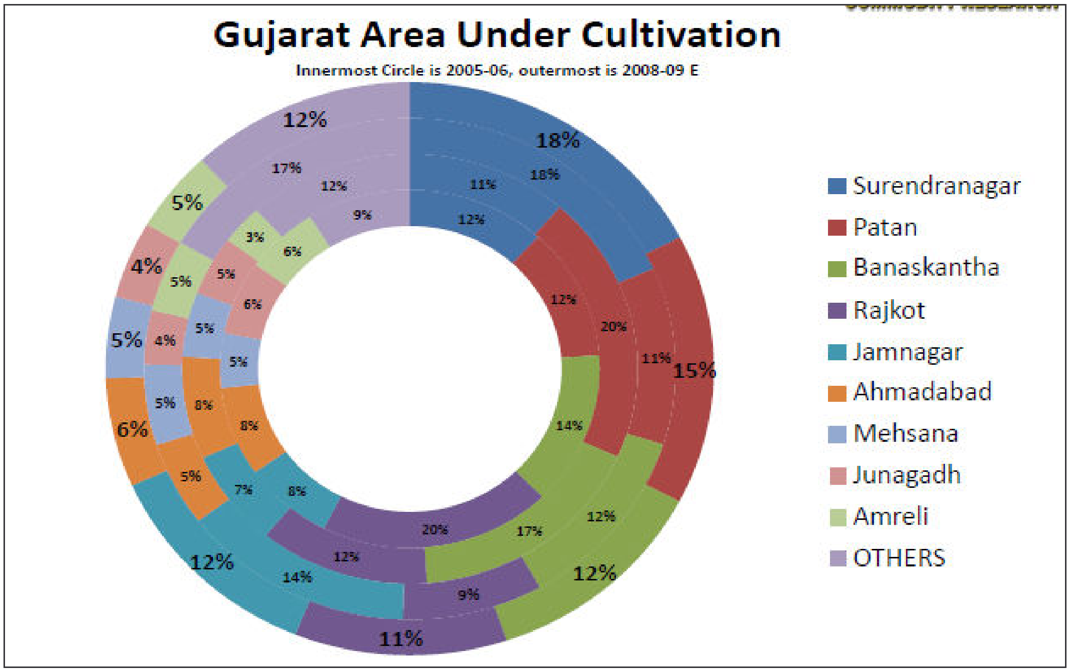
Source: Spice Board of India, 2010

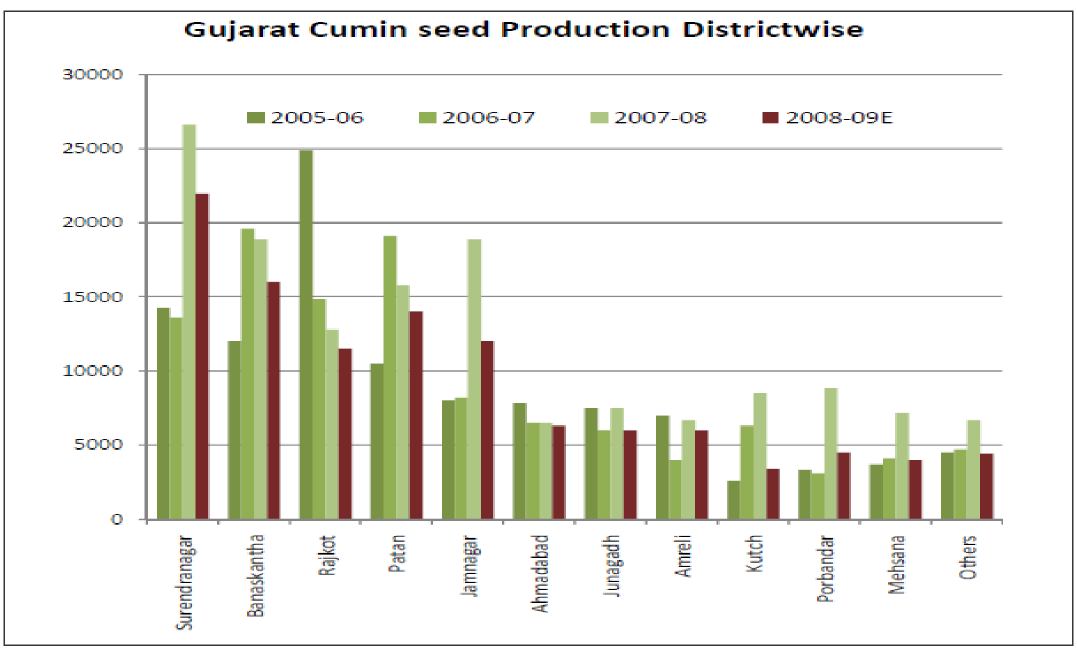
Fig 6.5 State-wise Area (lakh ha), Production (lakh tons) of cumin seeds

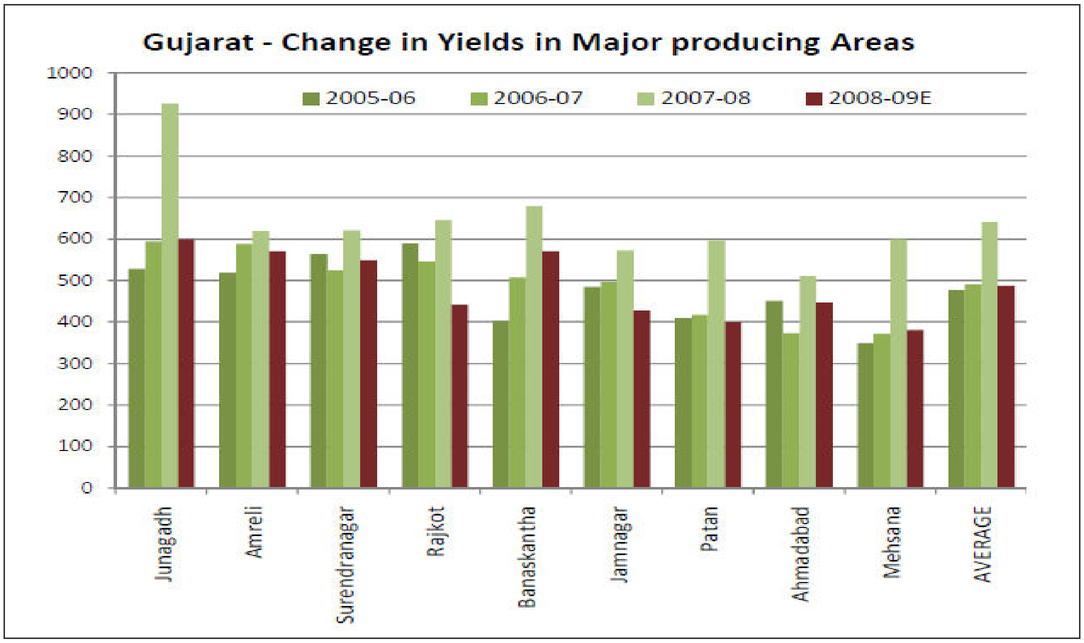
Based on the prices levels, crop shifting will take place for jeera with other crops such as cotton, fennel, isagbul. This happens in both the state of Gujarat and Rajasthan (fig. 6.5). The quality of jeera from Rajasthan is better than that of Gujarat, but due to high stalk its price is usually lower than that of Gujarat. The variation in prices due to color and visibility of ridgelines also makes difference. The produce from the North Gujarat fetches higher prices due to strength and longetivity of the seed. The produce from the Saurashtra region generally fetches lower prices as the short duration crop (hybrid variety) is grown here in two and half month (while it takes generally three and half months for other varieties) and the seeds remain thin with dull color.

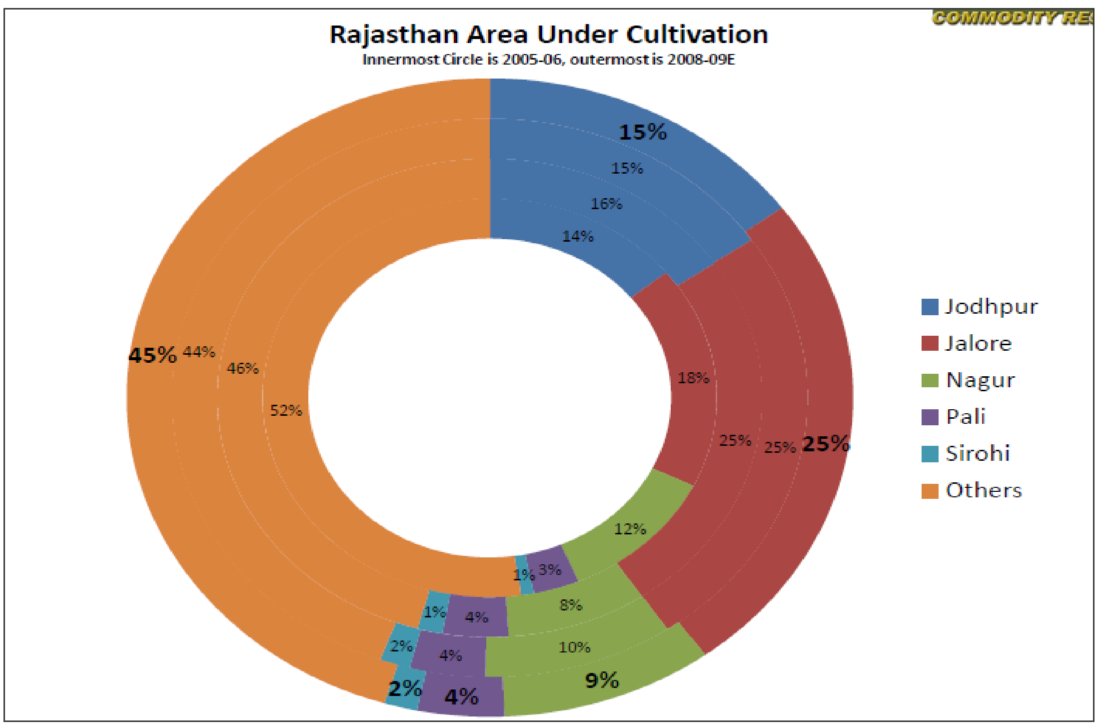
District-wise Cumin seed area, production and yield

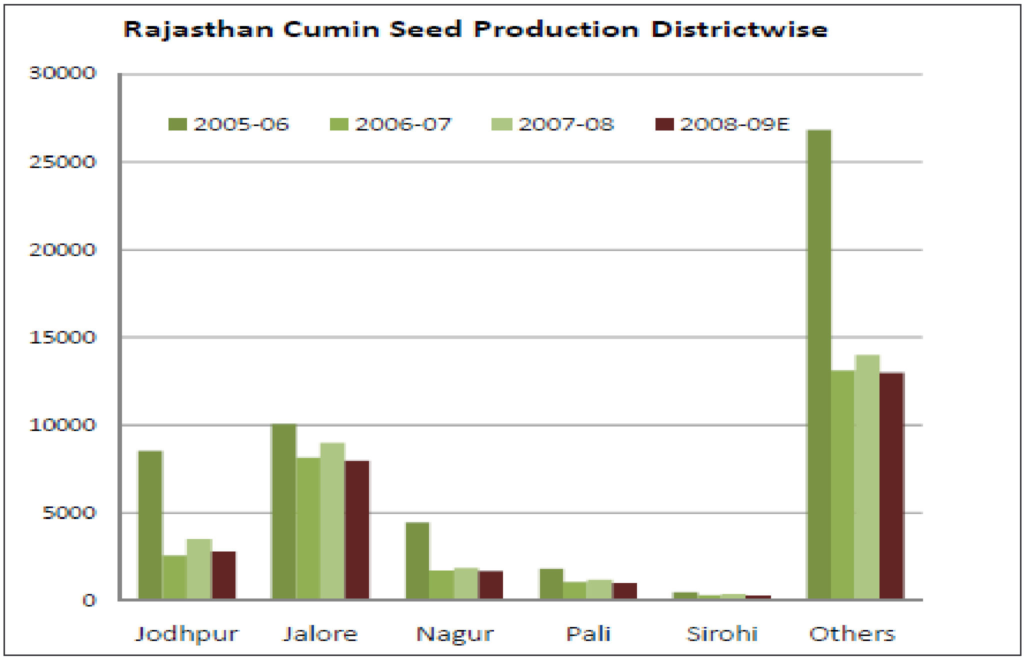
District wise cumin seed area, production and yield in the two major growing states are presented in the following diagrams:

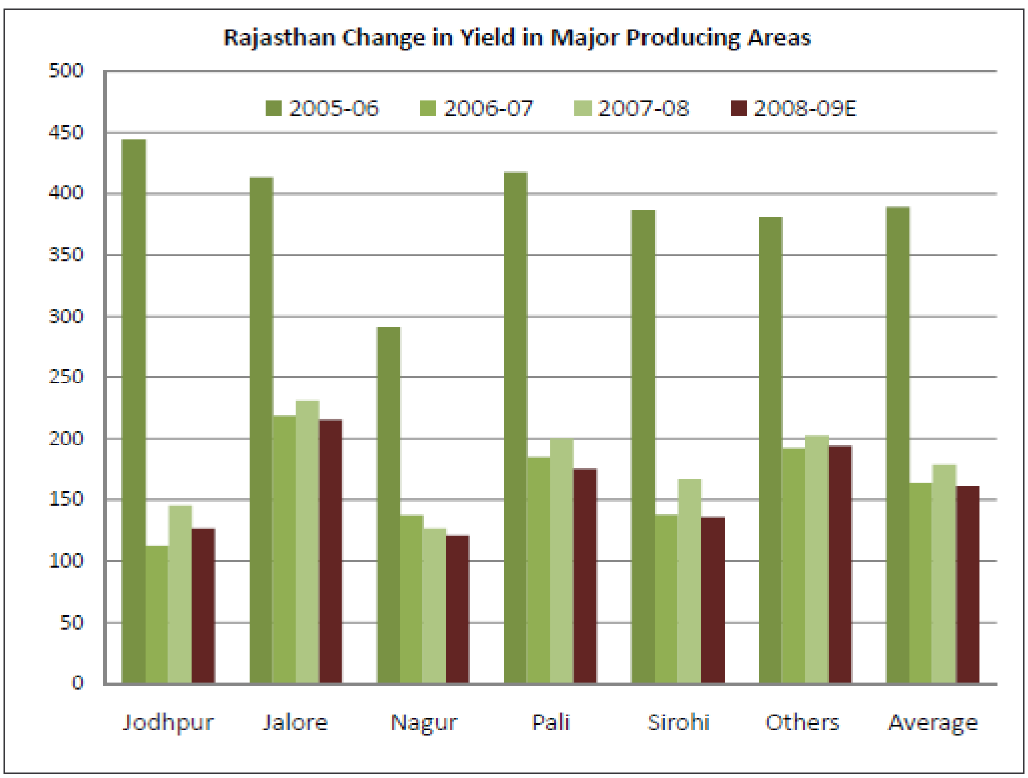





Gujarat - Change in Yields in Major producing Areas
2005-06
2006-07
2007-08
2008-09E
Junagadh
Amreli
Surendranagar
Rajkot
Banaskantha
Jamnagar
Patan
Ahmadabad
Mehsana
AVERAGE


Rajasthan Area Under Cultivation
Innermost Circle is 2005-06, outermost is 2008-09E
Jodhpur
Jalore
Nagur
Pali
Sirohi
Others

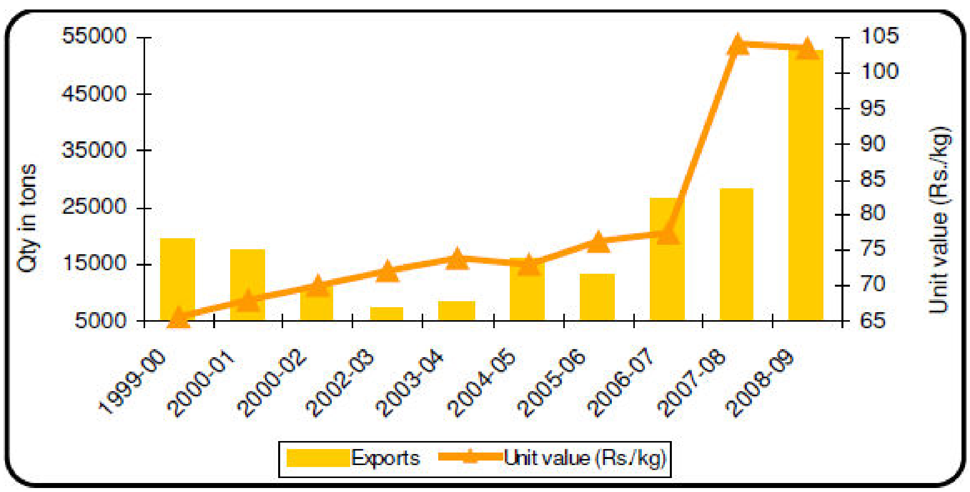

Rajasthan Cumin Seed Production Districtwise
30000
25000
20000
15000
10000
5000
0
2005-06
2006-07
2007-08
2008-09E
Jodhpur
Jalore
Nagur
Pali
Sirohi
Others


Rajasthan Change in Yield in Major Producing Areas
500
450
400
350
300
250
200
150
100
50
0
2005-06
2006-07
2007-08
2008-09E
Jodhpur
Jalore
Nagur
Pali
Sirohi
Others
Average

Exports from India

Unjha is the major trading center for jeera. Farmers bring their produce from neighboring state, Rajasthan also. Delhi, Juniper and Rajkot are the major terminal markets for jeera, from where it moves to other consumption centers of the country. Prices in Jaipur will be higher compared with Unjha market. This could be linked to the quality of Jaipur jeera, which is recognized as the best.

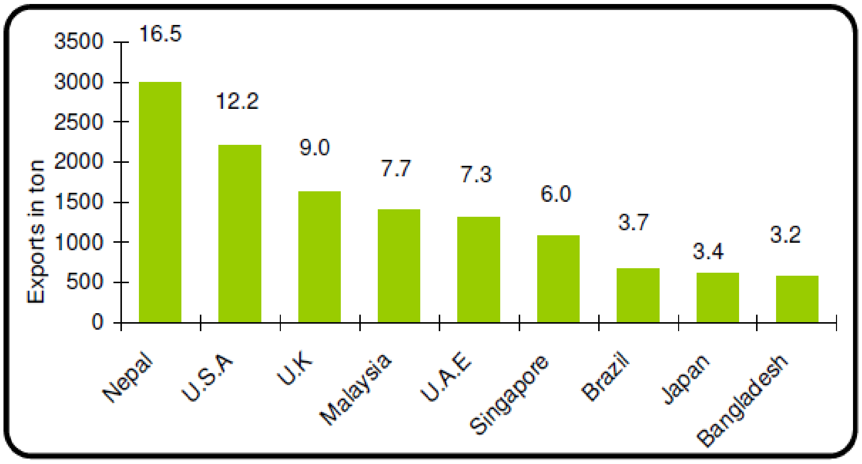
Indian jeera exports stood at a record level of 52,550 tons during 2008-09 compared with about 28,000 tons a year ago, which is higher by 88% (fig 6.6). In terms of value, jeera exports were up by 87% to Rs.54, 400 lakh during 2008-09 compared with a year ago. India exports about 19,600 tons of jeera per annum (average for last 10 years from 1999-00 to 2008-09). In India, out of the total output about 90% is consumed within the domestic market, while only 10% is left for exports. Jeera is harvested in the month of February, where as other major producing countries harvest in August–September. This provides an opportunity window for Indian jeera.



Source: Spice Board of India, 2010

Fig 6.6 Export trends from India

India exports cumin seed to many countries in Europe, Gulf, Far East Asia, Other Asian countries, America etc. where it is widely preferred over cumin of other origins. It is also exported in powder form mainly to U.S. and U.K. India also exports cumin oil and oleoresins but in very limited quantity (fig 6.7).



Source: Spice Board of India

Fig 6.7 Major importing countries from India, 2008-09

Different forms of jeera exports

Jeera seeds – Major destinations: US, Singapore, UAE, Bangladesh, Brazil, Japan, Malaysia, Nepal and UK

Jeera seed powder – Major destinations: UK and US.

Jeera oleoresins– Major destinations: USA, UK and UAE.

Table 6.2 India's Cumin trade balance sheet

India Cumin Balance Sheet *(Sources: ARG Research & Govt Data)*						
	2003-04	**2004-05**	**2005-06**	**2006-07**	**2007-08**	**2008-09F**
Opening Stock	109212	146833	167412	205251	217642	242814
Production	202980	176068	199854	176511	185000	136925
Imports	2599	1133	906	1000	2000	1000
Total Availability (A)	**314791**	**324034**	**368172**	**382762**	**404642**	**380739**
Domestic Demand	160000	140854	150000	140000	135000	118000
Export Demand	7958	15768	12921	25120	26828	31000
Total Consumption (B)	**167958**	**156622**	**162921**	**165120**	**161828**	**149000**
Ending Stocks (A-B)	146833	167412	205251	217642	242814	231739
Stock to Usage Ratio	**87**	**107**	**126**	**132**	**150**	**156**

The details of India's cumin balance sheet are summarized in table 6.2. The total availability of cumin in market was increasing significantly over the period of time. But, the domestic demand was also increasing alarmingly due to increase in the population in the country. The quantity exporting is in increasing trend for the study period. The stock to usage ratio has gone up to 156 from 87 during the same period.

Seasonality in Cumin seed prices

Exports of jeera have shown variations over a period of time due to fluctuating production in India. The price for cumin seed are highly volatile due to supply and demand fluctuations and also as the market is mainly dominated by stockiest and speculators (fig 6.8). India is having a very big domestic market so farmers need not to rely just on exports to get good price. With the availability of cumin seed futures, the traders can now hedge their risk on exchanges. Jeera spot prices have peaked during June 2007. This is on account of poor production due to crop damage.

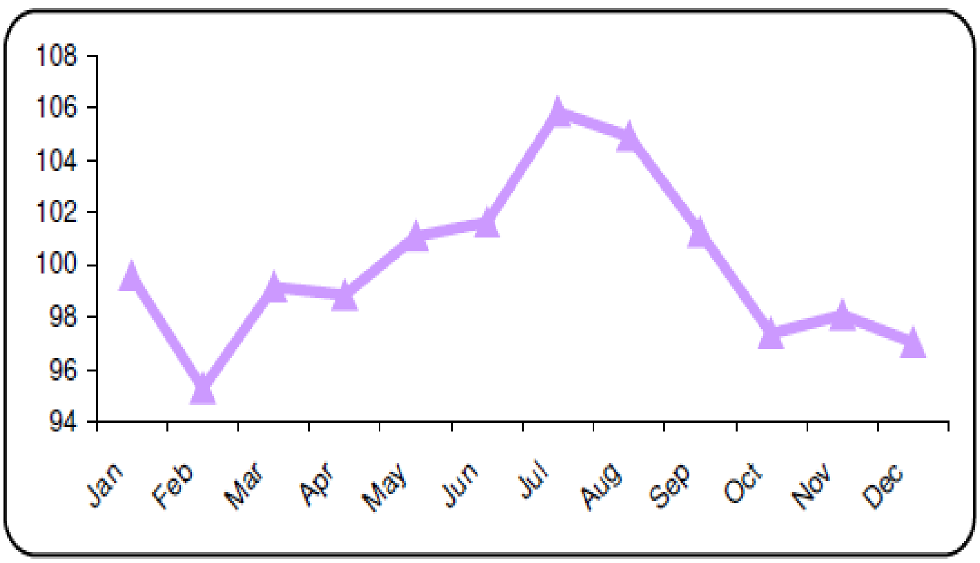


Fig 6.8 Price Seasonality index from 2003 to 2009

The details of wholesale prices of Cumin at Unjha market yard (Gujarat) is depicted in the fig 6.9 for the period 2005 to 2009. The wholesale price per qtl has increased nearly 35 per cent during the study period. However, there were huge fluctuations in the prices due to seasonality, market arrivals and domestic demand.

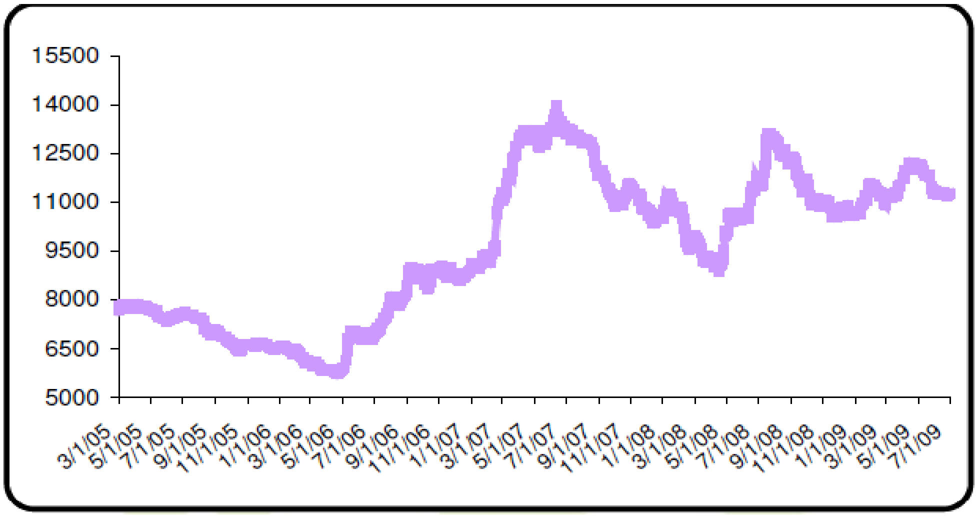


Fig 6.9 Unjha market prices from 2005 to 2009 (Rs per Qtl)

Cumin seed production scenario in Syria

The 95% of the Syrian cumin seed production is concentrated in the region of Aleppo, Idleb, Hama, Al-Rakka and Homs with Aleppo contributing around half of it. The production figure has shown high fluctuations mainly due to the changes in the total acreage area. It touched the high of 96650 tonnes in 2002 when the area under cumin production was very high (fig 6.10).

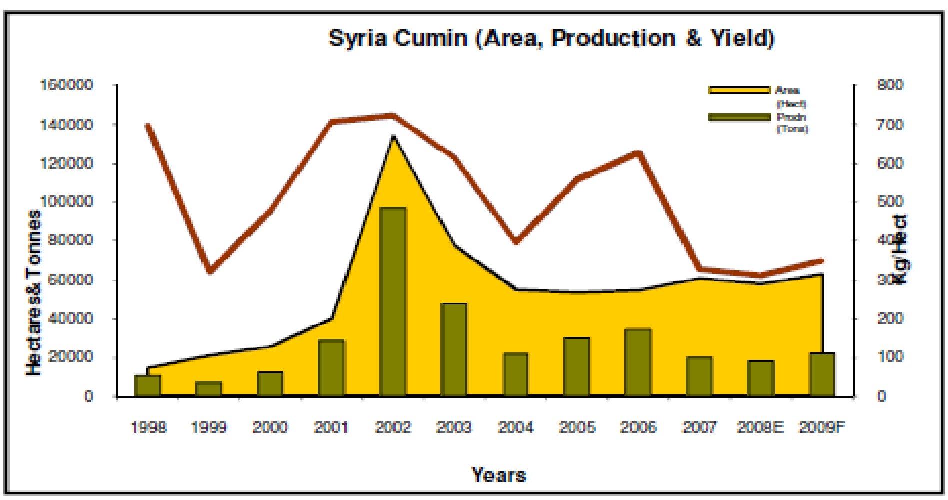


Fig 6.10 Cumin area, production and yield in Syria

Generally it is estimated to be in the region of 15000 to 20000 tons but for the season 2008 it was indicatively at 7000 tons. Thus, its fluctuating production has a big impact on cumin prices in world market. Syrian climate is conducive to cumin crop and grown in winter with sowing going on for 2 to 3 months depending upon the climatic conditions and harvested during June-July. Normally, Syrian and Iranian crop arrives in international market at the same time. The local consumption of cumin is very less and around 85-90% of its production is exported. Arab countries are the biggest buyer with UAE and Saudi Arabia among top two importers (Fig. 6.11).

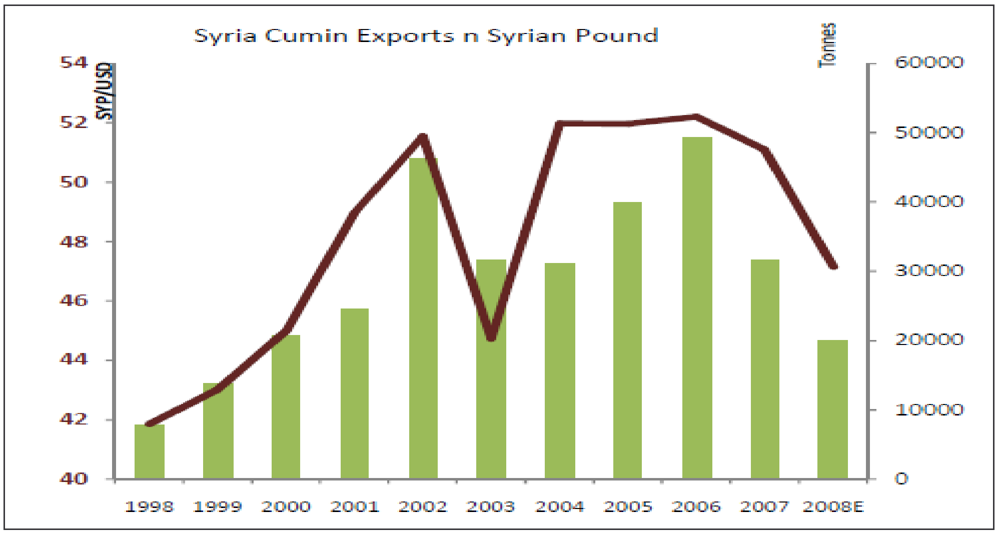


Fig 6.11 Cumin exports from Syria

Cumin seed production in Turkey scenario

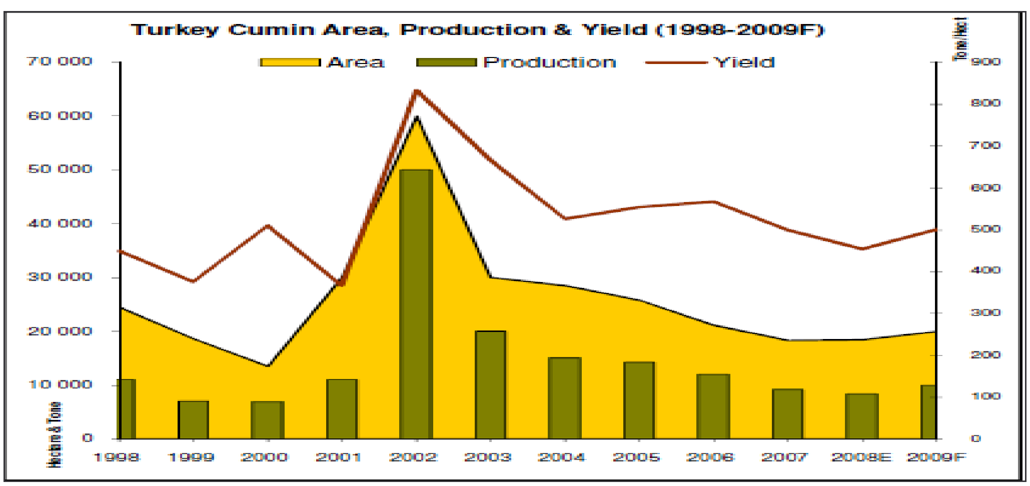


Fig 6.12 Cumin area, production and yield in Turkey

Heat wave conditions reduced the yields for 2007-08, and production stood at 8.5K Tons (fig. 6.12). Due to high quality of production Turkey cumin seed always fetches better prices in the World market. The higher prices are driving more and more area under Cumin cultivation in the country.

Cumin seed production scenario in Iran

In Iran, cumin seed is mainly produced in the Khorasan Province with around 4000 hectares of area under cultivation and estimated production of 30000 tons. The harvesting period is June-August coinciding with Syrian harvesting period. The local consumption unlike India is very limited and major produce is available for export. U.S., Europe and Middle-East countries remains the main target buyers for Iranian cumin. Its production plays an important role in determination of prices of other origins in international market as Iran is one of the major exporters to the world market.

Table 6.3 Contribution of cumin in total spice exports from India

TEM-WISE EXPORT OF SPICES FROM INDIA								(QTY. IN TONNES & VALUE IN Rs. LAKH		
	2005-06		2006-07		2007-08		2008-09 (E)		2009-10 (E)	
ITEM	QTY	VALUE	QTY	VALUE	QTY	VALUE	QTY	VALUE	QTY	VALUE
PEPPER	17,363	15094.81	28,750	30620.00	35,000	51950.00	25250	41373.50	19750	31392.50
CARDAMOM(S)	863	2682.13	650	2236.00	500	2475.00	750	4726.50	1975	16570.25
CARDAMOM(L)	1,046	1154.65	1,500	1695.00	1,325	1500.00	1875	2280.75	1000	1788.60
CHILLI	113,174	40300.51	148,500	80775.00	209,000	109750.00	188000	108095.00	204000	129172.80
GINGER	9,411	4295.52	7,500	3975.00	6,700	2800.00	5000	3482.50	5500	4675.00
TURMERIC	46,405	15286.02	51,500	16480.00	49,250	15700.00	52500	24857.75	50750	38123.00
CORIANDER	23,756	6770.73	20,500	7462.00	26,000	11025.00	30200	20378.75	47250	22585.50
CUMIN	12,879	9819.07	26,000	20150.00	28,000	29150.00	52550	54400.00	49750	54824.50
CELERY	4,165	1500.64	3,550	1320.50	2,900	1325.00	3650	2333.00	5000	2662.50
FENNEL	5,725	2782.33	3,575	2380.00	5,250	2850.00	8675	4315.00	6800	5623.60
FENUGREEK	15,525	3402.87	8,500	2698.50	11,100	3300.00	20750	7175.25	21000	6972.00
OTHER SEEDS (1)	12,670	3321.99	8,000	2240.00	8,850	3125.00	17500	6498.50	15500	5890.00
GARLIC	34,688	4798.38	11,500	2127.50	675	400.00	760	350.25	10750	3042.25
NUTMEG & MACE	1,530	3117.21	2,100	4273.50	1,300	2875.00	2155	6074.75	3275	9186.50
VANILLA	72	1226.80	125	1995.50	200	1775.00	305	2670.00	200	2251.50
OTHER SPICES (2)	21,134	7,492.76	19,500	7,280.00	19,000	8,100.00	20000	10564.00	20200	12524.00
CURRY POWDER	9,340	7838.03	9,500	8692.50	11,500	11100.00	13250	16375.00	14300	18918.50
MINT PRODUCTS (3)	14,544	81320.66	16,250	110095.00	21,100	128050.00	20500	142025.00	19000	118972.00
OILS & OLEORESINS	6,074	50557.34	6,250	51079.00	6,600	56300.00	6850	72050.00	6750	70875.00
TOTAL	350,363	262762.45	373,750	357575.00	444,250	443550.00	470520	530025.50	502750	556050.00
VALUE IN MILLION US $		592.90		792.95		1101.80		1168.40		1173.75

(1) INCLUDE AJWANSEED, DILL SEED, POPPY SEED, ANISEED, MUSTARD ETC.

(2) INCLUDE TAMARIND, ASAFOETIDA, CINNAMON, CASSIA, CAMBODGE, SAFFRON, SPICES (NES) ETC.

(3) INCLUDE MENTHOL, MENTHOL CRYSTALS AND MINT OILS.

SOURCE : DLE FROM CUSTOMS, DGCI&S, KOLKATA, EXPORTERS' RETURNS.

Table 6.4 Country-wise exports of Cumin from India

MAJOR ITEM-COUNTRY	2006-07 QTY (MT)	2006-07 VALUE (Rs. LAKHS)	2007-08 QTY (MT)	2007-08 VALUE (Rs. LAKHS)	2008-09 (E) QTY (MT)	2008-09 (E) VALUE (Rs. LAKHS)	2009-10(E) QTY (MT)	2009-10(E) VALUE (Rs. LAKHS)
U.A.E	1556.8	1047.3	2840.7	2708.8	12184.2	11596.9	5932.4	6224.9
BRAZIL	581.3	448.4	2216.7	2396.8	2276.8	2437.6	4935.6	5249.7
U.S.A	4245.6	3358.0	3013.8	3202.8	4760.4	5378.6	4001.8	4821.5
NEPAL	3227.6	2721.8	2919.1	3116.9	2608.1	2848.8	3728.8	4228.9
U.K	2010.3	1717.7	1860.5	2115.1	2897.6	3440.7	3447.0	3990.8
MALAYSIA	1883.9	1632.6	1213.5	1250.2	810.0	881.5	3063.5	3425.1
EGYPT(A.R.E)	105.0	73.7	813.6	831.4	4635.3	4815.5	2626.4	2756.4
BANGLADESH	125.5	66.4	1554.1	1080.6	3258.2	3051.1	2573.0	2577.8
PAKISTAN	58.1	34.4	219.2	131.3	647.3	586.0	1707.3	1732.5
PERU	228.8	137.6	26.0	28.9	1057.0	1122.1	1489.0	1563.7
ECUADOR	184.0	132.7	367.8	405.8	488.0	539.0	1321.8	1473.5
Y.A.R	96.0	66.5	319.7	320.5	938.0	820.0	1117.2	1112.5
SAUDI ARABIA	69.6	59.5	383.1	396.9	1773.9	1732.0	899.8	983.8
MEXICO	608.5	485.7	512.8	556.2	1066.5	1156.2	871.0	950.5
SPAIN	77.9	45.6	388.7	436.0	597.3	633.2	864.9	945.0
JAPAN	581.2	542.6	414.6	722.2	640.0	1031.9	558.9	943.5
SOUTH AFRICA	489.6	402.7	610.3	683.3	741.8	841.8	739.2	840.0
INDONESIA	251.5	179.4	413.5	340.7	597.3	501.1	857.0	814.8
COLUMBIA			475.0	484.6	1024.0	1105.8	728.3	746.2
SINGAPORE	1798.7	1154.3	1899.5	1940.5	1575.5	1588.6	655.1	679.7
AUSTRALIA	178.0	167.1	161.2	208.8	294.5	400.9	487.4	628.1
NETHERLANDS	75.1	55.9	1057.5	1140.9	647.9	703.0	579.3	620.0
HONDURAS	228.0	174.2	130.0	135.0	208.0	224.8	561.0	603.4
CANADA	191.0	179.0	223.5	292.0	226.9	302.0	399.9	523.6
CHILE	91.1	80.8	345.0	371.9	408.0	450.9	401.8	422.4
SRI LANKA	480.5	323.5	222.5	200.1	606.3	610.8	400.9	420.2
VENEZUELA			66.5	74.5	276.0	302.3	374.5	405.0
OMAN	79.3	67.1	85.9	94.6	63.9	74.5	325.9	377.7
GERMANY	290.4	233.2	78.9	70.7	300.0	274.2	296.2	335.4
BULGARIA	71.5	59.4	65.0	68.3	229.8	266.4	304.5	335.3
ISRAEL	201.7	143.3	199.9	224.9	416.1	443.6	264.9	297.7
BAHARAIN	15.2	16.0	81.2	99.3	135.9	203.4	157.4	230.5
BURMA(MYANMAR)	26.5	20.1			98.5	101.7	201.3	227.4
FRANCE	106.7	92.4	236.1	248.6	498.9	546.7	193.9	224.3
KUWAIT	51.6	44.9	129.5	139.0	173.6	181.8	173.2	213.3
ALGERIA	14.0	8.6	336.0	334.2	696.0	612.5	258.5	211.0
ITEM TOTAL (INCL. OTHERS)	26042.1	20224.1	28000.1	29150.0	52550.1	54400.0	49750.1	54824.5

The share of cumin in the country's total spice exports is summarized in table 6.3. India's cumin exports to different countries are presented in table 6.4 by quantity and its total value. The cumin exports have shown tremendous growth during the study period. Nearly 80 per cent growth was registered in quantity and value in exports from 2007-08 to 2008-2009. The major importers from India are U.A.E, Brazil, USA and Nepal. This trend was almost similar and consistent over the study period.

The commodity-wise imports of spices to India are tabulated in table 6.5. Pepper, Cassava and Ginger were the major spices importing to India from various countries.

Black cumin was also been imported during the study period but the quantity was very marginal.

Table 6.5 Commodity-wise imports of spices to India

	2004-05		2005-06		2006-07		2007-08(E)		2008-09(E)	
SPICES	QTY	VALUE	QTY	VALUE	QTY	VALUE	QTY	VALUE	QTY	VALUE
PEPPER (1)	17,733	11610.45	16,870	10358.39	15,701	13597.20	13,500	19388.75	10,750	17664.75
CARDAMOM(SMALL)	352	393.72	437	432.40	623	569.18	875	868.00	180	308.90
CARDAMOM(LARGE)	4,368	4284.83	4,935	4003.26	6,297	5485.81	5,850	4635.00	5,950	4996.25
CHILLI / PAPRIKA	680	300.71	933	444.09	1,595	1029.54	475	361.00	820	657.25
GINGER FRESH / DRY	18,335	3244.55	23,680	4662.62	32,518	4015.53	22,500	3275.25	27,750	3887.75
TURMERIC	1,615	702.25	4,022	1676.14	7,003	2519.82	4,650	1227.30	2,525	820.25
CORIANDER	1,220	609.81	1,838	813.81	2,270	1008.21	1,000	620.00	3,030	1906.90
CUMIN BLACK / WHITE	1,133	631.58	906	624.05	1,191	1010.39	2,000	1850.00	190	242.15
MUSTARD SEED	1,987	469.42	3,095	641.06	3,317	738.80	2,520	635.70	1,375	786.25
POPPY SEED	8,337	2939.55	5,798	2106.29	10,652	4885.38	5,300	3616.00	5,900	11741.80
GARLIC	19,907	2706.13	2,771	586.79	1,073	191.71	4,050	552.50	185	48.25
CLOVE	6,945	12430.02	7,721	13116.51	11,748	17752.25	8,450	11910.00	6,500	11516.25
NUTMEG	983	1352.43	862	1244.35	913	1411.45	950	1625.50	1,325	2533.00
MACE	657	1678.15	525	1481.20	916	2406.53	300	790.50	265	846.20
CASSIA	11,899	3446.71	9,721	2763.00	17,002	5090.16	8,900	3034.50	8,600	3567.40
STAR ANISE	1,779	982.16	2,232	1217.52	3,165	1815.45	1,725	950.00	1,375	981.40
OTHER SPICES (2)	4,028	7432.14	3,697	6039.19	10,225	13030.71	6,575	6435.00	6,100	6602.50
OILS &OLEORESINS (3	283	1097.19	367	1712.89	585	2349.70	380	2775.00	725	7431.40
TOTAL	102,241	56311.80	90,412	53923.56	126,794	78907.84	90,000	64550.00	83,545	76538.65
VALUE IN MILLION US $		125.50		121.45		174.32		160.60		167.55

NOTE (1) INCLUDE WHITE PEPPER, LIGHT PEPPER AND BLACK PEPPER FOR VALUE ADDITION AND RE- EXPORT.
(2) INCLUDE ASAFOETIDA, ANISEED, CAMBODGE, LONG PEPPER, CINNAMON, MASALAS AND HERBAL SPICES.
(3) INCLUDE CRUDE OLEORESINS FOR FURTHER PROCESSING/BLENDING AND RE-EXPORT.

SOURCE : DAILY LIST OF IMPORTS RECEIVED FROM CUSTOM HOUSES/ REPORTS FROM REGIONAL OFFICES

Market integration

The stationarity tests were conducted on cumin international prices and domestic market prices for the period 2005 to 2010 (month wise data). The results of ADF test indicated that the first differences showed significant estimates at 1 per cent level. This meant that data were stationary in first differences with order of integration being I (1) for cumin. As the two price series were found to be qualified for the pair-wise cointegration tests (table 6.6).

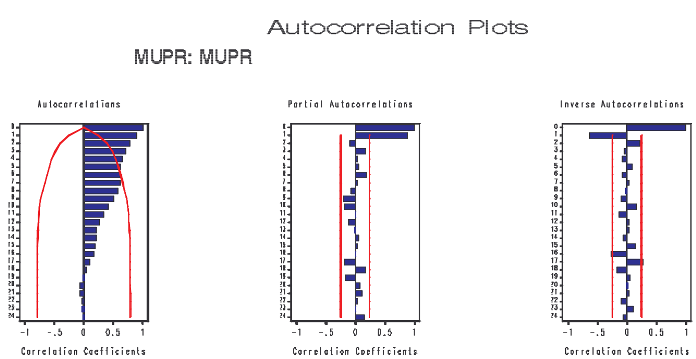
Table 6.6 Tests for stationarity

Market	ADF test#	
	I (0)	I (1)
International prices	-1.72	-3.12*
Mumbai market	-2.24	-2.67***
Unjha market	-1.53	-2.68***
Rajkot market	-2.07	-2.97**
Junagadh market	-1.12	-2.94**
Gondel market	-2.09	-2.88**

based on single mean type estimation
* Significant at 1 percent level
** Significant at 5 percent level
*** Significant at 10 percent level

If t (cal) > ADF critical value => not reject the null hypothesis, i.e., unit root exists in data variable

If t (cal) < ADF critical value => reject the null hypothesis, i.e., unit root does not exist in data variable



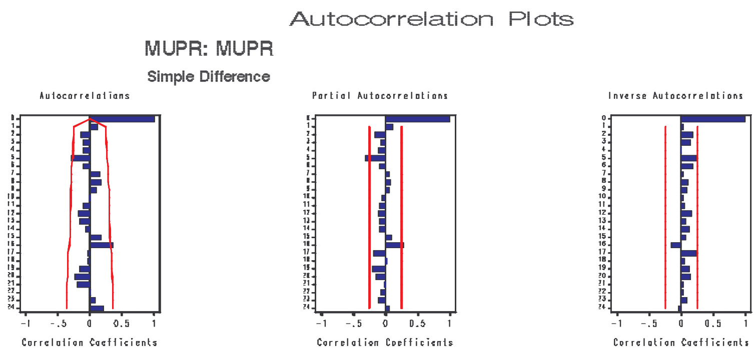


Fig 6.13 Mumbai market prices before and after differencing

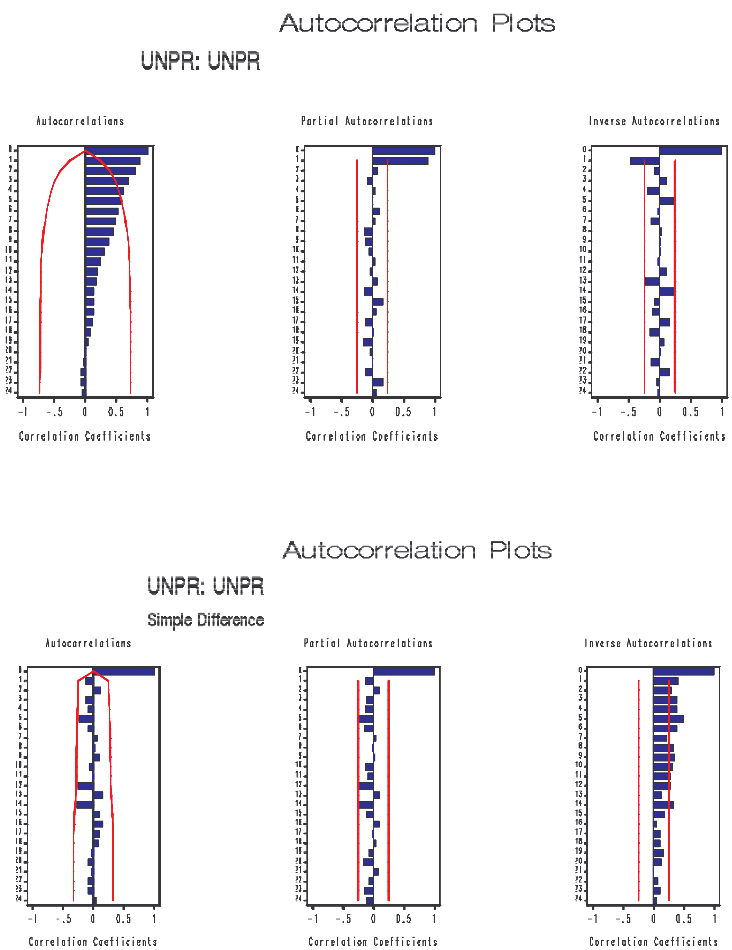


Fig 6.14 Unjha market prices before and after differencing

Table 6.7 Testing Cointegration between international and domestic markets

(ranking using trace method)

Series	H0: Rank=r	H1: Rank>r	Eigen Value	Trace	5% Critical Value
International prices and Mumbai prices	0	0	0.1741	13.1421	15.34
	1	1	0.0171	1.0880	3.84
International prices and Unjha prices	0	0	0.1716	13.6015	15.34
	1	1	0.0272	1.7381	3.84
International prices and Rajkot prices	0	0	0.1946	15.6235	15.34
	1	1	0.0311	1.9877	3.84
International prices and Gondel prices	0	0	0.2157	17.6233	15.34
	1	1	0.0361	2.3152	3.84
International prices and Junagadh prices	0	0	0.1571	11.5504	15.34
	1	1	0.0123	0.7797	3.84
Mumbai prices and Unjha prices	0	0	0.2412	19.0060	15.34
	1	1	0.0253	1.6136	3.84
Mumbai prices and Rajkot prices	0	0	0.1614	13.3625	15.34
	1	1	0.0354	2.2726	3.84
Mumbai prices and Gondel prices	0	0	0.1395	12.9033	15.34
	1	1	0.0531	3.4392	3.84
Mumbai prices and Junagadh prices	0	0	0.1432	10.9193	15.34
	1	1	0.0186	1.1826	3.84
Unjha prices and Rajkot prices	0	0	0.2565	21.3342	15.34
	1	1	0.0414	2.6653	3.84
Unjha prices and Gondel prices	0	0	0.3022	25.5432	15.34
	1	1	0.0446	2.8744	3.84
Unjha prices and Junagadh prices	0	0	0.3313	26.4277	15.34
	1	1	0.0169	1.0712	3.84
Rajkot prices and Gondel prices	0	0	0.1992	18.4000	15.34
	1	1	0.0675	4.4030	3.84
Rajkot prices and Junagadh prices	0	0	0.1102	8.7680	15.34
	1	1	0.0222	1.4111	3.84
Gondel prices and Junagadh prices	0	0	0.1274	11.6121	15.34
	1	1	0.0469	3.0257	3.84

Drift in ECM: Constant; Drift in process: Linear

The order of integration was tested for different combination of prices in order to find out the relationship between those prices. Maximum eigen value and significant trace indicated that international prices and domestic wholesale markets were integrated at order I (1) while the other combinations of prices were not (Table 6.7). Similarly, the results showed that the domestic markets integrated well.

Table 6.8 Granger-Causality Wald Test for long term integration

Dependant	Independent	Chi-Square	Pr > ChiSq
International price	Mumbai price	7.83	0.0200
Mumbai price	International price	3.44	0.1794
International price	Unjha price	6.90	0.0317
Unjha price	International price	0.82	0.6622
International price	Rajkot price	9.77	0.0076
Rajkot price	International price	5.59	0.0611
International price	Gondel price	9.90	0.0071
Gondel price	International price	4.93	0.0849
International price	Junagadh price	5.71	0.0576
Junagadh price	International price	1.48	0.4771
Mumbai price	Unjha price	0.78	0.6781
Unjha price	Mumbai price	15.43	0.0004
Mumbai price	Rajkot price	2.27	0.3218
Rajkot price	Mumbai price	0.26	0.8789
Mumbai price	Gondel price	6.71	0.0349
Gondel price	Mumbai price	0.84	0.6574
Mumbai price	Junagadh price	0.56	0.7542
Junagadh price	Mumbai price	7.30	0.0260
Unjha price	Rajkot price	16.34	0.0003
Rajkot price	Unjha price	1.58	0.4546
Unjha price	Gondel price	26.48	<.0001
Gondel price	Unjha price	0.15	0.9300
Unjha price	Junagadh price	21.24	<.0001
Junagadh price	Unjha price	1.24	0.5392
Rajkot price	Gondel price	6.57	0.0375
Gondel price	Rajkot price	3.38	0.1849
Rajkot price	Junagadh price	3.03	0.2198
Junagadh price	Rajkot price	10.68	0.0048
Gondel price	Junagadh price	0.54	0.7627
Junagadh price	Gondel price	6.48	0.0392

Results of Granger Causality Wald tests presented in table 6.8 indicate the direction of relationship (uni or bidirectional) between prices. International and domestic prices were influencing each other, while the influence of domestic prices on international price was found high. Domestic prices were found to influence international prices while the vice-versa was a little. For detailed VECM analysis (long run and short run relationships) please see Appendix tables A22 and A23.

Table 6.9 Trade competitiveness
(under exportable hypothesis)

			Cum-09-10@
Domestic Prices	Domestic price of Tradable output#	A	102505.0
	Domestic price of Non-Tradable output	B	15376.0
	Domestic price of Tradable input	C	40943.0
	Domestic price of Non-Tradable input	D	7101.0
Economic Prices	Border price of Tradable output$	E	128568.0
	Opportunity cost of Non-Tradable output	F	15376.0
	Border price of Tradable input	G	41000.0
	Opportunity cost of Non-Tradable input	H	7986.0
Surplus	Private Profit under Autarky (PPA)	(A+B)-(C+D)	69837
	Private Profit under Free Trade (PPFT)	(E+B)-(C+D)	95900
	Social Profit under Free Trade (SPFT)	(E+F)-(G+H)	94958
	Total Policy Transfer (TPT)	(PPA-SPFT)	-25121
Competitiveness Measure	Nominal Protection Coefficient (NPC)	(A/E)	0.80
	Effective Protection Coefficient (EPC)	(A-C)/(E-G)	0.70
	Effective Subsidy Coefficient (ESC)	[(A-C)+(H-D)]/(E-G)	0.71
	Domestic Resource Cost Ratio (DRCR)	(H-F)/(E-G)	-0.08

@ Author's own primary data collection from Gujarat
# Wholesale prices at Mumbai port after adjusting with transport costs
$ New York market prices after adjusting with transport costs

The results summarizes that Cumin is highly competitive under exportable hypothesis (table 6.9). The NPC value was 0.80 (less than one) indicates competitive in the international market. The PPA, PPFT, SPFT values were positive but TPT value was negative indicating higher taxation. The DRCR value was very low (less than one) indicates high comparative advantage in production of cumin when compared to global producers.

SWOT analysis of Cumin production in India

Strengths

- Favorable climatic condition
- Having larger area under production
- Emerging markets like Europe and other developed countries
- Large number of exporters are involved in export of spices (well established markets as well as supply chains)

Weaknesses

- Quality is not as per the international standards
- Contaminated with chemical residues (many import rejections due to various residues)
- Lack of skilled entrepreneurs

Opportunities

- India can become the largest exporter in the World as it capturing major international market shares
- Increase in the consumption in developed countries would increase more exports from India

Threats

- Due to lack of proper production and processing standards, India may lose its shares in International market
- Stiff Competition from countries like Syria, turkey and Iran
- Lack of potential production technologies

Current world market scenario

The cumin seed prices have shown sharp decline in recent times due to high production and lower export demand (fig 6.15). The cumin seed production is estimated higher this year at 2.9 million bags of 60 kg each up from 2.7 million bags in 2009. Cumin exports in February 2010 dropped 17 percent to 2,500 tonnes on year. Earlier this month, Indian cumin commodity was getting offered at USD 2300-

2550 per ton on fob basis. The buyers are waiting for prices to fall down further before start making purchases while the farmers are preferring to hold on to their stocks for better prices. Harvesting of Syrian cumin seed has started and it is getting offered in international market for US$ 2500 per ton. The production in Syria is estimated at 20000 tons while in Iran and Turkey it is expected to be 15000 tons each. The overseas demand and the pricing policy of other producers shall be deciding Indian cumin seed's future movements.

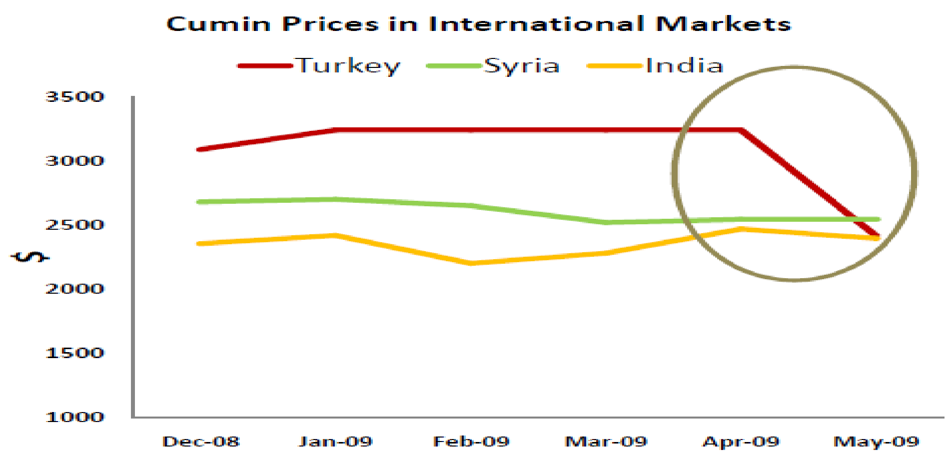


Fig 6.15 Current world cumin market scenario

Chapter 7

Plantation Crops: Cashewnut and Tea

7.1 Cashewnut

Cashew is one of the important plantation crops introduced into India during the 16th century. The potential of this crop in the international trade was first realized by India in the early 1900s' through the export of cashew kernels. Since cashew was considered as suitable for afforestation and soil conservation purpose, the cashew plantations raised till recently received very little attention. Further, cashew was always planted in the waste land and marginal lands with poor fertility status. Now India has largest area in cashew and it is also the largest producer, consumer and exporter of cashew in the world. Cashew is mostly grown in East Coast and West Coast of India and also in North-Eastern hilly regions to a limited extent. The present cashew area in the country is 8.93 lakh ha. Production during 2008-09 was 6.65 lakh tones. Brazil and Vietnam are the competitors to India for cashew production and export.

However, India needs about 15 – 20 lakh tons of raw cashew nuts per annum for feeding over 1700 cashew processing units. In order to meet the requirement of the processing industry, India imports annually about 5-6 lakh tons of raw cashew nuts from African and other countries. As these countries have started processing their own cashewnuts, the availability of nuts for import may reduce or may stop altogether in future.

About 30-35 thousand hectares are brought under cashew every year in the country by planting 60-70 lakh cashew grafts at the rate of 200 plants per hectare. It is expected that the cashew graft production can be increased to 90-100 lakhs per annum in XI Plan period and 150 lakhs in next 10-15 years. Besides increasing area, productivity per unit area also has to be increased in order to make India self-sufficient in production of raw cashew nuts.

Cashew kernels are very tasty as well as nutritious. Cashew kernels contain protein (21%), fat (47%)), carbohydrates (22%), minerals and vitamins. Cashew kernel proteins contain all the essential amino acids. Cashew kernel proteins are comparable with milk protein, casein, in terms of, Protein Efficiency Ratio (PER) which is 3.2. Cashew kernel does not contain any anti-nutritional factors. Cashew kernels contain 47 per cent fat which is quite rich in unsaturated fatty acids. Cashew kernels are free from bad cholesterol and contain sizeable quantity of mono unsaturated fatty acid (oleic acid) which is now believed to be as efficient as poly unsaturated fatty acids in lowering blood cholesterol through enhancing the levels of High Density Lipoprotein (HDL) cholesterol and reducing the levels of Low Density Lipoprotein (LDL) cholesterol. Thus, cashew kernel is most safe food.

Global production

Table 7.1 World Cashewnut (with shell) production, 2008

Country	Production(MT)	% in World production
Viet Nam	1190600	31.6
India	665000	17.8
Nigeria	660000	17.6
Côte d'Ivoire	280000	7.5
Brazil	243253	6.5
Indonesia	142536	3.8
Philippines	112334	3.0
United Republic of Tanzania	99100	2.6
Mozambique	85000	2.3
Guinea-Bissau	81000	2.2
World total production	3761078	100.0

Source: FAOSTAT, 2010

The details of cashew global production during 2008 are tabulated in table 7.1. Cashew is grown in nearly 25 countries of the world. Viet Nam, India, Brazil, Nigeria, Tanzania, Indonesia and Mozambique are the major producers in the world. About 21.09 per cent of the World's cultivated area under cashew nut was in India and the country accounted for 17.7 per cent of the world cashew production during the year 2008. As per FAO statistics, Viet Nam tops global production followed by India and Nigeria during 2008.

Table 7.2 Trends in world production (Area – ha and production – tons)

Country	2008		2000		1990	
	A	P	A	P	A	P
Africa						
Tanzania	94000	99100	90000	121200	35000	17060
Mozambique	60000	85000	69000	57894	40000	22524
Nigeria	330000	660000	259000	466000	50000	30000
Côte d'Ivoire	660000	280000	175966	63380	30000	6500
Asia						
India	868000	665000	686000	520000	530869	285590
Indonesia	308129	142536	561310	69927	125000	29907
Vietnam	402700	1190600	195600	270400	140000	140000
South America						
Brazil	747434	243253	651169	138608	582818	107664
Philippines	27517	112334	17000	7000	9382	3596
World Total	4114174	3761078	3241326	1918701	1725840	733428

Source: FAOSTAT, 2010

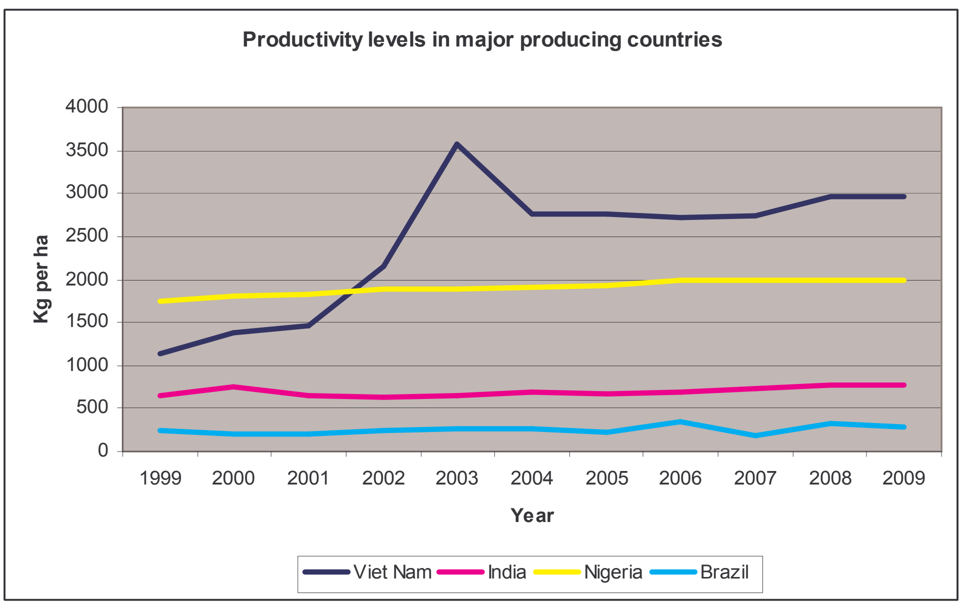


Fig 7.1 Productivity in major producing countries

The details of world cashew production across different regions are summarized in table 7.2. India, Brazil and Cote d'Ivoire were the major countries having higher proportion under area under them in 2008. The production was the highest in case of

Vietnam followed by India and Nigeria during the same period. The details of productivity levels among major countries are depicted in fig 7.1. Among all the countries, the productivity levels were the highest in case of Vietnam followed by Nigeria, India and Brazil. The Indian productivity was much lower when compared with other competing countries. It is because of existence of older plantations, lack of proper crop management and absence of potential germplasms. Development of hybrids and dissemination of improved technology in cashew production is the need of the hour for improving productivity in India.

Table 7.3 Cashewnut production in India

Year	Area (ha)	Production (tons)	Pdty (kg/ha)
1961	200000	85000	425.0
1965	230000	100000	434.7
1970	281171	123319	438.5
1975	361443	144254	399.1
1980	447376	180266	402.9
1985	509768	221330	434.1
1990	530869	285590	537.9
1995	577000	321640	557.4
2000	686000	520000	758.0
2005	820000	544000	663.4
2009	893000	695000	778.2
CGR#	*3.08*	*4.45*	*1.33*
C.V#	*40.41*	*61.76*	*22.82*

for the period 1961-2009
Source: FAOSTAT, 2010

In India, cashew is cultivated mostly in small holdings and about 70 per cent of cashew is grown by small farmers (table 7.3). The coastal states of India are the main cashew producing regions. It is grown in Kerala, Karnataka, Goa and Maharashtra along with West coast and Tamil Nadu, Andhra Pradesh, Orissa and West Bengal along the East coast. It is also grown in non-traditional areas like Madhya Pradesh, Manipur, Tripura, Meghalaya and Andaman and Nicobar islands. Maharashtra ranks first in terms of area and production of cashewnut. The annual growth rate was the highest in case of production followed by area and productivity.

However, the coefficient of variation in production was estimated at as high as 62 per cent. It was observed as the lowest in case of productivity.

Table 7.4 Growth and instability in area under major producing states ('000' ha)

Year	Kerala	Karnataka	Goa	Maharashtra	T.Nadu	A.P
1993-94	156	75	46	51	97	72
1994-95	156	75	48	58	97	73
1995-96	119	84	50	67	77	118
1996-97	119	85	51	80	79	121
1997-98	120	87	52	104	81	121
1998-99	122	89	53	119	83	101
1999-00	122	91	54	121	85	103
2000-01	100	91	55	121	86	130
2001-02	100	90	55	143	90	135
2002-03	100	92	55	148	92	136
2003-04	101	94	55	148	95	136
2004-05	102	95	55	160	105	150
2005-06	80	100	55	160	121	170
2006-07	80	102	55	164	123	171
2007-08	84	103	55	167	123	171
2008-09	70	107	55	170	131	182
2009-10	72	118	55	175	133	183
CGR	*-4.41*	*2.25*	*0.94*	*7.54*	*3.05*	*5.26*
C.V	*24.1*	*11.8*	*5.5*	*32.7*	*19.1*	*25.9*

Source: DCCD, Kochin

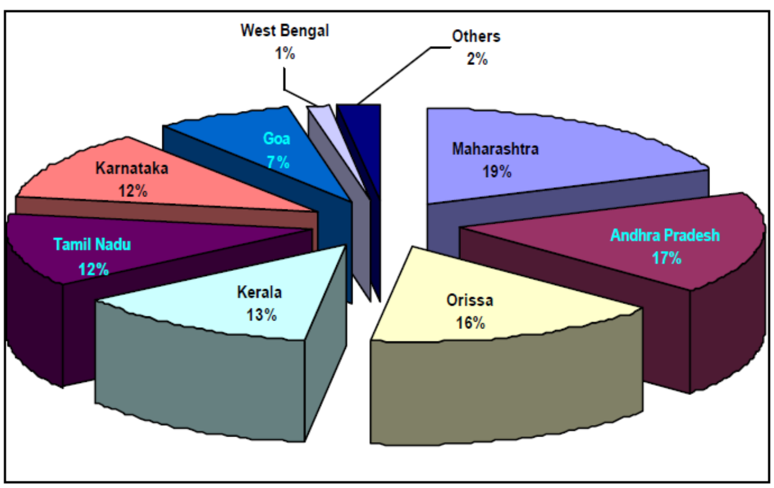


Fig 7.2 Per cent distribution of area in different states

Table 7.5 Growth and instability in cashew production ('000' MT)

Year	Kerala	Karnataka	Goa	Maharashtra	T.Nadu	A.P
1993-94	140	32	16	47	19	47
1994-95	119	26	17	38	22	59
1995-96	140	38	18	69	31	72
1996-97	134	52	20	80	30	60
1997-98	100	35	25	60	30	50
1998-99	130	40	20	85	35	80
1999-00	100	60	30	125	45	100
2000-01	76	42	25	98	59	75
2001-02	87	40	30	103	46	86
2002-03	90	40	30	110	50	90
2003-04	95	46	32	120	51	95
2004-05	64	43	26	174	53	88
2005-06	67	45	27	183	56	92
2006-07	72	52	29	197	60	99
2007-08	78	56	31	210	65	107
2008-09	75	60	30	225	68	112
2009-10	66	53	26	198	60	99
CGR	*-4.68*	*3.22*	*3.59*	*10.81*	*7.31*	*4.58*
C.V	*28.1*	*21.7*	*20.9*	*49.0*	*33.4*	*23.9*

Source: DCCD, Kochin

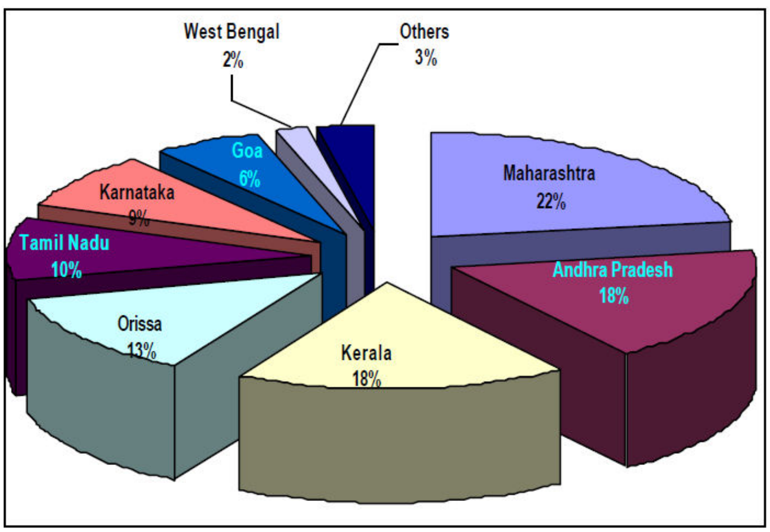


Fig 7.3 Per cent distribution of production in different states

Table 7.6 Growth and instability in productivity (kg per ha)

Year	Kerala	Karnataka	Goa	Maharashtra	T.Nadu	A.P
1993-94	925	500	370	1246	203	723
1994-95	781	400	390	1100	232	880
1995-96	1000	550	410	1440	330	1000
1996-97	1140	690	430	1570	390	830
1997-98	850	460	530	1500	390	690
1998-99	1100	500	420	1500	460	800
1999-00	850	700	610	1470	540	1100
2000-01	765	500	500	1050	750	650
2001-02	870	470	590	880	570	720
2002-03	890	470	660	1000	570	740
2003-04	890	500	690	1100	600	750
2004-05	900	680	660	1200	610	840
2005-06	900	700	690	1300	640	880
2006-07	900	700	690	1500	670	890
2007-08	900	710	700	1500	700	900
2008-09	1071	561	545	1323	519	615
2009-10	957	461	473	1186	472	544
CGR	*0.13*	*1.28*	*3.19*	*-0.23*	*5.64*	*-1.12*
C.V	*11.2*	*19.3*	*21.7*	*16.4*	*31.1*	*17.6*

Source: DCCD, Kochin

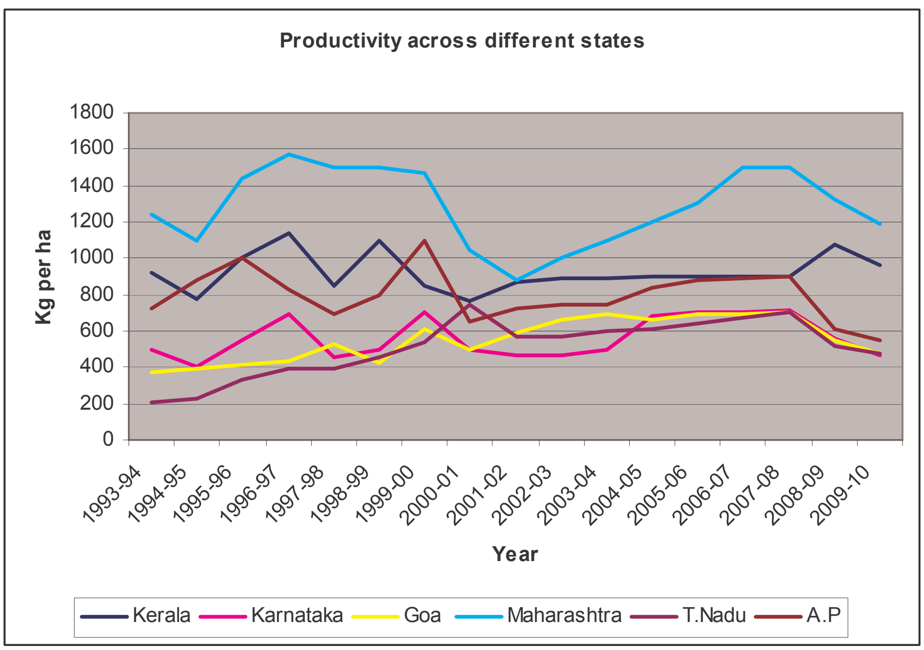


Fig 7.4 Productivity among major producing states

The growth and instability in area under major producing states is presented in table 7.4. The area under Kerala reduced significantly from 156,000 ha in 1993-94 to 72,000 ha in 2009-10. Nearly half of the area has been diverted to other crops in the state. The area under Goa was almost stagnant during the study period. But, the area under cashew was increased in case of Karnataka, Maharashtra, Tamil Nadu and Andhra Pradesh. The increase was more conspicuous in case of Maharashtra followed by Andhra Pradesh and Tamil Nadu. The annual compound growth rates calculated for different states was also confirmed the same trends among different states. The area shares for different states were represented in fig 7.2.

Similarly, the trend analysis was carried out for cashew production for different states for the same study period. The annual compound growth rates in production were observed to be very high in case of Maharashtra followed by Tamil Nadu and Andhra Pradesh. The negative production trend was noticed in case of Kerala. The production shares among different states were depicted in fig 7.3.

The annualized growth rates were carried out for different states based on the productivity data and the results were summarized in table 7.6. Surprisingly, the productivity growth was the highest in case of Tamil Nadu followed by Goa and Karnataka states. The declining productivity trends were observed in case of Andhra Pradesh and Maharashtra states. This trend was almost stagnant in case of Kerala state. These results were also represented in pictorial form in fig.7.4.

The production performance of major producing countries in the world for the period 1999 to 2008 was summarized in table 7.7. Vietnam has the highest share of 29 per cent followed by India (16.16%) and Nigeria (16.04%). The total value of the production was also summarized in table 7.8. The shares among countries exhibited similar trends in both the tables.

Table 7.7 Production performance of major producing countries in the World (MT)

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	*% in World-2008*
Vietnam	164800	270400	292800	515200	657600	818800	960800	1092400	1207600	1190600	*28.9*
India	460000	520000	450000	470000	500000	535000	544000	573000	620000	665000	*16.16*
Nigeria	417000	466000	485000	514000	524000	555000	594000	636000	660000	660000	*16.04*
Cote d'voire	74552	63380	87573	104985	84811	140636	185000	235000	280000	280000	*6.8*
Brazil	145437	138608	124073	164539	183094	187839	152751	243770	140675	243253	*5.91*
Indonesia	90321	69927	91586	110232	106931	131020	135070	140573	146148	142536	*3.46*
World	1728913	1918701	1933333	2213193	2437481	2867254	3147887	3458348	3635638	3761078	*100.0*

Source: FAOSTAT, 2010

Table 7.8 Total value of production in major producing countries (int $ '000')

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	*% in World 2008*
Vietnam	108278	177660	192378	338501	432062	537976	631274	717739	793429	782259	*31.7*
India	302233	341655	295663	308804	328515	351511	357424	376478	407358	436924	*17.7*
Nigeria	273981	306175	318659	337713	344283	364651	390275	417871	433639	433639	*17.6*
Cote d'voire	48982	41642	57538	68978	55723	92402	121550	154402	183968	183968	*7.4*
Brazil	95556	91069	81519	108107	120298	123415	100361	160164	92427	159824	*6.49*
Indonesia	59343	45944	60174	72425	70256	86084	88745	92360	96023	93650	*3.80*
World	1135896	1260586	1270199	1454068	1601425	1883786	2068161	2272135	2388615	2471028	*100.0*

Source: FAOSTAT, 2010

World import market

Table 7.9 Major Cashewnut, with shell importers (tons)

Country	2001	2002	2003	2004	2005	2006	2007	CGR	C.V
India	161790	402982	441500	468419	542607	585893	591329	18.9	32.6
Kenya	N.A	N.A	N.A	80	N.A	287	2527	-	-
France	78	431	1225	1492	1488	1838	2131	59.2	59.6
USA	1067	2013	1320	790	482	523	1245	-10.9	50.2
Indonesia	N.A	N.A	N.A	N.A	108	N.A	880	-	-
China	421	229	0	80	133	165	815	-	-
World	168021	408859	452237	481846	548769	595272	604125		

Table 7.10 Unit prices in major importing countries
(cashewnut with shell $/ton)

Country	2001	2002	2003	2004	2005	2006	2007	CGR	C.V
India	593	631	666	826	870	685	702	3.4	14.3
Kenya	N.A	N.A	N.A	425	N.A	366	670	-	-
France	4410	3782	4061	3964	5753	5447	5349	6.1	17.4
USA	4402	4449	2172	4632	4591	4769	5219	5.1	22.8
Indonesia	N.A	N.A	N.A	N.A	657	N.A	628	-	-
China	803	616	N.A	163	346	382	276	-	-
World	679	668	695	846	898	719	745		

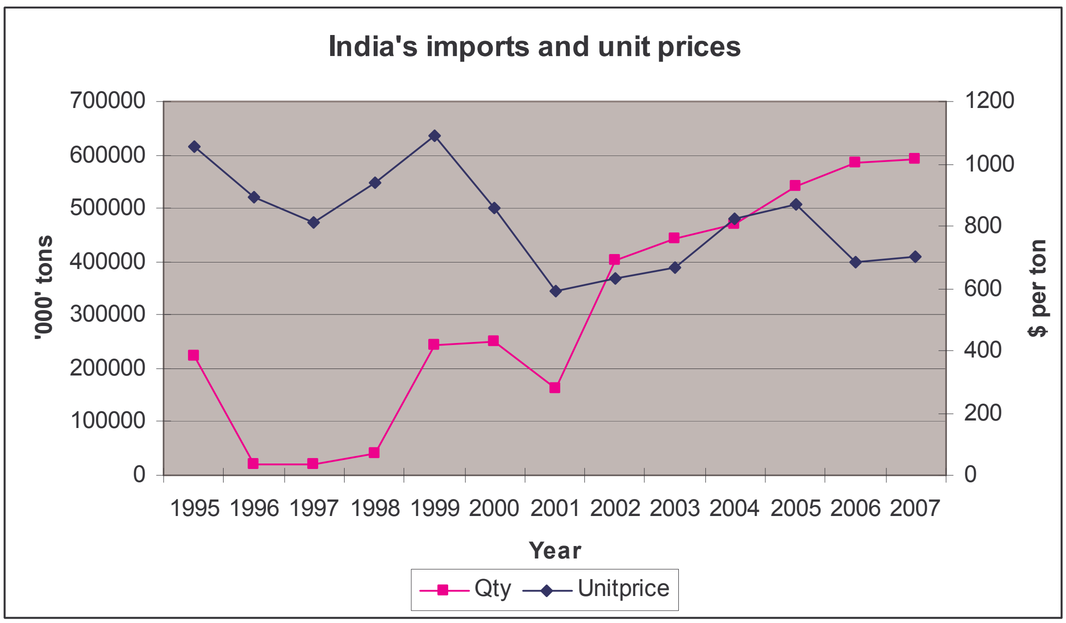


Fig 7.5 Import qty and unit prices of cashewnut

The major importers of cashewnuts (with shell) in the world are summarized in the table 7.9. India has a lion share in the total imports followed by USA and France. The unit prices were relatively low in India when compared to other competing countries (table 7.10). The long term data from 1995 to 2008 of the unit import prices exhibited declining trend. But, the quantity imported has gone up significantly during the same period (Fig. 7.5.). It was due to high demand from processing units existed in the country.

Table 7.11 Major Cashewnut shelled importers (tons)

Country	2002	2003	2004	2005	2006	2007	*CGR*	*C.V*
USA	95419	101772	130865	113991	115087	125420	*4.7*	*11.9*
Netherlands	20595	25407	24094	36181	42408	51495	*20.5*	*36.2*
UK	10359	10890	14985	21351	21366	24722	*21.2*	*35.0*
Germany	7379	8796	9274	12386	14459	18061	*19.6*	*34.4*
Australia	8695	10999	11896	12613	14130	14674	*10.3*	*17.9*
World	208250	228736	269232	284669	298655	343785	-	-

Table 7.12 Unit prices in major importing countries
(cashewnut shelled $/ton)

Country	2002	2003	2004	2005	2006	2007	*CGR*	*C.V*
USA	3702	3912	4349	4817	4416	4470	*4.1*	*9.5*
Netherlands	4087	4111	4481	4697	4854	4581	*3.2*	*7.0*
UK	3833	4119	4643	4357	3988	4108	*0.5*	*6.9*
Germany	4243	4483	4544	5469	5062	4921	*3.8*	*9.4*
Australia	3342	3452	4312	5051	4295	4460	*6.7*	*15.6*
World	3673	3739	4284	4698	4478	4528	-	-

The major importers of cashewnuts (shelled) in the world are summarized in the table 7.11. USA, Netherlands and UK are the major importers in the world. The unit prices were relatively similar among all importing countries (table 7.12). The growth in the unit prices was the highest for Australia followed by USA and Germany.

World export market

The details of major exporters of cashewnuts (with shell) in the world are presented in table 7.13. Cote d'Ivoire, Guinea-Bissau and Indonesia were the major players in the market. Benin, Mozambique and Ghana were the minor exporter in the world market. The unit prices among the major players were the highest in case of Indonesia in 2007. But, the annual growth rate was the highest in case of Benin (table 7.14).

Table 7.13 Major Cashewnut, with shell exporters (tons)

Country	2001	2002	2003	2004	2005	2006	2007	*CGR*	*C.V*
Côte d'Ivoire	85000	86625	84811	140636	167919	210728	250545	*22.6*	*45.4*
Guinea-Bissau	78597	72866	71694	80854	93490	69949	96284	*2.9*	*13.1*
Indonesia	39546	50385	57087	56491	65959	56556	71901	*8.1*	*18.3*
Benin	33458	43117	39328	36561	42872	69357	56607	*9.8*	*27.7*
Mozambique	N.A	38447	32659	39731	33492	24053	32671	-	-
Ghana	419	3892	6208	30702	21822	47797	21868	*91.1*	*89.3*
World	364851	413834	412687	506512	488724	570709	575374	-	-

Table 7.14 Unit prices in major exporting countries
(cashewnut with shell $/ton)

Country	2001	2002	2003	2004	2005	2006	2007	CGR	C.V
Côte d'Ivoire	415	567	446	487	589	432	406	-1.2	15.4
Guinea-Bissau	598	600	641	762	919	632	568	1.1	18.5
Indonesia	606	619	648	891	843	741	810	5.5	15.6
Benin	333	399	393	455	466	625	616	11.0	23.9
Mozambique	N.A	487	563	717	702	582	839	-	-
Ghana	212	373	419	641	1491	588	463	17.5	69.9
World	624	608	547	658	741	564	552	-	-

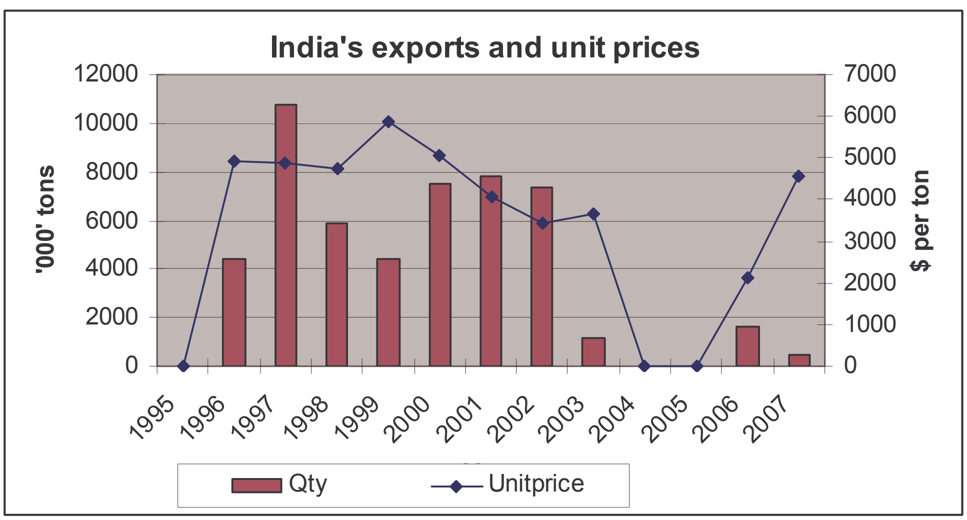


Fig 7.6 India exports qty and unit prices

The details of major exporters of cashewnuts (shelled) in the global market are summarized in table 7.15. Vietnam, India and Brazil are the major players in the world market. Vietnam was almost contributing nearly 50 per cent of total exports in the world. Netherlands realized the highest unit prices in the exports followed by India and Brazil (Fig. 7.7).

Table 7.15 Major Cashewnut shelled exporters (tons)

Country	2002	2003	2004	2005	2006	2007	*CGR*	*C.V*
Vietnam	62235	82200	105000	109000	128000	153000	18.2	30.2
India	122064	98546	109869	124966	121124	110815	0.8	8.7
Brazil	30114	41569	47442	41856	43231	51556	8.0	17.0
Netherlands	12772	12604	15798	20299	19123	26653	15.9	29.9
Indonesia	1332	3341	2881	3456	6850	11745	45.9	76.9
World	241792	255843	297011	324834	340703	383000		

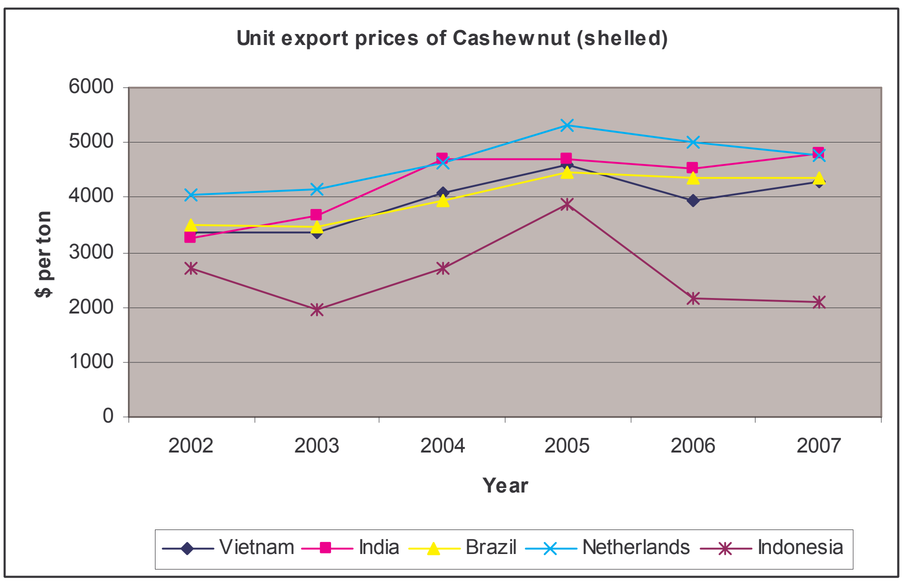


Fig 7.7 Unit export prices (cashewnuts shelled) from different countries

The details of exports of cashewnut kernels from India for the period 2007-2010 are summarized in table 7.16. The major importers are USA, UAE and Netherlands. These three countries were importing nearly 58 per cent of total exports from India. The performance of exports was consistent during the study period.

Table 7.16 Export of cashew kernels from India, 2007-2010

	2007-2008		2008-2009		2009-2010	
Countries	QTY	VALUE	QTY	VALUE	QTY	VALUE
	(M.T)	(Rs.Crs)	(M.T)	(Rs.Crs)	(M.T)	(Rs.Crs)
U.S.A	42694	838.35	36565	975.69	30804	806.63
U.A.E	12692	275.68	14100	388.86	18161	501.65
Netherlands	13627	256.27	13608	371.48	10314	273.99
Japan	5114	106.52	4908	145.16	5633	156.21
U.K	3758	78.39	3495	91.21	4477	114.18
Saudi Arabia	3422	70.02	3278	88.42	3827	101.26
France	4033	75.51	3843	104.1	3814	99.70
Spain	2831	58.73	2434	68.64	2782	74.07
Belgium	2387	46.18	2379	64.85	2470	81.92
Greece	1867	40.20	1852	53.32	2222	62.97
Egypt	1058	22.63	1381	39.31	2018	56.10
Australia	2848	52.57	2118	54.84	1482	33.90
Germany	1705	32.36	1479	38.28	1451	41.35
Turkey	819	17.53	1108	32.03	1282	34.22
Singapore	395	8.55	1141	31.13	1279	33.41
Norway	1064	20.85	1143	29.74	1239	32.81
Kuwait	812	18.55	1138	34.43	1178	33.74
Jordan	1019	21.99	1113	32.30	1039	31.56
Syrian Arab Rep	1470	31.32	1622	47.89	1010	29.95
Thailand	174	4.10	778	19.32	1000	24.95
Korea Rep.	742	15.88	725	21.09	856	24.02
Italy	636	12.87	991	27.66	651	17.97
Israel	695	15.55	806	23.86	580	16.78
Russia	873	14.34	0	0	543	14.10
Canada	659	12.68	752	19.79	531	13.21
Algeria	124	2.58	617	16.31	297	7.51
Others	6831	138.83	6148	168.69	7178	187.66
Total	**114345**	**2289.02**	**109522**	**2988.40**	**108120**	**2905.82**

Source: www.cashewindia.org

Table 7.17 Export of cashewnut shell liquid from India, 2007-2010

Countries	2007-2008 QTY (M.T)	2007-2008 VALUE (Rs.Crs)	2008-2009 QTY (M.T)	2008-2009 VALUE (Rs.Crs)	2009-2010 QTY (M.T)	2009-2010 VALUE (Rs.Crs)
USA	5512	7.58	5932	15.71	4827	9.79
China	638	1.15	1034	3.78	2770	7.94
Korea Rep.	1010	1.96	1048	3.17	1368	3.89
Japan	206	0.36	337	1.01	322	0.99
Indonesia	32	0.06	213	0.47	178	0.37
Taiwan	0	0	22	0.14	65	0.35
Slovenia	0	0	162	0.71	41	0.15
Thailand	0	0	31	0.11	31	0.12
Egypt	16	0.03	70	0.24	20	0.05
South Africa	0	0	32	0.13	16	0.06
United Kingdom	317	0.62	170	0.42	0	0.00
Zimbabwe	80	0.21	32	0.08	0	0.00
Russia	0	0	16	0.09	0	0.00
Others	3	0.01	0	0.00	110	0.42
Total	**7813**	**11.98**	**9099**	**26.06**	**9748**	**24.12**

Source: www.cashewindia.org

The details of exports of cashewnut shell liquid from India are presented in table 7.17. The major importers from India are USA, China and Korea Rep. Nearly 80 per cent of total exports were imported by these countries.

The exports of cashew nuts roasted/salted from India to different countries are presented in table 7.18. United States, UAE, Switzerland, Sweden, U.K and Malaysia are the major importers from India during the study period 2007-08 to 2009-2010.

Table 7.18 Exports of cashew nut roasted/salted

	2007-2008		2008-2009		2009-2010	
Country	**Qty**	**Value**	**Qty**	**Value**	**Qty**	**Value**
UNITED STATES	12,387.00	2,488,331.00	76,817.00	15,630,027.00	358,555.00	75,445,332.00
UNITED ARAB EMIRATES	41,388.00	9,089,257.00	39,371.00	6,696,623.00	34,976.00	8,897,034.00
SWITZERLAND	3,759.00	1,559,208.00	3,457.00	1,754,675.00	10,440.00	1,932,820.00
SWEDEN	24,507.00	4,911,011.00	22,860.00	3,302,169.00	12,200.00	1,824,307.00
UNITED KINGDOM	46,721.00	7,905,652.00	2,088.00	518,852.00	6,060.00	1,400,621.00
MALAYSIA	3,250.00	312,380.00	0	0	3,900.00	1,266,900.00
MALDIVES	3,519.00	1,197,186.00	4,503.00	1,920,543.00	3,142.00	1,229,092.00
BELGIUM	0	0	0	0	2,544.00	1,005,696.00
SINGAPORE	1,061.00	412,069.00	3,204.00	771,638.00	5,061.00	997,820.00
AUSTRIA	10,746.00	1,275,061.00	0	0	5,565.00	928,615.00
HONG KONG	1,532.00	412,140.00	2,977.00	1,137,748.00	2,070.00	895,843.00
NEW ZEALAND	400	63,620.00	0	0	6,305.00	854,522.00
CANADA	555	122,438.00	110	6,369.00	2,504.00	682,783.00
JAPAN	0	0	3,105.00	562,687.00	4,226.00	653,429.00
DENMARK	2,600.00	629,836.00	16,728.00	9,009,757.00	1,176.00	628,398.00
OMAN	5,727.00	448,241.00	0	0	900	509,975.00
MAURITIUS	2,315.00	304,612.00	925	409,911.00	1,500.00	412,725.00
SAUDI ARABIA	16,950.00	4,909,103.00	16,905.00	5,355,453.00	1,805.00	184,891.00
FIJI ISLANDS	420	96,329.00	100	30,171.00	2,000.00	180,449.00
AUSTRALIA	0	0	200	65,055.00	450	156,230.00
UNSPECIFIED	0	0	5,000.00	1,304,160.00	153	53,661.00
GERMANY	0	0	1,289.00	265,771.00	200	50,856.00
SEYCHELLES	160	32,862.00	0	0	194	44,307.00
ITALY	210	10,187.00	5,000.00	625,317.00	100	20,244.00
IRELAND	0	0	310	61,616.00	70	17,794.00
LIBERIA	0	0	0	0	60	14,952.00
CHILE	0	0	0	0	60	12,618.00
NETHERLANDANTIL	0	0	0	0	45	5,857.00
RUSSIA	0	0	0	0	61	5,562.00
FRANCE	1,529.00	479,503.00	1,199.00	433,945.00	21	3,968.00
SOUTH AFRICA	0	0	0	0	11	1,662.00
BAHRAIN	426	41,147.00	0	0	3	1,577.00
THAILAND	0	0	0	0	25	1,242.00
TAIWAN	0	0	900	129,880.00	0	0
SRI LANKA	0	0	13,467.00	3,159,220.00	0	0
ALGERIA	0	0	453	98,539.00	0	0
FINLAND	12,513.00	6,249,983.00	3,511.00	1,895,571.00	0	0
QATAR	37	3,500.00	1,201.00	211,714.00	0	0
REUNION	1,844.00	93,081.00	0	0	0	0
PHILIPPINES	8,483.00	1,551,862.00	0	0	0	0
NIGERIA	0	0	5,000.00	2,686,687.00	0	0
NETHERLAND	0	0	200	129,120.00	0	0
NEPAL	1,382.00	195,575.00	23	13,580.00	0	0
KUWAIT	513	306,336.00	129	17,819.00	0	0
Total	204,934	45,100,510	231,032	58,204,617	466,382	100,321,782

Source: DGCIS Annual Export

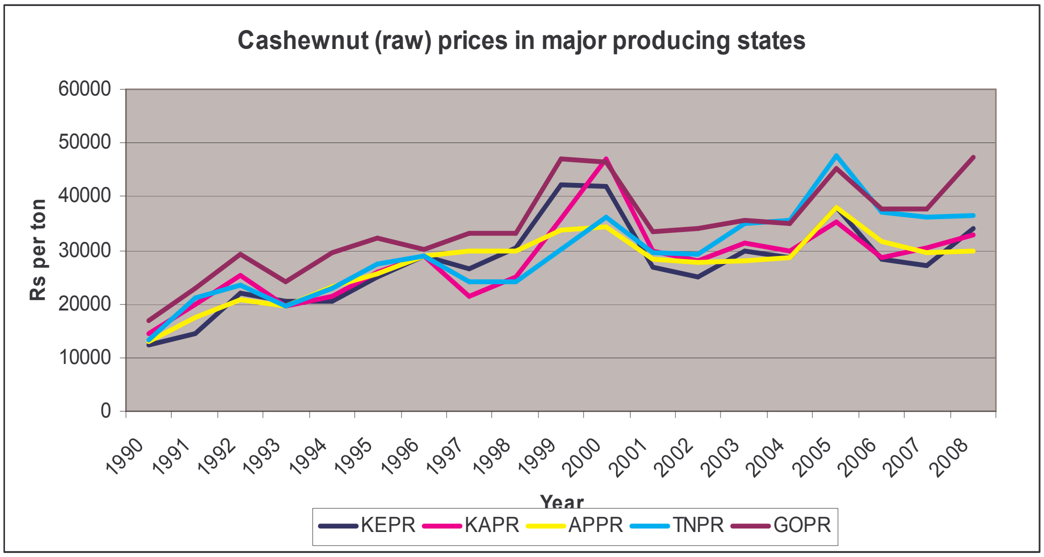


Fig 7.8 Unit raw cashewnut prices from major producing states

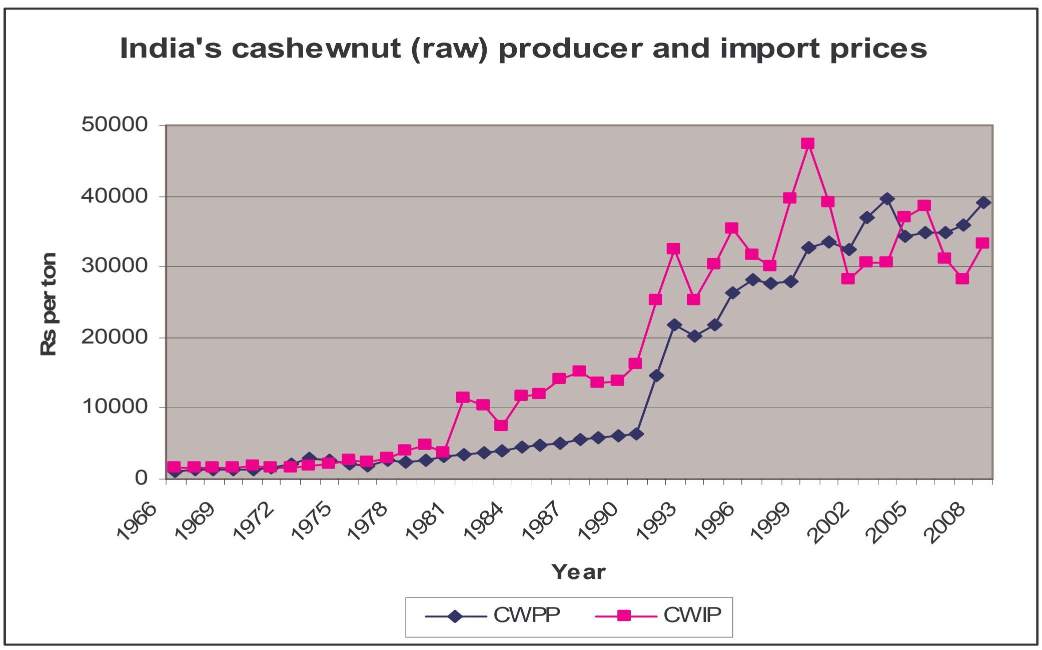


Fig 7.9 Cashewnut producer prices Vs import prices

The details of wholesale prices in major producing states in India are depicted in fig. 7.8. All the states were exhibited similar trends throughout the study period (1990-2008). The raw cashewnut producer and import prices are illustrated in the fig. 7.9. The imported prices dominated the producer prices from 1966 to till 2002. Thereafter, the imported prices were declined than domestic producer prices.

Market integration tests

The stationarity tests were conducted on cashewnut producer prices and import prices for the period 43 years (1966 to 2008) (table 7.19). The export prices for raw cashewnuts were not available for the study period. The results of ADF test indicated that the first differences showed significant estimates at 1 per cent level. This meant that data were stationary in first differences with order of integration being I (1) for cashewnut. As the two price series were found to be qualified for the pair-wise cointegration tests.

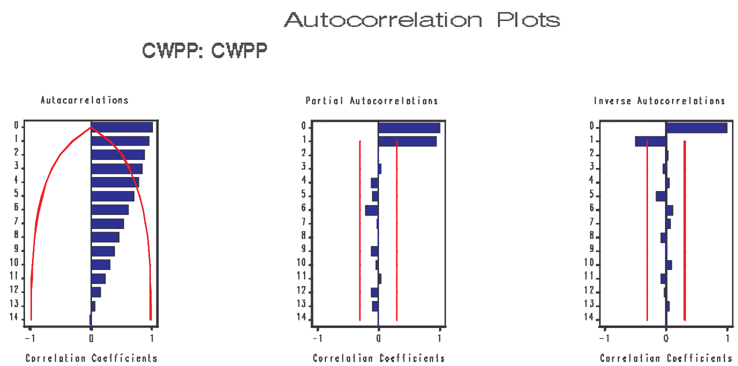
Relationship between producer and import prices

Table 7.19 Tests for stationarity

Market	ADF test#	
	I (0)	I (1)
Producer prices	0.34	-5.56*
Export prices	N.A	N.A
Import prices	-1.07	-7.55*

based on single mean type estimation
* Significant at 1 percent level

If t (cal) > ADF critical value => not reject the null hypothesis, i.e., unit root exists in data variable
If t (cal) < ADF critical value => reject the null hypothesis, i.e., unit root does not exist in data variable



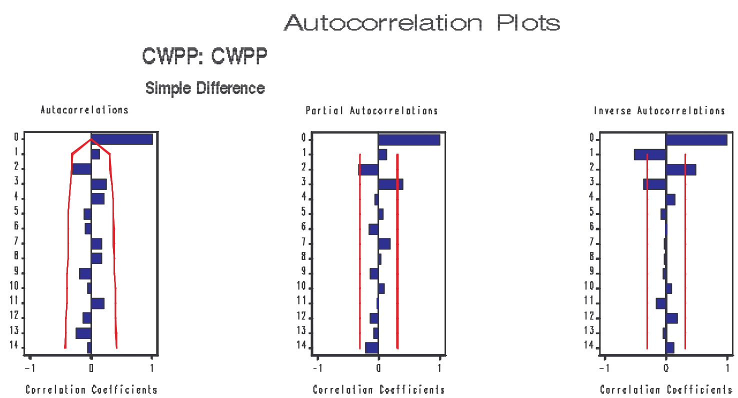
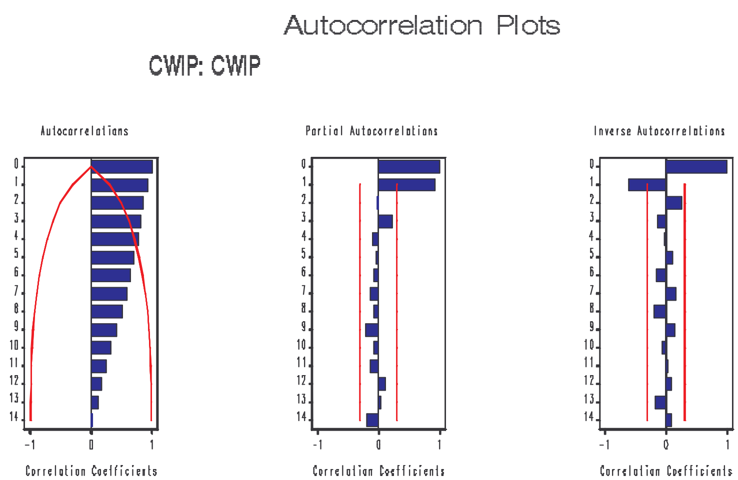


Fig 7.10 Producer price before and after differencing



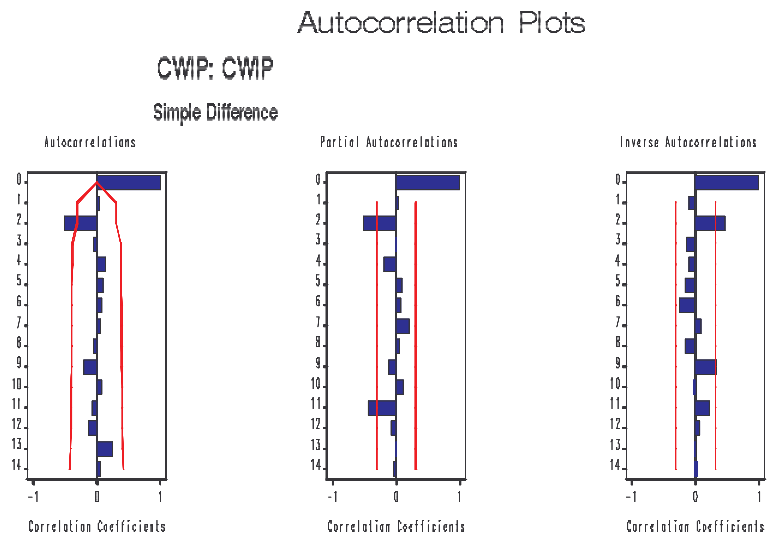


Fig 7.11 Import price before and after differencing

Table 7.20 Testing cointegration between producer and import price series (ranking using trace method)

Series	H0: Rank=r	H1: Rank>r	Eigen Value	Trace	5% Critical Value
Producer and import Prices	0	0	0.2015	9.2343	15.34
	1	1	0.0002	0.0083	3.84

Drift in ECM: Constant; Drift in process: Linear

The order of integration was tested for different combination of prices in order to find out the relationship between those prices (table 7.20). Maximum eigen value and significant trace indicated that producer price and import price were not integrated at order I (1).

Table 7.21 Granger-Causality Wald Test for long term integration

Dependant	Independent	Chi-Square	Pr > ChiSq
Producer Price	Import Price	3.31	0.1915
Import Price	Producer Price	2.51	0.2856

Results of Granger Causality Wald tests presented in table 7.21 indicate the direction of relationship (uni or bidirectional) between prices. Producer and import prices were influencing each other a little, while the influence of import price on producer price was found high. For detailed VECM analysis (long run and short run relationships) please see Appendix table A24. .

Relationship between international and domestic whole sale prices

The stationarity tests were conducted on cashewnut international prices and domestic wholesale prices for the period 18 years (1990 to 2008) (table 7.22). The results of ADF test indicated that the first differences showed significant estimates at 1 per cent level. This meant that data were stationary in first differences with order of integration being I (1) for cashewnut. As the two price series were found to be qualified for the pair-wise cointegration tests.

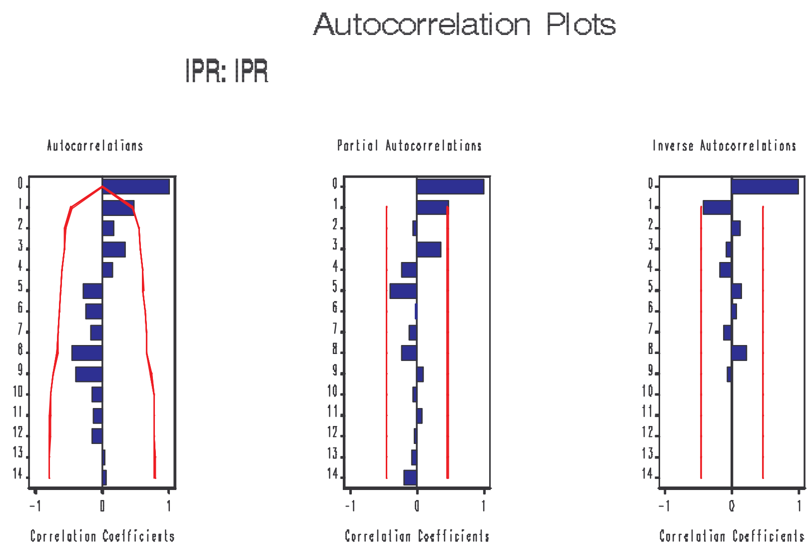
Table 7.22 Tests for stationarity

Market	ADF test#	
	I (0)	I (1)
International price	-2.21	-5.09*
Kerala market price	-2.60	-4.50*
Karnataka market price	-2.49	-4.83*
A.P market price	-2.29	-3.49**
T.N market price	-1.51	-4.38*
Goa market price	-1.91	-4.65*

based on single mean type estimation
* Significant at 1 percent level ** Significant at 5 percent level

If t (cal) > ADF critical value => not reject the null hypothesis, i.e., unit root exists in data variable

If t (cal) < ADF critical value => reject the null hypothesis, i.e., unit root does not exist in data variable



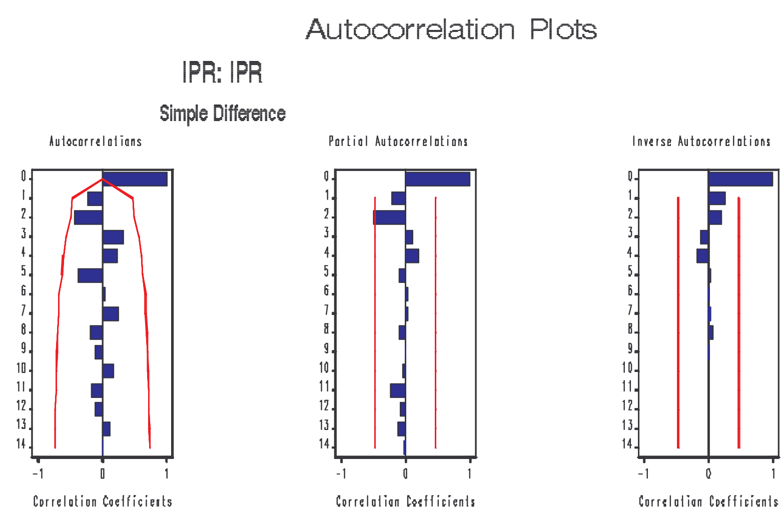
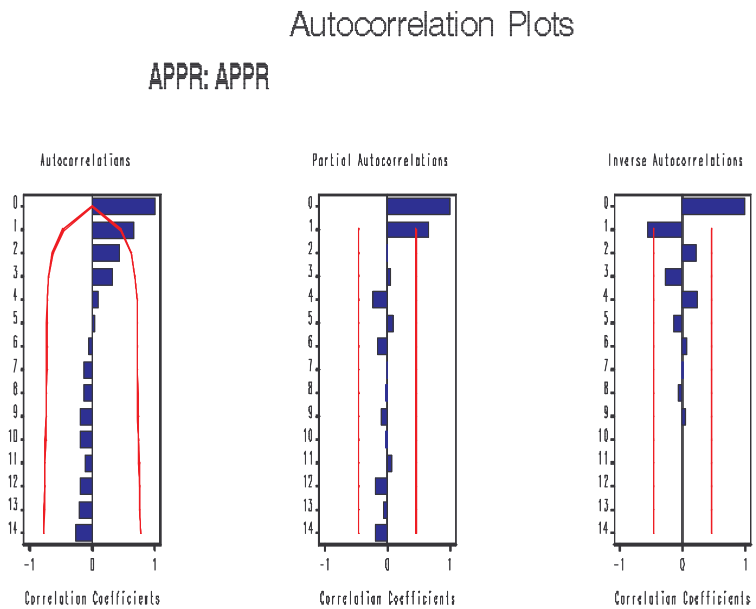


Fig 7.12 International price before and after differencing



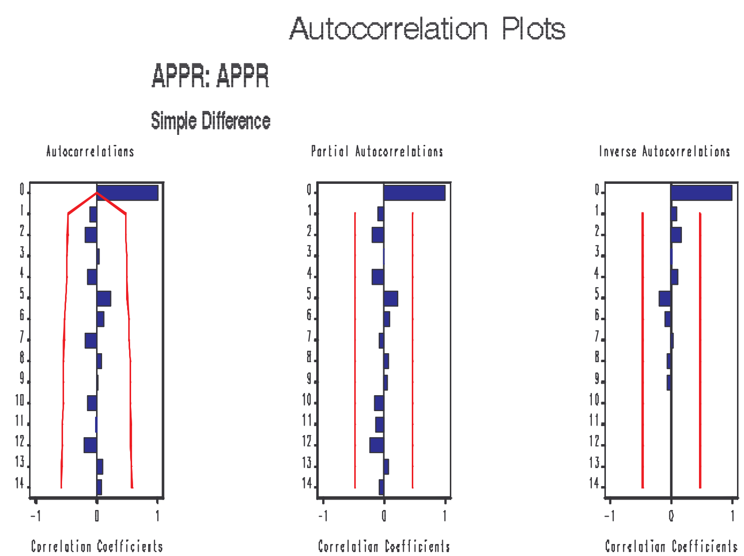


Fig 7.13 AP whole market price before and after differencing

Table 7.23 Testing Cointegration between international price and domestic market (ranking using trace method)

Series	H0: Rank=r	H1: Rank>r	Eigen Value	Trace	5% Critical Value
International price and Kerala market	0	0	0.3005	7.9782	15.34
	1	1	0.1058	1.9018	3.84
International price and Karnataka market	0	0	0.3345	9.9887	15.34
	1	1	0.1650	3.0657	3.84
International price and A.P market	0	0	0.3094	9.6043	15.34
	1	1	0.1770	3.3120	3.84
International price and T.N market	0	0	0.3003	6.7753	15.34
	1	1	0.0406	0.7051	3.84
International price and Goa market	0	0	0.2876	6.0810	15.34
	1	1	0.0184	0.3156	3.84
Kerala market and Karnataka market	0	0	0.4803	19.2749	15.34
	1	1	0.3808	8.1479	3.84
Kerala market and A.P market	0	0	0.5841	19.9262	15.34
	1	1	0.2554	5.0131	3.84
Kerala market and T.N market	0	0	0.4525	12.1409	15.34
	1	1	0.1057	1.8989	3.84
Kerala market and Goa market	0	0	0.3698	8.6863	15.34
	1	1	0.0481	0.8381	3.84
Karnataka market and A.P market	0	0	0.5457	19.0076	15.34
	1	1	0.2804	5.5937	3.84
Karnataka market and T.N market	0	0	0.3744	9.7279	15.34
	1	1	0.0980	1.7537	3.84
Karnataka market and Goa market	0	0	0.4894	14.6573	15.34
	1	1	0.1731	3.2309	3.84
A.P market and T.N market	0	0	0.3300	9.3025	15.34
	1	1	0.1365	2.4946	3.84
A.P market and Goa market	0	0	0.4455	14.6034	15.34
	1	1	0.2361	4.5779	3.84
T.N market and Goa market	0	0	0.2520	6.9126	15.34
	1	1	0.1098	1.9771	3.84

Drift in ECM: Constant; Drift in process: Linear

Table 7.24 Granger-Causality Wald Test for long term integration

Dependant	Independent	Chi-Square	Pr > ChiSq
International price	Kerala price	0.85	0.6548
Kerala price	International price	2.81	0.2458
International price	Karnataka price	3.26	0.1962
Karnataka price	International price	3.26	0.1962
International price	A.P price	0.41	0.8157
A.P price	International price	1.76	0.4153
International price	T.N price	1.18	0.5555
T.N price	International price	1.14	0.5665
International price	Goa price	0.15	0.9298
Goa price	International price	0.63	0.7292
Kerala price	Karnataka price	4.60	0.1003
Karnataka price	Kerala price	5.44	0.0660
Kerala price	A.P price	4.58	0.1013
A.P price	Kerala price	0.76	0.6855
Kerala price	T.N price	1.53	0.4660
T.N price	Kerala price	0.03	0.9875
Kerala price	Goa price	0.20	0.9061
Goa price	Kerala price	0.01	0.9951
Karnataka price	A.P price	6.04	0.0487
A.P price	Karnataka price	1.77	0.4125
Karnataka price	T.N price	0.48	0.7873
T.N price	Karnataka price	0.24	0.8869
Karnataka price	Goa price	8.50	0.0142
Goa price	Karnataka price	4.63	0.0986
A.P price	T.N price	0.25	0.8819
T.N price	A.P price	0.64	0.7266
A.P price	Goa price	1.80	0.4069
Goa price	A.P price	5.70	0.0578
T.N price	Goa price	0.45	0.7998
Goa price	T.N price	0.99	0.6091

The order of integration was tested for different combination of prices in order to find out the relationship between those prices. Maximum eigen value and significant trace indicated that domestic prices and international price were not integrated at order I (1) (Table 7.23). However, integration was found among different domestic markets.

Results of Granger Causality Wald tests presented in table 7.24 indicate the direction of relationship (uni or bidirectional) between prices. International and domestic prices were not influencing each other, while the influence was observed between domestic markets. Kerala market was found to influence by A.P and Karnataka market prices while the vice-versa a little was significant. For detailed VECM analysis (long run and short run relationships) please see Appendix table A25 to A29.

Producer prices

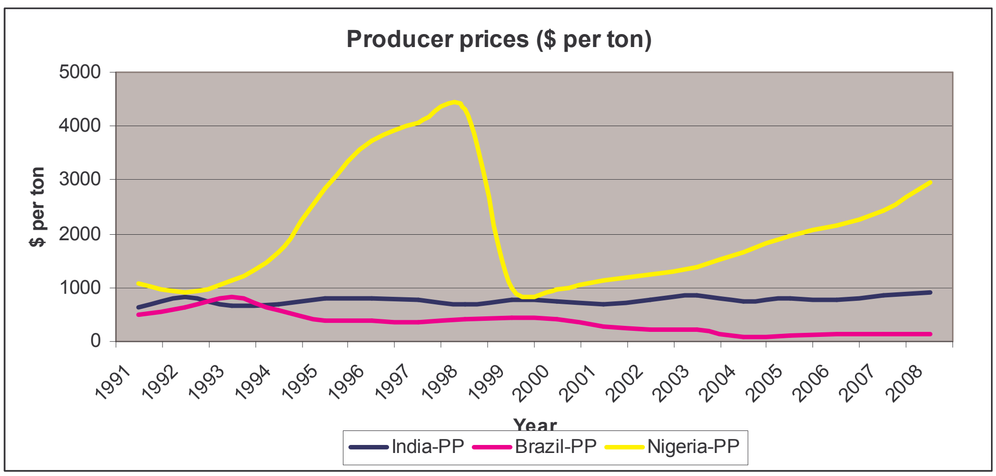


Fig 7.14 Cost of production across different countries

The details of producer prices of major producers in the world are illustrated in the fig 7.14. Per unit costs of production in India was almost stable from the last two decades. But, the production costs were much lower in Brazil when compared to India. The per unit costs of production was highly fluctuating in case of Nigeria for the same period.

Economics of cashew production in India

The economics of the sample farmers cultivating seedlings, varieties like VRI-II and III have been presented below:

The seedlings are produced by the farmer themselves. They start yielding only from 4th year onwards. During the first four years, farmers grow intercrops (black gram preferred) to earn sufficient revenues. The investment cost of cashew plantations raised on seedlings under irrigated and rainfed conditions is given in table 7.25.

Table 7.25 Average investment cost per ha (Rs.)

Item	Seedlings with irrigation	Seedlings with rainfed
Land preparation	2815	2815
Planting the seed	350	350
Plant stacking	2250	2250
Fencing the land area	7500	7500
Farmyard manure	4500	4500
Labor for manure application and fencing	4100	4100
Fertilizer application	1500	3000
Weeding	1250	1250
Pruning	3750	3750
Watering	4000	5000
Pesticide spray	1200	1200
Harvesting	3000	5000
Total	36215	40715

Source: NABARD Regional office, Chennai (2007)

The annual maintenance cost per ha is Rs.14025 and Rs.10825 respectively for irrigated and rainfed orchards (table 7.26).

Table 7.26 Maintenance cost from 6th year onwards (Rs per ha)

Item	Seedlings with irrigation	Seedlings with rainfed
Farmyard manure	1800	1800
Labor costs	750	750
Fertilizer application	3000	1250
Irrigation costs	1000	--
Pesticide spray	1350	900
Weeding	625	625
Pruning	500	500
Harvesting cost	5000	5000
Total	14025	10825

Source: NABARD Regional office, Chennai (2007)

Table 7.27 Productivity levels (Average yield in bags of 80 kg)

Type	6-10 years	> 10 years
Seedlings plantation (irrigated)	12.0	15.0
Seedlings plantation (rainfed)	7.5	10.0
Seedlings plantation (grafted)	16.4	20.0
Plantations (partially organic)	16.0	20.0
Old orchards replaced with graft plantations	**14.4**	**20.0**

Source: NABARD Regional office, Chennai (2007)

Shortcomings in cashew nut production

Cashew research in India was initiated through ad-hoc schemes in different states which concentrated mainly on collection of germplasm and selection of high yielding trees for propagation. As cashew is a cross pollinated crop, the initial research efforts of identification of mother trees and their multiplication through seeds is one of the causes responsible for the poor yield in plantations established by Forest Departments and Cashew Development Corporations as well as by small farmers.

There was very little concern for the nutritional aspect in the initial research efforts. As it is considered mostly as a crop which can withstand neglected conditions, none of the plantations established earlier received fertilizer input. Even in research, the nutritional aspect received attention only after the establishment of CPCRI and All India Coordinated Spices and Cashew Improvement Project in 1970 and 1971 respectively. Results of which were available only in late 1970s and even then, the transfer of technology was not effective for convincing the farmers for going in for fertilizer application for enhanced productivity.

Cashew crop luckily does not have any major disease problem, however, tea mosquito and stem and root borer are the two major insect pests which are the limiting factors for production. The yield loss due to tea mosquito bug infestation ranged between 30 and 50 per cent in different years, while the stem and root borer infestation in neglected plantations will be around 8 to 10 per cent. The recommendations for the control of tea mosquito bug infestation both by traditional ground spray as well as aerial spraying for large plantations were standardized in late 1970s. However, even these plant protection measures are being adopted only in the recent years. This aspect should receive highest attention in the development programmes.

The self sufficiency in cashewnut production in the country can be achieved within about 10 years by resorting to following two strategies:

- Area expansion both in traditional and non-traditional areas.
- Increase in productivity which is possible by developing high yielding dwarf and compact cashew types suitable for high density planting and also by developing other cashew production technologies with farmers and Cashew Corporation / forest corporations adopting them in their cashew orchards.

Factors Influencing Kernel rejects

Studies on identification of factors influencing the kernel rejects have indicated that processing of immature nuts and floaters resulted in increased per cent kernel rejects with decreased shelling percentage, peeling outturn and per cent wholes recovered.

SWOT analysis of Indian cashewnut production

Strength

- One of the main advantages which India enjoys is the superior processing capacity established in the country. Further in the international trade, linkages developed by India are much stronger than any other country. India exports cashew to over 65 countries of the world and India has been in this trade for over one century and Indian Cashew is considered as best. Another advantage for the cashew export itself is that none of the cashew importing countries has cashew cultivation. India also has the advantage of importing raw nuts from other cashew producing countries.
- There is best linkage between organizations dealing with Research (NRCC, AICRPCashew, SAUs) and those engaged in development

(DCCD, State Dept. of Hort. / Agr.) and those working on export promotion (CEPC) & Industries.

- In the international market Indian cashew kernels are rated as the best and the demand for the same is likely to continue as compared to cashew kernels which are processed mechanically by other countries.
- Availability of high yielding varieties released from different Research Centres and Agricultural Universities during last 25 years is one of the major strengths. Out of the 37 varieties released so far 27 varieties have the potential of 1 ton/ha.
- As large planting material is needed both for area expansion and replanting programmes, regional nurseries have been established and these nurseries have the capacity of producing abut 60 -70 lakh grafts annually and graft production is being increased every year with establishment of more nurseries. This will help in increasing the production of raw nuts and achieving self sufficiency by 2015 AD.

Weaknesses

- Low productivity of cashew in India is the major weakness. Shortage of raw nuts and higher cost of production are also the important aspects coming in the way of smooth running of cashew industries. Indian needs to import huge quantity of raw cashewnuts from abroad for feeding its factories. Another research weakness is the non-availability of efficient and cost effective technology for the utilization of cashew apple which is otherwise being wasted. India, being a developing country cannot afford to waste this highly nutritious fruit and if apples are utilized economically and effectively, farmers would get additional income from cashew apples in addition to the income from nuts.
- Transfer of Technology from Research centres to Farmers Fields is not adequate. At present the package which is used for the export of cashew kernels is quite expensive. We need to develop low cost packaging acceptable to European countries so that Indian produce can compete with kernels being exported from other countries.

- Although extensive research work has been done since 1950's, very little work has been done on the understanding of basic metabolic changes during flowering, which is one of the major weaknesses. This need immediate attention so that, synchronized flowering could be achieved which would help farmers in reducing the harvesting period. In the frontiers areas of Bio-technology product diversification, IPM particularly pheromone technology, technical expertise is inadequate.

Opportunities

- Infrastructure for research and development can be effectively exploited with proper financial input. One of the factors, which is in favour of the cashew cultivation is the stable price of the cashew kernels in the international market compared to other edible nuts like almonds, hazel nuts etc. The prices of cashew kernels are most stable. With the effective market strategy India has a good opportunity to catch sizable market in the international trade.
- It is also advantageous to have a variety with lesser free sterol and higher triglyceride content as glycerides are rich in unsaturated fatty acids. Cashew kernels compare well with other tree nuts and scores well with regard to some of the factors such as higher protein, carbohydrate, minerals and unsaturated fatty acid contents and very nutritious.
- Supply chain and value addition has great scope in Indian cashew industry. Cashew apple can be utilized for bio-fuel and industrial alcohol production. The by-product Cashew Nut Shell Liquid (CNSL) has good scope in emerging field of Nano-Technology which has lot of application in Medical field for targeted drug delivery.
- Organic cashew can be profitably exported. As cashew is basically organic by default, so easily it can be converted into organic. The research net work available in the country must work on this aspect and exploit the opportunity which is available.
- Research efforts in developing integrated pest management have given some encouraging leads. There is ample scope for development

of eco -friendly pest management approach through the use of pheromone and kairomone technology.

Threats

- The South East Asian countries namely, Indonesia, Vietnam and Thailand have taken up cashew cultivation in the recent years. Brazil has also initiated well organized state supported programme of cashew development. Panama has also entered into the scene. Research efforts of cashew are also started in Brazil by establishing a National Research Centre or Cashew. In addition, research efforts are also in progress in Tanzania. So, there is stiff competition from different countries.
- As many African countries are establishing their own cashew processing units to process their cashew nuts, India may not be able to continue to import raw cashewnuts from those countries to feed our cashew factories. This threat can be over come if we can develop an aggressive market strategy to import raw nuts from some South East Asian countries which are yet to develop proper processing facilities.
- Indian had started this crop cultivation in neglected areas and the South East Asian countries which are now taking up cashew cultivation are utilizing some of the best areas suitable for higher production.

Cashewnut processing and value addition

Table 7.28 Cashew processing units in India, 2005-06*

States	Processing Units (Nos.)	Capacity	Current Utilization (000 MT)		
			Indigenous	Import	Total
Kerala	432	600	67	320	387
Karnataka	266	300	45	20	65
Goa	45	50	21	--	21
Maharashtra*	2200	50	20	--	20
Tamil Nadu	417	400	294	225	519
Andhra Pradesh	175	100	92	--	92
Orissa	209	100	11	--	11
West Bengal	30	8	8	--	8
Chattisgarh	3	5	--	--	--
NE States	22	10	15	--	15
Total	3799	1623	573	565	1138

* Includes 1850 small scale cottage industry

Competitiveness

Guledgudda (2005) estimated the nominal protection coefficients of cashew kernel for the year 2004-05 under importable and exportable hypothesis and the results of the analysis are presented in Table 7.29a and 7.29b.

The nominal protection coefficients of raw cashew for the year 2004-05 under importable hypothesis are presented in Table 7.29a indicates that the NPCs was found to be less than unity (0.88), which indicates a good import substitute of raw cashewnut. The nominal protection coefficients of export of cashew kernel were found to be lower than unity (0.98) under exportable hypothesis. This implies that cashew kernel is a good exportable product. The foregoing results revealed that cashew kernel was competitive in the international market and has vast potential for expansion of the domestic industry.

Table 7.29a NPC of raw cashew imports (2004-05)

Sl. No.	Particulars	Unit	Value
1	FOB Price (in US)	$ / Qtls	606.26
2	Plus freight from US to India	$ / Qtls	3.41
3	Plus insurance at 2% of price	$ / Qtls	12.13
4	Equals CIF price(1+2+3)	$ / Qtls	621.80
5	Exchange rate	1 $ = Rs	44.00
6	Equals CIF price (row4*row5)	Rs / Qtls	27358.99
7	Plus port clearing charges (Chennai)	Rs / Qtls	120.10
8	Equals landed cost(6+7)	Rs / Qtls	27479.09
9	Plus transport cost (Mangalore)	Rs / Qtls	51.10
10	Equals landed cost(8+9)	Rs / Qtls	27530.19
11	Reference price (9+10)	Rs / Qtls	27581.29
12	Whole sale price of C.K.	Rs / Qtls	24314.00
13	NPC (row 12 / row 11)		0.88

Table 7.29b NPC values of cashew kernels exports (2004-05)

Sl. No.	Particulars	Place	Unit	Value
1	Wholesale price of cashew kernel	Mangalore	Rs./ Qtls.	24314.00
2	Plus transport cost to	Chennai	Rs./ Qtls.	51.10
3	Plus marketing margin (5%)		Rs./ Qtls.	1215.70
4	Plus Port clearing & handling charges		Rs./ Qtls.	120.10
5	Equal FOB Price(1+2+3+4)	Chennai	Rs./ Qtls.	25700.90
6	Plus Freight charge		Rs./ Qtls.	194.00
7	Plus insurance at 2% of price		Rs./ Qtls.	486.28
8	Equals landed cost (5+6+7)	US	Rs/Qtls	26381.18
9	Exchange rate		1$=Rs	44.00
10	CIF price (row 8 / row 9)		US $ / Qtl	599.57
11	Reference price	US	US $ / Qtl	606.26
12	NPC of cashew kernels (row 10/row 11)			0.98

Shalini Yadav (2010) estimated the export competitiveness of Indian cashew is based on NPC for 2005-06. Table below depicts the NPC of cashew for Kerala, Orissa and Tamil Nadu. Domestic price is the average of wholesale price of exportable grades (W 240 & W 320) in the three States collected from the sample processors. The unit value of FOB has been derived from the annual export data.

State	NPC
Kerala	1.41
Orissa	1.10
Tamil Nadu	1.07
Average	1.19

The NPC estimates measuring the degree of export competitiveness of Indian Cashew during 2005-06 suggest less export competitive nature of cashew in the three States. Cashew in Tamil Nadu was almost at borderline and could be considered to be promising from export point of view. However, more information for other years would be required to substantiate the export competitiveness. Export competitiveness of cashew in Kerala, Orissa and Tamil Nadu are not efficient due to the ageing trees and declining productivity.

High Yielding Varieties of cashew have to be introduced and promoted on a large scale through public private participation.

Table 7.29c Trade (export) competitiveness
(under importable hypothesis)

			CW-09-10@
Domestic Prices	Domestic price of Tradable output#	A	51253.0
	Domestic price of Non-Tradable output	B	9579.0
	Domestic price of Tradable input	C	16737.0
	Domestic price of Non-Tradable input	D	5138.0
Economic Prices	Border price of Tradable output$	E	42256.0
	Opportunity cost of Non-Tradable output	F	9579.0
	Border price of Tradable input	G	16737.0
	Opportunity cost of Non-Tradable input	H	6200.0
Surplus	Private Profit under Autarky (PPA)	(A+B)-(C+D)	38957
	Private Profit under Free Trade (PPFT)	(E+B)-(C+D)	29960
	Social Profit under Free Trade (SPFT)	(E+F)-(G+H)	28898
	Total Policy Transfer (TPT)	(PPA-SPFT)	10059
Competitiveness Measure	Nominal Protection Coefficient (NPC)	(A/E)	1.21
	Effective Protection Coefficient (EPC)	(A-C)/(E-G)	1.35
	Effective Subsidy Coefficient (ESC)	[(A-C)+(H-D)]/(E-G)	1.39
	Domestic Resource Cost Ratio (DRCR)	(H-F)/(E-G)	-0.13

@ Authors estimates from Tamil Nadu state
# Wholesale price at Chennai port after adjusting with transport costs
$ Wholesale prices at Cote d'Ivoire prices after adjusting with transport costs

The competitiveness of raw cashewnuts was assessed under importable hypothesis. The results showed that importing raw cashewnuts was not competitive. India has comparative advantage in exporting cashewnut kernels (shelled). Indian cashewnut industry is facing the problem of shortage of raw nuts in the country. The value of DRCR is low which indicates high comparative advantage in the production of cashewnuts in the country. The earlier studies conducted by various researchers also concluded that India is losing its competitiveness over a period of time. The need of hour is replacement of old plantations with new potential hybrids and linking the small and marginal cashew growers to the marketing channels.

Agri Export Zone for Cashew in Cuddalore District (Tamil Nadu)

To set up a Cashew Export Zone at Panruti in Cuddalore district, a Memorandum of Understanding was signed between GoTN and APEDA (Agriculture and Processed Food Products Export Development Authority) at a project cost of Rs.17 crore in April 2005. M/s Sattva Agro Export Pvt. Ltd. has been selected as the anchor promoter for cashew Agri Export Zone through private participation. The work for AEZ commenced in 2006-07 with the construction of infrastructure facilities. Modern nursery has been established for providing quality seedlings to the farmers and the construction of processing unit and pack house has been completed (Agriculture Policy Note 2009-10, Government of Tamil Nadu, 2009-10).

Issues and future strategies

- ✓ Issues which should receive immediate attention are the germplasm conservation, developing varieties, molecular characterization of germplasm accessions and mass multiplication of planting material required for replanting / fresh planting envisaged in the years to come. Integrated nutritive management including organic farming is another issue which should receive the prioritization in research programmes.
- ✓ Canopy architecturing and limb pruning techniques should be standardized to suit the requirement of different plant densities and system of planting.
- ✓ Usage of pesticides should be minimized in cashew and suitable IPM package should be developed involving pheromone and kairomone technology.
- ✓ Except in Goa, cashew apple is wasted in almost all the states. Even though a number of products have been developed both by the Universities and CSIR laboratories market acceptability is very low. Developing acceptable product from the apple will increase farmer’s attractiveness for taking up cashew cultivation profitably. There is great

scope to utilize cashew apple for production of bio-fuel and industrial alcohol.

7.2 Tea

Tea is the most popular beverage in world and it is the national beverage of India. It was first discovered by the Chinese in sometime in 2000- 1500 BC. India is producing and consuming tea from 500 BC. But it was only 19th century when India commercially started producing tea. India is the second largest grower of tea in the world after China but the largest consumer of tea. 12% of world's tea is produced in India. Also India produces the finest quality of tea that is Darjeeling tea. Currently India earns 4% of its national income from tea. Tea production, certification, exportation, and all other facets of the tea trade in India are controlled by the Tea Board of India. The genesis of the Tea Board India dates back to 1903 when the Indian Tea CESS Bill was passed. The Bill provided for levying a CESS on tea exports - the proceeds of which were to be used for the promotion of Indian tea both within and outside India.

The present Tea Board set up under section 4 of the Tea Act 1953 was constituted on 1st April 1954. It has succeeded the Central Tea Board and the Indian Tea Licensing Committee which functioned respectively under the Central Tea Board Act, 1949 and the Indian Tea Control Act, 1938 which were repealed. In 2008, world tea production reached over 4.73 million tons. The total turnover of the tea industry is around Rs. 10,000 crores (www.teauction.com). There are more than 14000 tea estates in India. There are several types of tea: black tea, green tea, white tea, yellow tea. In India mainly black tea is produced. Region wise, Indian tea is divided in three groups, Assam Tea, Darjeeling Tea and Nilgiri Tea. India produces 90% tea by CTC (Crush Tear Curle) method and 10% in the orthodox method. Apart from Orthodox, CTC & Green tea, powder tea which is known as "Instant tea": is also being manufactured in India. The Instant tea is manufactured in separate factories known as Instant tea factory. The procedure for manufacturing Instant tea is different from that of black tea or green tea.

According to the data of 2002 tea industry of India involves 12.55 labors in the industry.

Table 7.30 World production of tea

Country	2006	2007	2008
China	1,047,345	1,183,002	1,257,384
India	928,000	949,220	805,180
Kenya	310,580	369,600	345,800
Sri Lanka	310,800	305,220	318,470
Turkey	201,866	206,160	1,100,257
Vietnam	151,000	164,000	174,900
Indonesia	146,858	150,224	150,851
Japan	91,800	94,100	94,100
Argentina	72,129	76,000	76,000
Iran	59,180	60,000	60,000
Bangladesh	58,000	58,500	59,000
Malawi	45,009	46,000	46,000
Uganda	34,334	44,923	42,808
Other countries	189,551	193,782	205,211
Total	**3,646,452**	**3,887,308**	**4,735,961**

Source: FAO

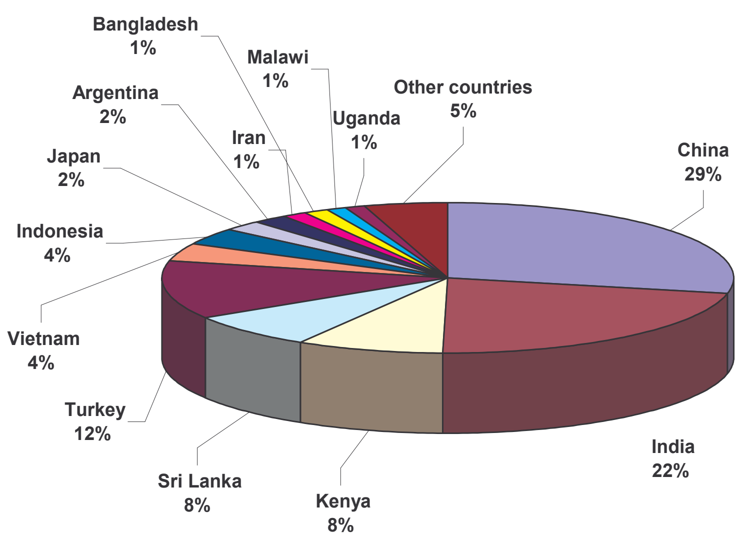


Fig 7.15 Major Producers of Tea (Triennium average)

World competition

Although India is largest producer of tea, it's increasingly facing competition. Its biggest competitor is Sri Lanka. Another competitor of India is Kenya. Tea is a new industry in Kenya but its expanding quiet fast. The US, UK, Netherlands, and Australia are the biggest importers of tea.

Table 7.31 Values of tea export from India in last few years

(Rs. in Crores)

Country	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
UK	151.56	177.8	177.12	177.12	177.14	57.08
Germany	72.5	90.53	107.32	107.32	82.5	39.61
Russian Federation	420.96	302.74	274.1	274.1	241.09	91.8
Kazakhstan	129	129.64	120.96	120.96	74.74	14.67
Poland	52.59	33.95	33.01	33.01	30.75	13.36
USA	91.05	108.19	110.76	110.76	131.3	45.36
Iran	15.21	10.65	10.23	10.23	52.98	11.58
UAE	315.46	291.45	280.84	280.84	263.28	60.32
Iraq	160.03	222.41	87.41	87.41	148.57	101.15
Pakistan	13.05	20.46	28.95	28.95	43.24	51.76
Australia	9.35	21.2	70.69	70.69	81.4	40.74

(Source: www.indiastat.com)

Prices

Relationship between the international prices and domestic prices of tea is given in the following figure. Since late 1990s, the national prices have been below the international prices, while the difference between the prices was very narrow in earlier periods.

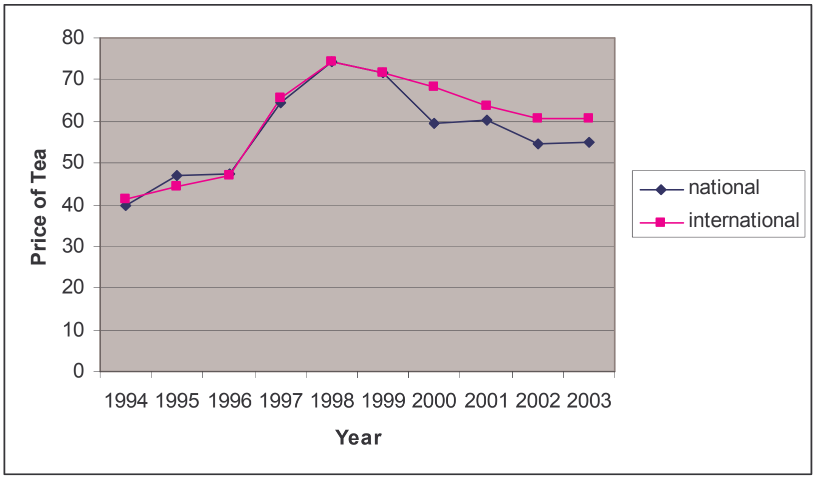


Fig 7.16 Movement of international and domestic price of tea

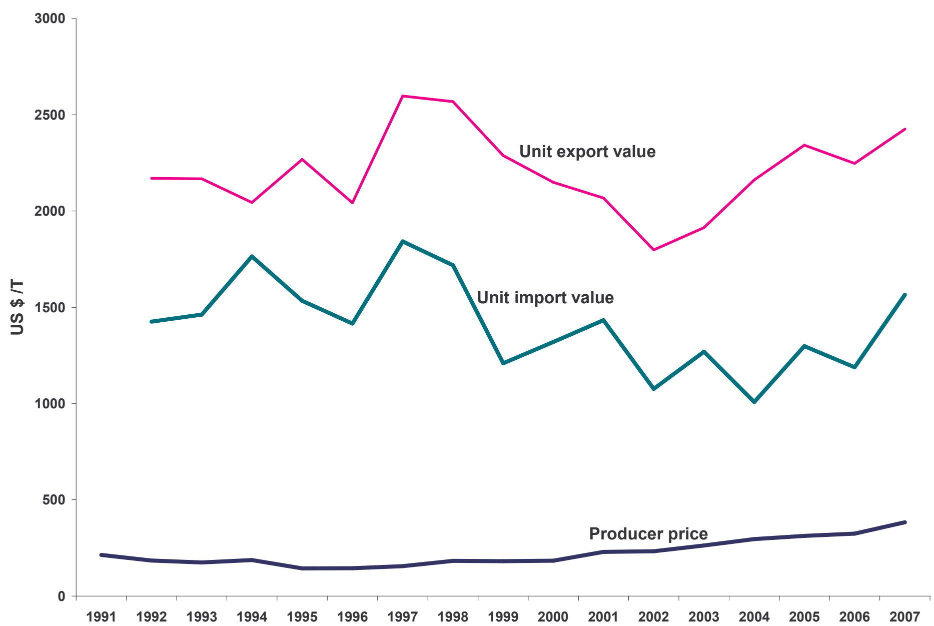


Fig 7.17 Trend in Producer price, unit export value and unit import value of Tea

Export and import prices were moving in a similar pattern throughout the periods.

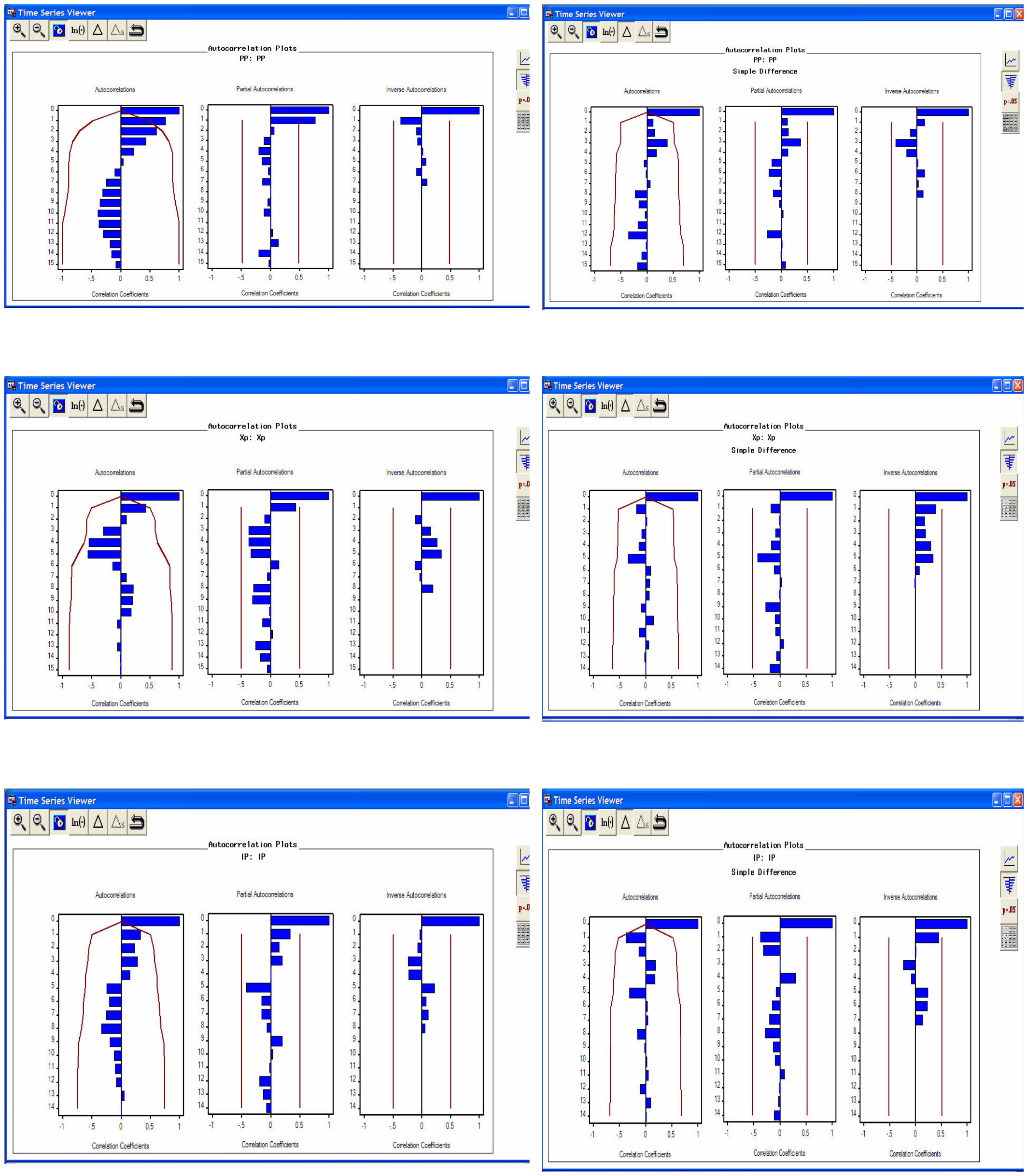


Fig 7.18 Testing the stationarity of price series of Tea

Integration and transmission among the prices is discussed below:

Table 7.32 Testing Cointegration between different price series and the rank using trace

Series	H0: Rank=r	H1: Rank>r	Eigen Value	Trace	5% Critical Value
Producer and Export Prices	**0**	**0**	0.2442	6.6419	15.34
	1	**1**	0.1767	2.7229	3.84
Producer and Import Prices	**0**	**0**	0.4715	9.2182	15.34
	1	**1**	0.0205	0.2893	3.84
Export and Import Prices	**0**	**0**	0.2341	6.6520	15.34
	1	**1**	0.1882	2.9188	3.84

Drift in ECM: Constant; Drift in process: Linear

Table 7.33 Granger-Causality Wald Test for long term integration

Dependant	Independent	Chi-Square	Pr > ChiSq
Producer Price	Export Price	0.04	0.9809
Export Price	Producer Price	0.03	0.9849
Producer Price	Import Price	1.90	0.3862
Import Price	Producer Price	3.43	0.1798
Export Price	Import Price	0.10	0.9521
Import Price	Export Price	0.02	0.9888

Based on the above results, it could be concluded that producer, export and import prices are not integrated and not able to influence each other (table 7.22). There was no long term integration between the above prices. Producer prices are nearly one tenth of export or import prices and trade largely takes place after value addition. Since the prices are not integrated and there is no cause and effect relationship, we cannot find the price transmission between the series (table 7.13). Prices are largely influenced by their own lag (one or two lags). For more detailed analysis, see Appendix tables A30 to A32.

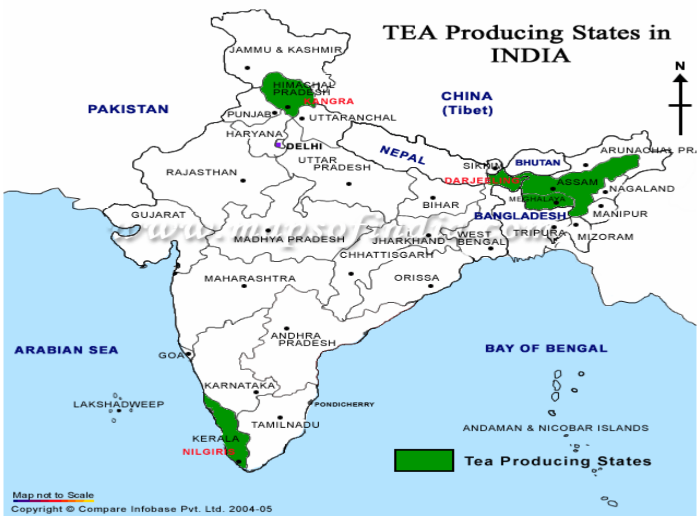


Fig 7.19 Tea Producing Regions in India

Assam Tea

Assam is called the birthplace of Indian tea. In Assam there are more than 600 tea estates on either side of Bramhaputra River. . It's the world's largest tea growing region. In Assam tea is grown on 2, 16,200 hectares of land and has more than 100 tea estates. It grows more than 360 million kg tea yearly. Assam tea is a black tea. Assam, like Darjeeling tea, has a first flush and a second flush tea. The first flush has a rich and refreshing aroma; the second flush produces the famous "tippy teas." Two types of black tea are produced In Assam, orthodox and CTC (crush, tear and curl). Tea produced in the orthodox method is valued the most in international market. CTC is mostly sold in the domestic market.

Tea in Assam was already grown and brewed by the local folks. But it was Robert Bruce who took found it (1823) and gave it an industrial face as Assam Tea. Although he was not alive till it was planted as a commercial crop, but only sent the leaves for testing at the botanical laboratory for testing. The Tea Committee was formed in 1834 to assess the scientific nature and commercial potential of Assam tea.

Nilgiri Tea

South India has the highest average yield levels in the country, and possibly the world. In the south total 88000 hectare of land is under tea cultivation. Nilgiri tea is grown in the slopes of the mountains of Western Ghats of Tamil Nadu, south India. Nilgiri is the largest tea producing district in South India. Nilgiri on an average produces 14 million kg of tea annually. This is the kind of black tea. In Nilgiri, tea is grown round the year. Most tea plantations here get two monsoons, due to which the tea bushes in South India 'flush' all the year round resulting in cropping season throughout the year. The Highfield Tea Factory, Kodanad Estate, Vigneshwar Estate Tea Factory and Hittakkal Estate Tea Factory, are the most well known tea estates in Nilgiri. Other noteworthy tea estates in Nilgiri are Ripon Tea Estate, Mayfield Tea Estate, Goomankhan Tea Estate, Lockhart Tea Estate, Glendale Tea Estate, Parkside Tea Estate, and many more.

Darjeeling Tea

Under international law, Geographical Indications mean indications which identify a product as originating in the territory of a member, or a region or a locality in that territory, where a given quality, reputation or other characteristic of the product is essentially attributable to its geographical origin.Darjeeling tea is India’s Geographical Indication. It forms a very important part of India’s cultural and collective intellectual heritage. The overseas trade of Darjeeling Tea has created its reputation in the international markets also.

Growth

Tea in Darjeeling came with Dr. Campbell. He was a civil surgeon of the Indian Medical Service and got transferred from Kathmandu in 1839 as Superintendent of this new territory and of the Sanitarium. He brought China Tea Seeds from Kumeon and planted near his residence. The main motive behind this was to attract settlers. Tea is a labor intensive agro product. It requires sufficient numbers of workers in all the stages of cultivation like, planting, tending, plucking and finally processing of the produce. The program was a success. The garden started bringing people at and around the area. In 1847 the government decided to set tea nurseries in this area. Employment was being offered to people from across the border of Nepal. From the very first stage the tea industry in Darjeeling has shown a steady progress. It had spread in all the nearby regions and the number of tea gardens had increased with time. Government distributed 725 kg of tea seed to the natives of the hills round about the Sanitarium. Several hundreds ha of forest land were cleared, from 750 m elevation above the sea to 1800 m. In 1866, Darjeeling had 39 gardens producing a total crop of 21,000 kilograms of tea. In 1870, the number of gardens increased to 56 to produce about 71,000 kg of tea harvested from 4,400 hectares.

During 1860-64, the “Darjeeling Company” was established with 4 gardens while the Darjeeling Consolidated Tea Co. dates back to 1896. The First Annual General Meeting of the Darjeeling Planters was held in 1873 to consult different issues related to the Darjeeling Tea Estates. In 1892, the Darjeeling Planter's Association (DPA) was formed. The association was affiliated to the Indian Tea Association (ITA) in 1910. By 1874 there were 113 gardens spanning approximately 6,000 hectares. Gradually with time, the owners of Darjeeling Tea Estates, considering its unique nature, special problems and attention needed for the development, promotion and protection of Darjeeling Tea – decided unanimously to form a sole independent Association to address their common affairs. On the 20th of December, 1983 the present ‘Darjeeling Planters’ Association’ was formed under the chairmanship of Mr. S.K. Bhasin, dissolving DBITA Darjeeling Planter's Association, is one of the constituent member of the ‘Consultative Committee of Plantation Associations’ (CCPA) in India. All teas in the tea growing areas of India, including Darjeeling are administered by the Tea Board, India under the Tea Act, 1953. It has the sole control over the growing and exporting of Darjeeling tea. Currently there are 87 Tea Estates which produce Darjeeling Tea on a total area of 19,000 hectares. The tea from Darjeeling makes up for only 3 per cent of India's total production, which is a very small amount in relative term, but because of its uniqueness, it grabs a huge portion of market. Employee strength of Darjeeling tea industry is 52 heads on a permanent basis; further 15,000 persons are engaged during the plucking season which lasts from March to November. More than 60 percent are women and the employment is on a family basis. The income of a garden worker is half in the form of cash and the other half by way of perquisites which have over the years. The workers are also provided with free accommodation, subsidized cereal ration and free medical benefits.

From the months of March to November we get four different types of tea grown in Darjeeling, all of the having diverse taste and colors. They are the Spring tea, plucked in March and April, then from May onwards comes the Summer tea. The Monsoon tea is produced between mid July and September and the tea season ends with the Autumnal tea of October and November. All the quality will again have different yields. The high quality results in extremely low yields, which is about 10 million kilos of tea a year.

Authenticity

The statistic says Darjeeling produces only 10 million kg tea but about 40 million kg of 'Darjeeling tea' is available in the world market every year. The Tea Board of India took steps to protect the name 'Darjeeling Tea' against erroneous use. Under section 3 of Part II of the World Trade Organization (WTO) TRIPS Agreement, products which are shown to have special qualities which are related to a certain geographical region, are regarded as Geographical Indicators (GI) and are protected, internationally, by the TRIPS Agreement, which is signed by most countries in the World. All teas produced in the tea growing areas of India are administered by the Tea Board of India under the Tea Act, 1953. The objective of the Tea Board, under the Darjeeling Certification Trade Mark Protection Scheme, is to put in place a mechanism to ensure the supply chain integrity for Darjeeling tea so that the tea leaving the shores of India and claimed as 'Darjeeling' tea worldwide is genuine. For fair and competitive marketing of Indian tea in the international markets, the Tea Board has been administering its intellectual properties; they have also designed the logo of Darjeeling Tea. It serves the purpose of indicating trade origin. It serves the purpose of distinguishing the goods of one trader from those of other traders. The logo is used by all producers, packers and exporters of Darjeeling tea, under license and authority of the Tea Board.

Marketing of Darjeeling Tea

Marketing of Darjeeling Tea is mainly done through auctions, which brings about free competition and also ensures transparent price to the buyer and guaranteed payment to the seller. The market trends and other related information are generated through this process. More than 50% of the produce is sold through the Calcutta Auction Centre. The Four registered Brokers, who sell the majority of Darjeeling Tea, are: J. Thomas & Co. Pvt. Ltd., Carritt Moran & Co. Ltd., Contemporary Target Ltd. Paramount Tea Marketing Pvt. Ltd. Darjeeling Tea is famous for its authenticity.

From 2000, over a period of four years, 171 companies dealing with Darjeeling tea have registered with the Tea Board. This became possible only after making the registration system compulsory. Certificates of Origin are then issued for export consignments. Data is entered from the garden invoices (the first point of movement outside the factory) into a database, and export of each consignment of Darjeeling tea is authenticated by issue of the Certificates of Origin by crosschecking the details. This ensures the supply-chain integrity of Darjeeling tea until consignments leave the shores of India. Customs authorities have instructed all Customs checkpoints to check for and ensure that Certificates of Origin accompany Darjeeling Tea consignments. Overseas importers are thus ensured of 100% authentic Darjeeling tea in all their consignments. Moreover, the Darjeeling logo and word are registered or applied for registration under the relevant laws available in the country where registration is sought. In addition to the above, the Tea Board has also undertaken efforts to get certification mark/collective mark for "Darjeeling" and/or Darjeeling logo in Australia, Canada, Germany and a number of other countries.

Competitiveness

Due to paucity of reliable time series data, the competitiveness was not estimated in case of tea. Similarly, the comparative advantage was not also assessed critically. Systematic efforts would be needed for data collection as well as for more detailed analysis.

Chapter 8

Fruits: Mango and Mango pulp

Mango is also called the “king of fruits” and being appreciated for its great taste. A single mango can provide up to 40 per cent of the daily dietary fiber needs and it is a potent protector against heart disease, cancer and cholesterol build up. In addition it also contains potassium, beta carotene and antioxidants. India is the biggest producer of mango in the world. Mango gardens/orchards covered 1.6 million hectares and produced over 10.8 million metric tons in 2004, which increased to 19 million MT in 2008. The majority of India’s mango gardens are owned by small farmers; about 72 per cent of the farms are of less than three hectares. Mango amounts to almost 50 per cent of total tropical fruits produced round the globe. Although India produces half of worlds total mango production, its full export potential has not been realized. Only less than two per cent of its production is exported. It is estimated that nearly 15 percent of India’s mango production is wasted due to lack of adequate infrastructure facilities.

The major mango growing states of India are Andhra Pradesh, Uttar Pradesh, Bihar, West Bengal, Maharashtra, Goa, Gujarat and Karnataka. Uttar Pradesh has the largest area of 0.27 million hectares under mango whereas Andhra Pradesh has the highest productivity of 12 MT per hectare on an average during recent years. Andhra Pradesh ranks first in mango production with a share of 20 per cent and new mango plantations are coming up extensively in some States like Maharashtra and Gujarat.

Varieties

About one thousand varieties of mangoes are produced in India. However, only a few varieties are cultivated for commercial purposes. Most of the Indian mango varieties have specific eco-geographical requirements for optimum growth and yield. The Northern/Eastern Indian varieties are usually late bearing compared to Southern and Western Indian varieties due differences in atmosphere. Some of the local varieties of mango bear fruits throughout the year in extreme southern parts of India. The cultivated mango is probably a natural hybrid between M. Indica and M. Sylvatica occurring in south-eastern Asia to India. The varieties grown in India are Alphonso, Bangalora, Banganpalli, Bombai, Bombay Green, Dashehari, Fajli, Fernnadin, Himsagar, Kesar, Kishen Bhog, Langra, Mankurad, Mulgoa, Neelum, Chausa, Suvarnarekha, Vanraj, and Zardalu. Hybrid Varieties produced in India are Amarapali, Mallika, Arka Aruna, Arka Puneet, Arka Anmol, Arka Neelkiran, Ratna, Sindhu, Au Rumani, and Manjeera. Other hybrid varieties released are Alfazali, Sundar Langra, Sabri, Jawahar, Neelphonso, Neeleshan, Neeleshwari and PKM2. Among these; Alphonso, Benishan (Banganpalli in Telugu and Tamil) and Kesar are considered to be the best ones in the Southern states. Dashehari and Langra are most popular in the Northern states of India. Commonly exported, the Alphonso cultivar is grown exclusively in the Konkan region of Maharashtra.

Mango processing (pulp) and quality control in India

With the introduction of liberalization India started exploring the important inter linkage between food processing and agricultural growth. That time the Indian food processing industry used to be referred as a 'sunrise industry'. The industry's immense export potential was realized. In general, about 20 per cent of all foods produced in India, valued at about Rs. 50,000 crores, are wasted. The cost of such wastage is estimated to be over six times the amount spent on food subsidies by the government. The processing sector has immense growth potential since less than 5 per cent of fresh fruits and vegetables are utilized for processing. It provides nearly 60 per cent of the total exports of processed foods in value terms. The industry has strong linkages both backward and forward with agriculture and modern markets respectively. This sector also has employment potential as more than 70 per cent of capacity is located in small and cottage scale units.

The production of processed fruit and vegetable items in India is governed by the Fruit Products Order (FPO), 1955. The units have to get licenses from FPO, due to the matter of quality standard. Production capacity exists predominantly in household and cottage sized units. Roughly two thirds of the units are in the home and cottage-scales. Around 20 per cent are small units and the remaining are large units. Small units occupy largely the traditional Indian (syrups, 'chutneys' and pickles) and traditional western (ketchups, jams, squashes) segments of the market.

During the period 1991-95, nearly 15 per cent per annum growth rate was achieved in the exports of processed food products. The processed food export growth rate more than doubled that of the output growth rate in the same period. But next was the stagnation period, 1995-99 (less than a one per cent growth rate). This happened mainly due to the imposition of SPS measure. It has impacted largely the food products which have undergone a higher degree of processing. A list of instances of application of SPS measures are given to see the impact on India's export. Australia, China and Japan do not allow Indian mangoes and grapes on the ground that certain fruit flies are present. Ironically, China imposed a ban on grapes for a species of fruit fly that does not exist in India. The Japanese stipulation of Vapor Heat Treatment (VHT) of fruits is yet another instance of SPS becoming the key non tariff barrier. The technological upgrading to comply with VHT protocol needs huge monetary investment. It also takes time of at least five years, although the success at the end is not assured. The SPS relevant exports have strong backward and forward linkages with deep ramifications. Finally, processed food product lines depend on a host of players in both exporting and importing countries.

India has now days established elaborate system of quality inspection and certification before any product is exported. It has become more rigorous in recent time. The domestic system is evolving in response to the reported number of rejections of exportable commodities. The Export Inspection Council (EIC) is the apex designated agency that is charged with this responsibility. For brevity, SPS compliant exports are facilitated by the EIC, which imposes a system of three types of inspection and certification, namely consignment wise inspection; in process quality control and a food safety management system based certification. The US is probably the only country, which provides information on the detention of shipments based on a pre-inspection basis. During May 1999-April 2000, the total number of detentions by the US originating from all (52) countries was 9875, of which 860 shipments originated from India. This was the highest number of shipments rejected by USFDA that originated from a single country. The total number of detentions of shipments during December 2001-November 2002 increased to 997.

Mango pulp falls in the “Processed Fruits and Vegetables” category. With the establishment of the food processing industry India started producing and exporting mango pulp. This took a jump with the abolition of trade barriers in the early nineties and value of mango pulp exports increased manifold (refer figures in Tables).

Predominantly small individual private growers rule the processing sector, few corporate are entering recently. There are only about nine major exporters of mango pulp in the country. Sourcing is done primarily from the Chittoor District of Andhra Pradesh and Krishnagiri District of Tamil Nadu in South India. APEDA has taken important export promotion measures for Mango pulp. During 1997-98, 12 processing units in Chittoor District were taken up. Subsequently, 12 units in the Krishnagiri District of Tamil Nadu have been taken up, with an investment of about Rs.3.5 million. APEDA has both financially and technically helped these farms to implement HACCP. All the participating units in the Chittoor District have implemented HACCP. Five units were assessed and certified by International Standards Certification (ISC) South Asia Pvt. Ltd. during the 1998 mango season. Six units of Chittoor District and 6 units of Krishnagiri District were assessed during the 1999 mango season. The National Sanitation Foundation (NSF) has recommended all the participating units of Chittoor District for certification after the certification audit. In the case of units in Krishnagiri District, Quality Assurance Service (Australia) has carried out certification audits of 6 and all of these have been recommended for certification. However, small units have not been able to benefit from APEDA’s efforts as problems in applying HACCP at the farm level occur given the nature of farms and practices in India. The quality norms under the Prevention of Food Adulteration Act (PFA) of India do not fully match with Codex. According to some small exporters, HACCP has not been followed in the pulp industry. Although HACCP will certainly increase market accessibility there are some problems involved in adopting this.

- Keeping record at the field level is impossible due to the small size and huge number of orchards.
- The fruit is seasonal, so its no point keeping permanent staff, and training new staff every year is also too costly;
- The new units which are setting up will not have any serious problems to be compliant, but the old units have to revamp their infrastructure which is a costly affair.
- Financial institutions do not fund HACCP activities.
- It is quite costly to get ISO certification.

Apart from HACCP, pesticide residue also affects Mango Pulp industry. Other quality issues are, that Indian pulp is brown in colour, is supplied in punctured bags, drums in which it is exported are of poor quality, experience feathering, rusting, metallic taste and damage to seam of the tin or drum. Testing is a major problem for the units. There are a number of institutions all over the country but their charges are quite high. Most laboratories in India do not have the sophisticated equipment required to carry out the increasingly more complicated tests necessary to comply with HACCP. Foreign health authorities are moving from testing for parts per million (ppm) to parts per billion (ppb). Indian laboratories are not equipped to do these tests. There are differences between the test results of India and those of Europe, allegedly due to the methods of testing, and not due to different test objectives. Successful exporters feel that the quality of Indian food has to be monitored for exports, and APEDA should introduce licensing. The FPO has issued 4700 licenses for food processing units, of which 21 are large units, 156 medium and the rest are small scale; 90 per cent of these units produce mango pulp. The quality issue becomes a major hurdle when the buyers have excess stock or when the international market prices of the goods have fallen below the agreed/contracted prices. In such cases, sometimes the exporters have to accept price discounts, especially when goods are perishable. On a positive note the positive impact of pro-active measures by an apex export agency like APEDA in enhancing quality export earnings.

History of mango trade

The fruit production and export sector is regulated by the Fruit Products Order, 1955 (FPO), issued under the Essential Commodities Act. All the processing units are required to obtain a license under this order. Periodic inspections of units are carried out. The consignments of fruit & vegetable products intended for export are subject to pre shipment inspection under the FPO. However, recognized Export Houses and Star Trading Houses are exempt from this inspection. Since liberalization, India had actively participated in overseas trade and took serious interest in promotion of export of horticulture products.

From 1989, there was an 18 year ban on mango export from India to the US. In 2007 India restarted selling of mango to the US. Two years have gone by and the Alphonso mango could generate only Rs. 2 crores revenue from exports, despite the huge demand for the exotic fruit. This is attributed to the high cost faced by Indian exporters. A 3.5 kg packet of mango from India is sold for $22 (about Rs 1,110) in the US, while the same quantity, less sweet mangoes from Mexico and Costa Rica costs less than $10 (about Rs 505). The main reason behind the high cost to the exporters is quality control measures. The cost of irradiation is going up raising the price of Indian mangos in the US. Irradiation is a process that involves exposing the mangoes to high energy electron beams generated by high voltage electricity (not radioactive material) to control microbial, pathogens, parasites and pests in food, preserving food or inhibiting physiological processes such as sprouting or ripening. The cost of irradiation is Rs 4 per kg, while setting up an irradiation facility is about Rs 12 crore. The total mango export from India during the year 2007-08 was 54350.80 MT with the value of Rs. 127.42 Crores.

Major players and India's trade status

India's major competitors are China, Thailand, Mexico and Indonesia, respectively according to the ranking in the world market. The following diagram shows the share mango trade of the above countries in the international market.

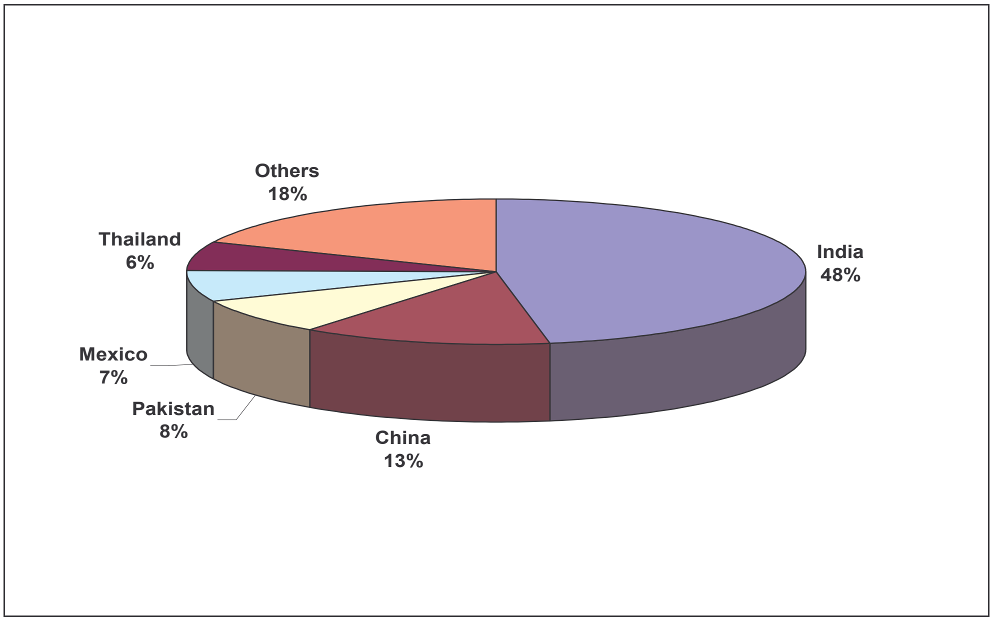


Fig 8.1 Major mango exports in the world

By changes in orchard management, improvements in infrastructure, use of advanced technologies, and meeting the food quality standards such as ISO9001, HACCP, India has the potential to become the number one exporter consistent with its number one rank in the production of mangoes.

Table 8.1 Trend of total export (at five years interval) of mango by India

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

	Quantity				Value			
Year:	*1991*	*1995*	*2000*	*2005*	*1991*	*1995*	*2000*	*2005*
Mango:	19378.3	25414.4	34631.2	53480.0	3121.6	4502.7	7154.9	8961.1

Source: *India Trades Database*

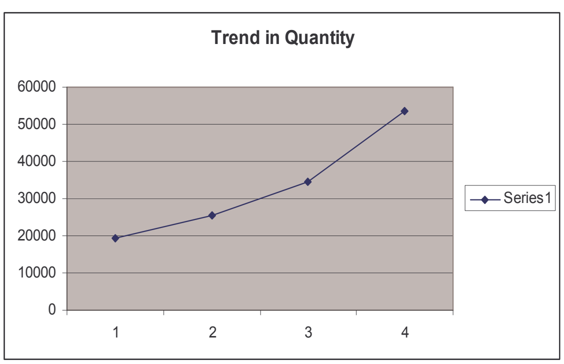


Fig 8.2 Quantity of Mango Exports

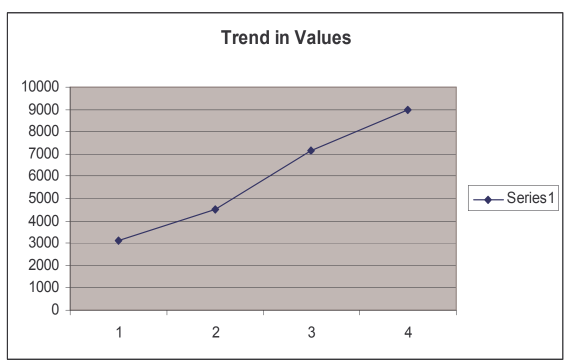


Fig 8.3 Value of Mango exports

Analyzing the above two diagrams it can be easily concluded that, in last few years India has seen a substantial rise in both quantity produced and the price realized. This gives a lot of incentive to the Indian mango cultivators to invest more.

Direction of mango and pulp exports

India is exporting mangoes to England from its colonial days. Currently India is exporting mango to Bangladesh, UAE, Nepal, and Saudi Arabia. Average share of export to different countries is given in the following diagram and recent export figures are given in Table 10:

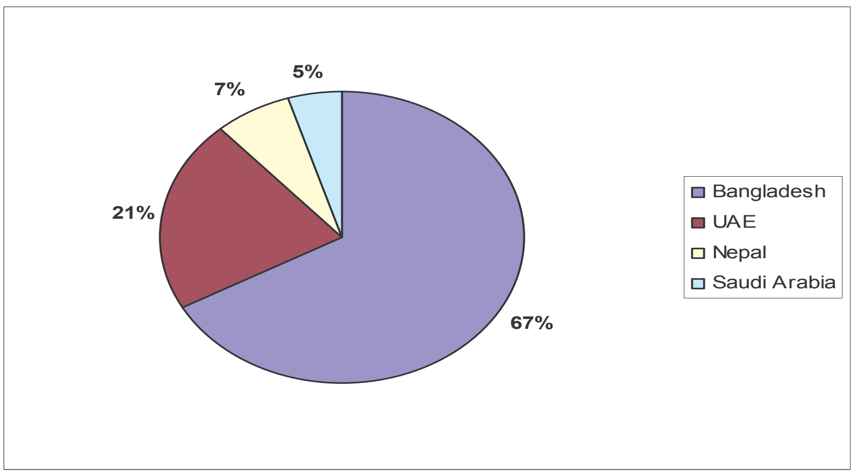


Fig 8.4 Export share of different countries

Time series analysis (causality and direction of influence; price transmission effects) is not carried out due to paucity of adequate data.

Table 8.2 Quantity of value of export of Fresh Mangoes to different countries from India

(Value in Rs. Lakh, Quantity in MT)

	2005-2006		2005-2006		2006-2007		2006-2007		2007-2008		2007-2008	
Country	**QTY**	**%**	**Value**	**%**	**QTY**	**%**	**Value**	**%**	**QTY**	**%**	**Value**	**%**
Bangladesh	32,770.90	47.08	2,766.36	21.59	42,887.52	54.25	3,994.83	28.14	17,063.60	31.40	1,595.46	12.52
U Arab Emts	26,533.76	38.12	7,304.40	57.02	22,045.51	27.88	6,581.02	46.36	22,469.62	41.34	6,320.93	49.61
Nepal	4,116.01	5.91	322.98	2.52	8,055.73	10.19	707.26	4.98	7,550.89	13.89	636.3	4.99
UK	839.97	1.21	537.93	4.20	1,883.19	2.38	1,141.28	8.04	2,575.37	4.74	1,981.66	15.55
Saudi Arabia	1,564.15	2.25	442.2	3.45	1,323.56	1.67	422.32	2.98	1,488.95	2.74	459.77	3.61
Bahrain	620.81	0.89	243.56	1.90	489.32	0.62	171.76	1.21	474.23	0.87	175.7	1.38
Kuwait	104.59	0.15	107.32	0.84	428.04	0.54	244.89	1.73	460.84	0.85	306.18	2.40
Malaysia	243.66	0.35	60.21	0.47	332.22	0.42	86.72	0.61	411.69	0.76	129.44	1.02
Germany	4.25	0.01	3.66	0.03	58.84	0.07	40.3	0.28	343.8	0.63	144.06	1.13
Singapore	242.24	0.35	91.83	0.72	230.86	0.29	131.8	0.93	340.32	0.63	168.57	1.32
Switzerland	9.01	0.01	14.72	0.11	167.71	0.21	105.41	0.74	174.23	0.32	111.26	0.87
USA	83.21	0.12	42.29	0.33	0.06	0.00	0.02	0.00	142.49	0.26	195.77	1.54
Japan	70.16	0.10	47.3	0.37	74.54	0.09	54.05	0.38	122.81	0.23	112.22	0.88
Total	69,606.59	100.00	12,811.16	100.00	79,060.88	100.00	14,193.99	100.00	54,350.80	100.00	12,741.72	100.00

Source: DGCIS Annual Export

Table 8.3 Quantity of value of export of Mango Pulp to different countries from India

(Value in Rs., Quantity in Kg)

Country	2005-2006		2005-2006		2006-2007		2006-2007		2007-2008		2007-2008	
	QTY	%	QTY	%	QTY	%	QTY	%	QTY	%	QTY	%
Saudi Arabia	45033192	33.45	1023760458	28.11	48420779	30.87	1351661540	26.72	46434622	27.85	1183586240	23.22
Yemen Republc	16616280	12.34	316053601	8.68	19611920	12.50	432037058	8.54	21678932	13.00	430211157	8.44
Netherland	9291708	6.90	393807048	10.81	19190906	12.24	843977666	16.69	19044396	11.42	773290515	15.17
U Arab Emts	13296537	9.88	317780372	8.72	14135085	9.01	400953976	7.93	15177483	9.10	399290807	7.83
Kuwait	6839750	5.08	165342046	4.54	7082205	4.52	213282032	4.22	8439108	5.06	216325413	4.24
UK	4602754	3.42	157730868	4.33	5410781	3.45	203407589	4.02	7283103	4.37	289566771	5.68
Japan	2459071	1.83	159397631	4.38	3950470	2.52	261502682	5.17	5375994	3.22	348756797	6.84
Russia	2882000	2.14	88767953	2.44	3298900	2.10	106868078	2.11	4503721	2.70	133314172	2.62
USA	2934180	2.18	118234036	3.25	3650876	2.33	151624720	3.00	4043567	2.42	186228978	3.65
Nepal	2170720	1.61	47770006	1.31	1368466	0.87	37098054	0.73	3210073	1.93	80906844	1.59
Sudan	2857500	2.12	72548490	1.99	3648283	2.33	105860868	2.09	3077440	1.85	76570255	1.50
France	1602585	1.19	73693975	2.02	1899241	1.21	97111126	1.92	2979749	1.79	162271241	3.18
Lebanon	3300875	2.45	75512289	2.07	2564116	1.63	66072081	1.31	2663326	1.60	58992822	1.16
Uganda	428000	0.32	13005465	0.36	702500	0.45	24442862	0.48	2496360	1.50	84249502	1.65
Germany	1663265	1.24	65062534	1.79	1973492	1.26	85420523	1.69	2266971	1.36	93439566	1.83
Total	134613203	100.00	3642412050	100.00	156835507	100.00	5058279177	100.00	166752172	100.00	5096850696	100.00

Source: DGCIS Annual Export

Case Studies related to Kesar Mango grown around Navsari Region

The following cases of the two cooperatives of Gujarat and Andhra Pradesh are the examples of knowledge networking and institution building, and they work as a bridge between the farmers and the new ideas that are floating all around the world.

CASE -1:

Amalsad Vivaag Vividh Karyakari Sahakari Khedat Mandali Ltd.:

This is a cooperative situated in the village of Amalsad, in Navsari Dist. of southern Gujarat. This cooperative provides multiple services to the farmers and the dwellers of the nearby villages. The main activities of this organization are:

- Providing short and medium term loans to the farmers for agricultural purposes also receiving deposits from members
- Procurement and sell of agricultural products
- Providing homoeopathic medical services
- Supplying animal food is also arranged

Retailing

The cooperative is running total 17 stores in the area. They have also flour mill outlets run in 5 villages out of total 17. They also sell fertilizers (manufactured by IFCO, KRIBHCO, GNFC, & GSFC), seeds, insecticides, medicines to the farmers for development of agricultural land.

Sell of Agro Products

The local farmers mainly produce the Kesar variety of mango. The cooperative procures these produces from the farmers and sell in the market. The farmers also get a satisfying price. The farmers get the opportunity of selling their mango in the international market too through this organization. They have arranged for vans with the facilities of cooling and refrigeration's systems which reduces post harvest losses. After procurement some part of the fruit goes for processing at their own processing unit. The brand name is

"Amidhara" in which it is sold in the international market and is available in tinned packs. During the year 2006-2007 the society managed to pay 356 members Rs 81, 39,309.00 for the value of total 672 tons mangoes. The rates of mangoes are decided as per quality and 75% value is paid immediately by the society to the members when they bring at our location and balance 25% are settled finally in the end of the season. Mangoes are usually affected by disease and already research project to protect the crop from disease has been started, organized by the cooperative.

The price data for Kesar, Totapuri, Rajpuri, Alphanso /Haphoos, Dasheri has been collected for last 16 years. The price movement over time has been shown in the following diagrams for different qualities of mango.

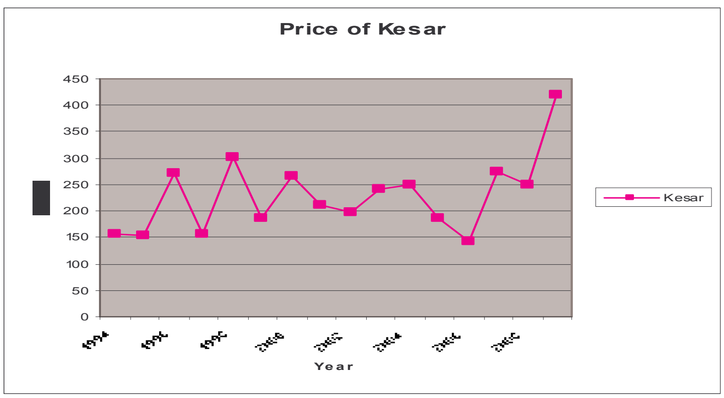


Fig 8.5 Prices of Kesar over the years

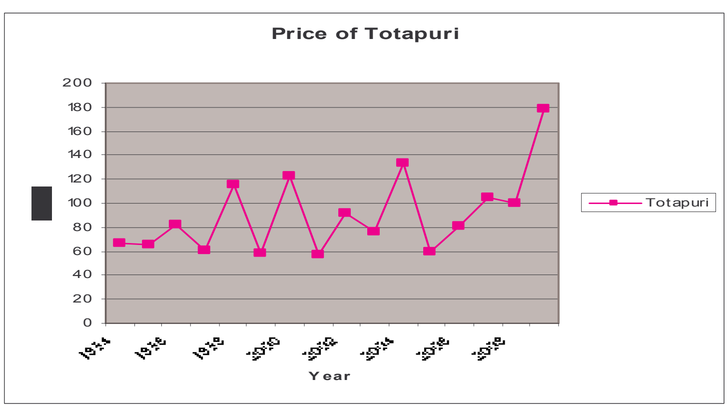


Fig 8.6 Prices of Totapuri over the years

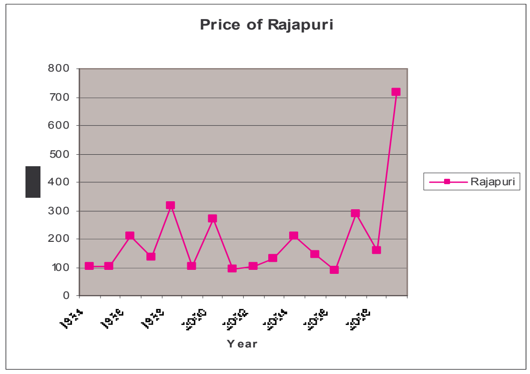


Fig 8.7 Prices of Rajapuri over the years

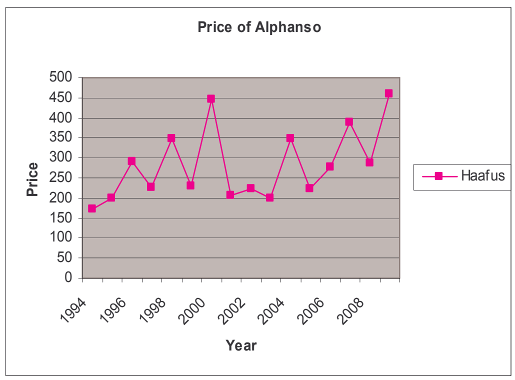


Fig 8.8 Prices of Alphonso over the years

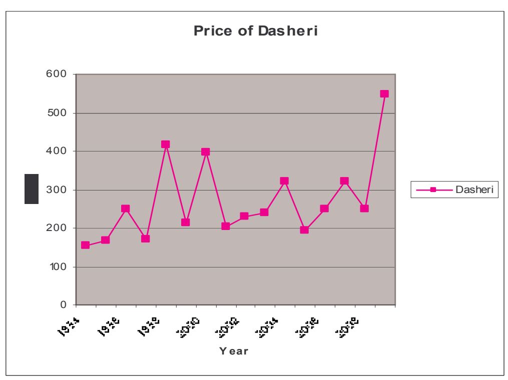


Fig 8.9 Prices of Dasheri over the years

Above figures (14 through 18) clearly show the variability in prices and it can be correlated with the level of supply, which is given in the figures 19 through 23. The relation between movements of price with respect to quantity is found from the data obtained from the Cooperative and represented in the following diagrams for each variety. In the year of 2009 price of all varieties have gone extraordinarily high.

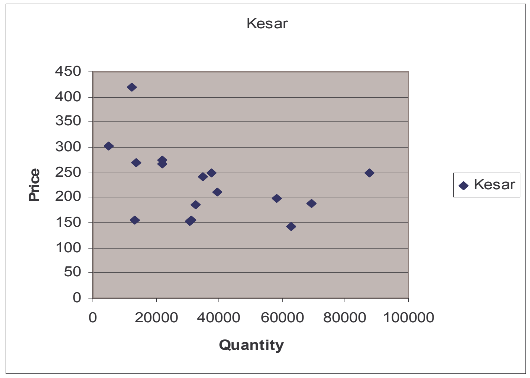


Fig 8.10 Supply – Price pattern of Kesar

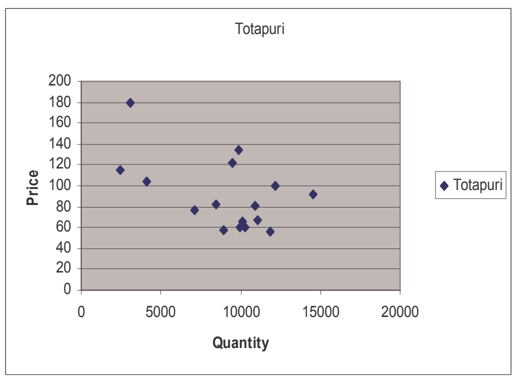


Fig 8.11 Supply – Price pattern of Totapuri

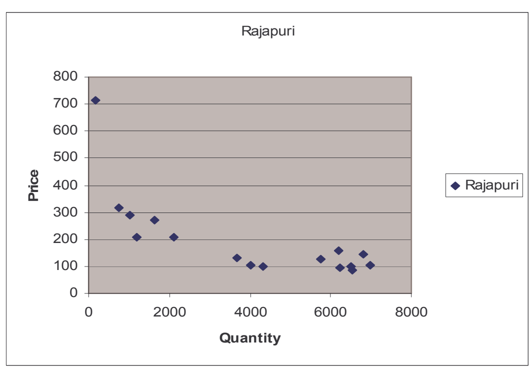


Fig 8.12 Supply – Price pattern of Rajpuri

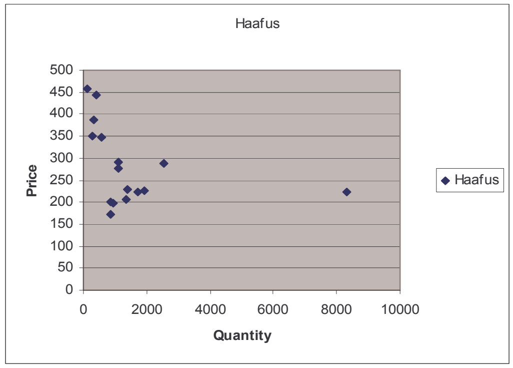


Fig 8.13 Supply – Price pattern of Haafus

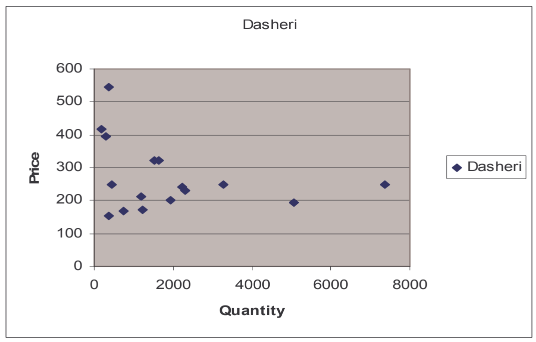


Fig 8.14 Supply – Price pattern of Dasheri

The above diagrams indicate that for each variety of mangos price and quantity are negatively related. Thus a cyclical movement of quantity produced over years can be concluded. The extraordinary price hike in the last year, which has been already noticed, can be explained by the very low production in that year. The scarce supply of fruit has raised the price to some unusual high.

Fig 8.15 Pulp of Kesar Mango with different brand names

Chairman of the cooperative explained that this cooperative collects mango from the local farmers and sell them in international market. Some part is also sent for processing and then sold in overseas markets. 90% of the fruits are exported. UK, US, Canada are the major markets for them. According to him, weakness in mango production is the poor and traditional harvesting pattern. It has to be improved, which shall reduce the spoilage and also raise the quality and will have a thrust on the export market. The grading is done according to ripening of the fruits but not the size. 50% of the mangoes go for processing and the rest is sold raw. But whatever is processed is exported totally. For quality control, they take care of the handling and go for natural ripening of the fruit. The wastes are sent to the fertilizer unit. About the export, they feel that the cost of sea fare depends on the country and it fluctuates between 10-90%. Marketing strategy which they follow is to build the brand and grow on the basis of this.

Fig 8.16 Fruit collection cum staking yard and Quality Control Lab at pulp unit

Nimesh Suresh Bhai Naik, farmer by profession, is practicing both mango and chikoo farming. He is into this profession for last fifteen years. His educational qualification is up to secondary level. His land holding is 60 acres of which 50% is irrigated. The size of the mango orchard is 30 acres with total 3000 mango trees. He owns almost all needed farming equipments to him. The total land of mango cultivation is divided between different varieties of mango in the following manner, Kesar-15 acres, Totapuri- 9 acres, Dasera- 5 acres and Rajpuri- 1 acre. All the varieties are well demanded in the market. After plantation it takes 7 years to start bearing fruit. Per acre yield is 150kg. The fruit bearing pattern of the trees is of alternate year. The farmer gets subsidized irrigation equipments. They face the problem of pastes but it's taken care of by using spray.

They products are sent to the markets at a very low cost of transaction. This is done via Primary Agricultural Cooperative Societies. The mango growers sell the products to the PACS and from there it goes to the Federation or the Traders. This reduces their marketing cost and they get a satisfying price.

SWOT analysis

The weakness of farming of Kesar mango in this region is, due to lack of irrigation facilities, the parameters of quality, that is taste, and aroma, color and shape are at the average level. The process of quality control is very poor. Another weakness is the fruit bearing is of alternate year, like a business cycle. Thus the earning to the farmers is not at a constant level, but varies in each year. But the get a good yield in good years. Pest is a big problem to the mango farmers and also the fruit diseases. But due to the availability of the cooperative facility, as discussed before, the cost of marketing is very less on the farmers, which includes transportation costs, market fees, and commission charges. They also get a satisfactory price from them. Part of the mango goes to the fruit processors. The relation of the farmers with the processors is very strong and this gives them a string bargaining opportunity. But they have no link with the exporter.

<u>CASE -2: The Vijaya Model</u>

(Learning Networks Matter: Challenges to Developing Learning-Based Competence in Mango Production and Post-Harvest in Andhra Pradesh, India, Laxmi Prasad Pant, Helen Hambly Odame, Andy Hall and Rasheed Sulaiman V)

The Vijaya Fruit and Vegetable Growers Association (Vijaya) was established in 1992 in I village of Andhra Pradesh. The association was made up of 16 fruit and vegetable cooperatives (primary societies) spread over three districts around Vijayawada. The primary society membership consisted of approximately 500 small and medium scale farmers (1-10 acres). They cultivated almost 3,000 acres of mangoes. Vijaya undertook the role of coordination of the marketing of mangoes in export and high value domestic markets. It had the goal of finding a better price for farmer members' produce through direct marketing. It used to avoid middlemen, wholesalers and traders. This fetches the farmers a premium price for fruit of export quality. In turn, a key function of Vijaya was to act as a source of technical advice and inputs to assist farmers in increasing the proportion of fruit which reaches export quality criteria.

Initially it could aim only the big domestic market due to high cost of export and also quality control. In 1995 Vijaya began exploring the potential of European markets. APEDA had a big role in expansion of this kind. APEDA provided various assistances to Vijaya in its efforts to link farmers to this new export market. It provided subsidies for collecting market intelligence; cost of samples and trial shipments; cost of producing promotional literature; and underwriting commercial shipments. APEDA also supported the technical capacity of Vijaya and its farmers, not only by providing 50 per cent of the costs of engaging national scientists but also in forming linkages between Vijaya and relevant sources of technical expertise both nationally and internationally.

The Processing Unit

In 1992, the Andhra Pradesh Department of Marketing (DoM), with financial support from APEDA, established a pilot facility in Gollapudi, near Vijayawada to process table mangoes for export. The facility was managed by an Agricultural Market Committee (AMC). Exporters were able to use this facility for a nominal fee as Vijaya was one of the first exporters to utilize it. At the same time, the Natural Resources Institute (NRI), a specialized Institute at the University of Greenwich at Medway, United Kingdom proposed APEDA to implement a component of the DFID's Crop Post Harvest Program (CPHP) in India. A second phase of the project aimed at developing an integrated package of treatments for successful mango export. Pilot scale equipment for hot water treatment was designed and established in the Gollapudi market yard. Several sea shipments of mangoes were sent to London and South East Asian markets without, however, any encouraging success.

But some problems were identified. Those were basically technical in nature and included recommendations for the regulation of temperature and carbon dioxide in the refrigerated containers. In fact, constraints were more institutional than technological *per se*. Actually, the main problem was a complete disconnect between organisations involved in technology development (public sector R&D bodies who themselves operated in “silos”) on the one hand and private sector producers and their affiliates on the other. As a result, the project ended its second phase with a revised focus on institutional issues.

In 1999 Vijaya was renamed as the Vijaya Sun Gold Agri Farms and Exports Ltd., a public limited company. In fact, ‘Vijaya Sun Gold’ was already the brand name for its mangoes, but this had been used thus far without legal protection. In 2002 Vijaya was again restructured as an Association of Fruit and Vegetable Growers representing 217 individual members in order to revitalize collective action in mango export. One of Vijaya’s subsidiaries, Vijaya Laxmi Agro Service Centre (hereafter Vijaya Laxmi), recently diversified its activities to include marketing of agricultural produce.

The AEZ

In 2002 APEDA declared Krishna District as an Agricultural Export Zone (AEZ) for mangoes. Additional land was acquired to develop an integrated packing house in Nuzvid, a town that is relatively closer to mango-growing areas than Gollapudi. Another piece of land was also acquired to strengthen the activities of the Mango Research Station in Nuzvid, as a subsidiary of the Acharya NG Ranga Agricultural University (ANGRAU). This shift in location for infrastructure development, while existing infrastructure in Gollapudi remained underutilized, was largely due, it is claimed, to political interests.

Failure

Despite all these interventions, however, the mango sector in Andhra Pradesh has failed to succeed in high-value export markets. Clearly, part of the challenge has been the failure to meet different types of market demands at play. This included quality standards of the importers. Importers are concerned with QA issues, such as shelf-life, pesticide residue and insect pest and disease infestation. For example, the US has made it obligatory for imported Indian mangoes to be irradiated (exposing mangoes to a kind of radiation that kills insects and pathogens). In 2007, APEDA acquired 1.4 tons of mangoes from Krishna District and sent them to the US as a promotional scheme. Before shipping them off, they were subjected to post-harvest processing in the Gollapudi market yard and then to an irradiation facility in Maharasthra, a neighboring Indian state where cobalt ray irradiation facility for mangoes is currently available. ANGRAU conducts research on irradiation dosages for a few selected mango varieties. Likewise, vapor heat treatment (VHT) of mangoes to eliminate fruit flies is mandatory on mangoes being exported to Japan. In 2006, Japan lifted its 20 year-ban on imports of Indian mangoes under an agreement that the fruit would be subjected to VHT before shipping.

Experience of local exporters from Gujarat

J. K Horticulture

J K Horticulture is a small exporting company from Ahmedabad. They are in the market from year 2005. The company gets the support of the DEPB export scheme of government. The firm exports pear, black berry, blueberries, raspberries, fresh fruits, apple, peach, pear, cherry currant, frozen vegetables, mango, guava, berries, watermelon, papaya, green vegetables, frozen broccoli, banana, and orange. But the main product is Kesar mango. The procurement of mango is done from the orchards of the Kuchh district and also Saurashtra. Maturity, shape, size, sugar percentage are the quality parameters which are taken care of. For quality control, they concentrate on post harvest caring, the mangos are given hot wash and cold wash and left for natural ripening. The company has direct contact with the farmers, so the products are bought at a negotiable price. If the quality of the mango is not of international standard, it is sold only in the locally. In the high yield years the market price falls due to excess supply.

The initial investment made by the company to is of Rs. 10 lakhs. Current capacity is of procuring 4 tons per day. In form of infrastructure, it has an office room at Agarwal Center, Ashram Road, Ahmedabad. The products are displayed on their website. Trucks are hired for transportations of fruits and for overseas transport they hire local cargos like, Ahmedabad Air Cargo or Air India, British Airways. The source of communication with the foreign customer is mainly telephone and also e-mails. APEDA's booklets and website are followed to get information.

The importers are regular from the very beginning. So the problem of delay in payment has never cropped up. The exporters of Mumbai are the biggest competitor of this firm. But J. K. Horticulture has their edge in the quality of the fruit which they sell and also the reasonable price which they charge and the delivery of product is always made on time. But still the expansion of their export base is slow. They plan to expand the quantity of mango exported and start export of fresh vegetables. But it's taking time due to lack of local facilities and also availability of quality products. The importing countries have not imposed any kind of barriers. But export to US is not happening as they do not have the facilities of irradiation of mango.

The firm is planning to have a kind of joint venture with the farmers, where the farmers will have to improve the quality of the fruit, for that they will be paid a higher share of the market price.

SWOT

The domestic movement of the firms products are free which is an opportunity, reduces the cost. Nature of the supply of raw material is seasonal, which is a weakness of the firm. Strength of the firm is they have direct contact with the farmers which give the opportunity to negotiate directly about the price and the quality. Also the changing pattern of consumption due to increasing per capita income is favourable. But one threat to the firm is the fluctuation of the international price level. The cost of quality control is high. Packing cost is low, so is the domestic transport cost and cost of shipping. There is a need to increase the working capital and thus investment. Overall supply chain is quite efficient this is an opportunity for the company. No problem of deterioration of quality of product after shipment is there. Customs are facilitating trade. Although the present situation of the global market is not much favorable, they did a good business. They have adequate trained personnel to manage the work.

Vadilal Group

Vadilal group is known for ice cream for a very long time. They started with a retail outlet of ice cream in 1926. Now it is one of the big names in ice creams and other related products. They have entered into horticulture processing in 1991. In processed food, they are doing business in frozen and canned food. In the mango processing sector they are making pulp of *totapuri*, *kesar* and *alphanso* for the last 19 years. For quality control, HACCP system is adopted by the company. The company is awarded with both the DEPB licensing and also VKWI scheme. The present capacity of the mango processing unit is of 4500 MT. Rate of capacity utilization is 95%. The Vadilal group is a fully developed corporate office. The sources of communication those are used are: telephones, e-mails and some through associations. The firm’s foreign network, private trade portals, journals, exhibitions, and trade fairs are the general sources of information. They procurement of mango is done from both farmers and wholesalers. The fluctuating yield and price are the problems they face while procurement. Many times they have faced the problem of default in payment and also supply of product.

In the international market they have regular importers for last seven to ten years. But the other competitors are also targeting same buyers. This is again raising the competition. Consistent quality, round the year supply, broad product range, these are the edge of Vadilal. There are plans to expand the product range and tie ups for private label.

SWOT

The strengths of the company are abundant availability of raw material, free domestic movement of the same, direct interaction with the farmers, low pest/ microbial incidence. They see high cost of packaging, shipping, requirement of working capital, requirement of investment as their strength. Rising per capita income changing consumption pattern is in favor of the company. Export price of the product is higher than that in domestic market, which is strength, as it’s bringing them more money. But the biggest threat to the company is the seasonal availability of raw material and the fluctuating price in the international market. Weaknesses of the company are lack of quality control and the testing methods, high cost such facilities, lack of infrastructural facilities. There is also problem of less availability of market intelligence and trained personnel. Again the less number of intermediaries in the market bring them a better price. The overall supply chain is efficient. Also the problem of deterioration of quality after shipping is very low.

The company faces the strict eco labelling and environmental regulation. Importing countries charge high level tariff. That too the current global market situation is quiet adverse with reduced demand due to the recession along with the increasing competition with other countries.

Competitiveness

Due to paucity in availability of long term time series data, the exercises related to estimation of competitiveness and assessment of comparative advantage was not carried for Mango and Mango pulp.

Chapter 9

Post-harvest losses of Fruit and Vegetables and other Perishable Agricultural Commodities in India [1]

9.1 Introduction

India has enhanced its annual production level of horticultural crops, touching over 214 million tons during 2008-09 and thus, it is the second largest producer of fruits (68 million tons) and vegetables (129 million tons) contributing nearly 12 per cent and 15 per cent, respectively of the total global production. It is estimated that between 30 and 35% of India's total vegetable production is lost owing to poor postharvest practices. Less than 2% of the total vegetable production in the country is commercially processed as compared to 70% in Brazil and 65% in the USA. Approximately 1.5 lakh MT of vegetables is sold in the processed form.

The livestock sector, which contributes 29.7 per cent to the GDP from agriculture and allied activities, is of special importance and a main source of family income of the farmers. In 2008-09, livestock sector produced 59.8 billion eggs, 43.2 million kg of wool and around 4.0 million tons of meat from organized sector. And also India ranks first in the world in milk production, which rose from 17 MT in 1950-51 to around 112.5 MT by 2008-09 (Economic Survey, 2009-10).

The poultry sector is providing direct and indirect employment to over five million people, producing around 1.85 M.T of meat in 2008-09 and a substantial amount of fish with a production rise from 0.75 M.T in 1950-51 to 7.85 M.T in 2008-09. Due to various developmental efforts taken by Indian government, production of perishable and essential agricultural commodities like fruits, vegetables, milk, meat, fish etc. has increased tremendously over a period of time.

However, perishable agricultural commodities produced in the farm fields have to undergo a series of post-harvest operations such as harvesting, cleaning, grading, standardization, packaging, quality certification, transportation, storage, processing and exchange before they reach the consumer and there are appreciable losses in

[1] We are highly thankful to Dr. TM Gajanana, Principal Scientist (Ag.Econ), IIHR, Bangalore for his generous support in building this chapter.

agricultural commodities output at all these stages. The total quantity of outputs lost in these operations at all these stages is referred to as post-harvest losses.

Perishable agricultural commodities are not having proper scientific storage, packing, transport and handing technologies and which are inadequate and hence, considerable amount of produce is wasted. Perishable agricultural commodities, due to their perishable nature, are very much prone to deterioration in quality and quantity, especially under tropical conditions. Moreover, the perishables, especially fruits, vegetables and meat are biologically active after the harvest and carry out transpiration, respiration, ripening and other biochemical activities, which contribute to deterioration in the quality of these produce. Post-harvest losses can occur in the field, in packaging areas, in storage, during transportation and in wholesale and retail markets. Severe losses occur because of poor facilities, lack of know-how, poor management and improper market facilities or due to careless handling of the produce by farmers, market intermediaries and consumers. It is, therefore, important that the post-harvest practices be given as much attention as production practices.

Qualitative losses (such as loss of caloric and nutritive value, loss of acceptability by consumers, and loss of edibility) are more difficult to measure than quantitative losses of fresh fruits and vegetables. While reduction of quantitative losses is a higher priority than qualitative losses in developing countries, the opposite is true in developed countries where consumer dissatisfaction with produce quality results in a greater percentage of the total post-harvest losses. Providing consumers with fruits and vegetables that taste good can greatly increase their consumption of the recommended minimum of five servings per day for better health.

9.1.1 Production of fruits, vegetables and other perishables

As summarized in table 9.1, the area under fruits has increased from 2874 ha to 6101 ha with in span of nearly two decades. Similarly, the production has increased from 28632 MT to 68466 MT for the same period. It is almost a growth rate of 139 per cent over base period. In case of vegetables, the area has increased from 5593 ha to 7981 ha. But, the production has increased from 58532 MT to 129077 MT. It was also noted a growth rate of nearly 120 per cent.

Table 9.1 Production of fruits and vegetables in India

YEAR	FRUITS A	FRUITS P	VEGETABLES A	VEGETABLES P
1991-92	2874	28632	5593	58532
2001-02	4010	43001	6156	88622
2002-03	3788	45203	6092	84815
2003-04	4661	45942	6082	88334
2004-05	5049	50867	6744	101246
2005-06	5324	55356	7213	111399
2006-07	5554	59563	7581	114993
2007-08	5857	65587	7848	128449
2008-09	6101	68466	7981	129077

A = AREA (IN 000'HA)
P = PRODUCTION (IN 000'MT)
Note: Totals may slightly differ due to rounding of figures

Table 9.2 Production of major livestock products in India

Year	Milk (Million Tonnes)	Eggs (Million Nos.)	Wool (Million Kgs.)	Meat* (Million Tonnes)
1950-51	17.0	1,832	27.5	-
1955-56	19.0	1,908	27.5	-
1960-61	20.0	2,881	28.7	-
1968-69	21.2	5,300	29.8	-
1973-74	23.2	7,755	30.1	-
1979-80	30.4	9,523	30.9	-
1980-81	31.6	10,060	32.0	-
1981-82	34.3	10,876	33.1	-
1982-83	35.8	11,454	34.5	-
1983-84	38.8	12,792	36.1	-
1984-85	41.5	14,252	38.0	-
1985-86	44.0	16,128	39.1	-
1986-87	46.1	17,310	40.0	-
1987-88	46.7	17,795	40.1	-
1988-89	48.4	18,980	40.8	-
1989-90	51.4	20,204	41.7	-
1990-91	53.9	21,101	41.2	-
1991-92	55.7	21,983	41.6	-
1992-93	58.0	22,929	38.8	-
1993-94	60.6	24,167	39.9	-
1994-95	64.0	25,975	40.6	-
1995-96	66.2	27,187	42.4	-
1996-97	69.1	27,496	44.4	-
1997-98	72.1	28,680	45.6	-
1998-99	75.4	29,476	46.9	1.9
1999-2000	78.3	30,447	47.9	1.9
2000-01	80.6	36,632	48.4	1.9
2001-02	84.4	38,729	49.5	1.9
2002-03	86.2	39,823	50.5	2.1
2003-04	88.1	40,403	48.5	2.1
2004-05	92.5	45,201	44.6	2.2
2005-06	97.1	46,166	44.9	2.3
2006-07	100.9	50,663	45.1	2.3

** From recognized sector* *- Not Available*

The growth in different livestock products have been summarized in table 9.2. The production of all these products is increasing steadily since 1950s.

9.1.2 Broad reasons for post-harvest losses (PHL)

The reasons for post-harvest losses can be broadly classified as follows:

Biological and environmental causes of losses

Biological (internal) causes of deterioration include respiration rate, ethylene production and action, rates of compositional changes (associated with colour, texture, flavour, and nutritive value), mechanical injuries, water stress, sprouting and rooting, physiological disorders, and pathological breakdown. The rate of biological deterioration depends on several environmental (external) factors, including temperature, relative humidity, air velocity, and atmospheric composition (concentrations of oxygen, carbon dioxide, and ethylene), and sanitation procedures. All these factors have been discussed by numerous authors (Bartz and Brecht, 2002; Bourne, 1977; Bourne, 1983; Coursey 1983; FAO, 1981; FAO, 1989; Gross et al, 2002; Harvey, 1987; Kader, 1983; Kader, 2002; Kitinoja and Gorny, 1999; Musa, 1984; Tindall and Proctor, 1980).

Socio-economic factors

Although the biological and environmental factors that contribute to postharvest losses are well understood and many technologies have been developed to reduce these losses, they have not been implemented due to one or more of the following socio-economic factors (Kader, 1983).

Inadequate Marketing Systems

Growers can produce large quantities of good-quality fruits, ornamentals, and vegetables, but, if they do not have a dependable, fast, and equitable means of getting such commodities to the consumer, losses will be extensive. This problem exists in many locations within India as well as in developing countries. It is accentuated by lack of communication between producers and receivers, and lack of market information. Marketing cooperatives should be encouraged among producers of major commodities in important production areas. Such organizations are especially needed in developing countries because of the relatively small farm size like India. Advantages of marketing cooperatives include: providing central accumulation points for the harvested commodity, purchasing harvesting and packing supplies and materials in quantity, providing for proper preparation for market and storage when needed, facilitating transportation to the markets, and acting as a common selling unit for the members, coordinating the marketing program, and distributing profits equitable.

Alternative distribution systems, such as direct selling to the consumer (roadside stands, produce markets in cities, local farmers' market in the countryside, etc.) should be encouraged. Production should be maintained as close to the major population centres as possible to minimize transportation costs. Wholesale markets in most of the developing countries are in desperate need of improvement in terms of facilities and sanitation. These are overcrowded, unsanitary, and lack adequate facilities for loading, unloading, ripening, consumer packaging, and temporary storage. In several countries, there are plans to build better wholesale marketing facilities, but their implementation has been delayed more because of social and political than financial considerations.

Inadequate Transportation Facilities

In most of production places, road connectivity is not adequate for proper transport of horticultural crops. Also, transport vehicles and other modes, especially those suited for fresh horticultural perishables, are in short supply. This is true whether for local marketing or export to other countries. The majority of producers have small holdings and cannot afford to own their own transport vehicles. In a few cases, marketing organizations and cooperatives have been able to acquire transport vehicles, but they cannot do much about poor road conditions.

Government Regulations and Legislations

The degree of governmental controls, especially on wholesale and retail prices of fresh fruits and vegetables, varies from one country to another. In many cases, price controls are counter-productive. Although intended for consumer protection, such regulations encourage fraud and provide no incentive for producing high-quality produce or for postharvest quality maintenance. On the other hand, regulations covering proper handling procedures and public health aspects (food safety issues) during marketing are, if enforced properly, very important to the consumer.

Unavailability of Needed Tools and Equipment

Even if growers and handlers of fresh horticultural crops were convinced of the merits of using some special tools and/or equipment in harvesting and postharvest handling, they most likely will not be able to find them in the domestic market. This is true of harvesting aids; containers; equipment for cleaning, waxing, and packing; and cooling facilities. Most of the tools are neither manufactured locally nor imported in sufficient quantity to meet demand. Various governmental regulations in some countries do not permit direct importation by producers of their needs. It is imperative that the tools that will enable handlers to use recommended technology for a given situation be available for them to use. In many cases, such tools can be manufactured locally at much lower cost than those imported.

Lack of Information

The human element in postharvest handling of horticultural commodities is extremely important. Most handlers involved directly in harvesting, packaging, transporting, and marketing in developing countries have limited or no appreciation for the need for, or how, to maintain quality. An effective and far-reaching educational (extension) program on these aspects is needed critically now and will continue to be essential in the future. The availability of needed information on the Internet (numerous websites including:http://www.fao.org/inpho;http://www.postharvest.com.au;http://postharvest.ucdavis.edu; http://www.postharvest.ifas.ufl.edu; and www.postharvest.org) is an important step in the right direction, especially with the expanded access to the Internet worldwide.

Poor Maintenance

In many developing countries like India, some good facilities that were built a few years ago are currently “out of order” or not functioning properly because of lack of maintenance and unavailability of spare parts. This problem is especially true of public-sector facilities. Any new project should include in its plan adequate funds for maintenance to ensure its success and extended usefulness.

9.2 An overview of post-harvest losses (PHL) in India and World

The details of post-harvest value addition scenario in different countries have been presented in table 9.3. It was concluded that the proportion of area under value addition was very low in India when compared with rest of the countries. Table 9.4 summarizes information on the proportion of different food items being processed in India. It indicates that oilseeds, spices and cereals on the top of the list. The perishables like fruits and vegetables occupied the lowest position. The share of milk, meat and fish are far exceeding than the share of fruits and vegetables in the country.

Table 9.3 Post-harvest value addition scenario in different countries

Country	Post-harvest value addition (%)
India	7%
China	23%
Thailand	30%
Brazil	70%
Philippines	78%
Malaysia	80%

According to study conducted by Ali, 1998, the levels of post-production losses are 5-15% in durables, 20-30% in semi-perishables and 30-50% in perishables. He classified different types of food commodities and their estimated post-harvest losses along with monetary values are given in Table 9.5. It shows that various food items, to the tune of 65 million tons, worth Rs. 76,000 crores per annum, are lost during post-harvest phase. A substantial amount of these losses could be prevented if appropriate agro-processing centres having backward linkage with farmers to ensure constant supply of quality raw food materials are established and operated.

Table 9.4 Processing levels in different foods in India

Item	Proportion of processing (%)
Cereals	50 per cent
Pulses	75 per cent
Oil seeds	90 per cent
Sugarcane	88 per cent
Fruits and vegetables	2 per cent
Spices	90 per cent
Tea and Coffee	100 per cent
Milk	33 per cent
Meat	7.5 per cent
Fisheries	10 per cent

Table 9.5 Production of different food commodities and estimated post-harvest losses

Type of food commodity	Present Level of production			Post-harvest losses		
	Quantity Mt	Average price Rs/t	Value, Rs, Cr.	%	Quantity, Mt	Monetary value, Rs, Cr.
1. Durables (Cereals, pulses and oilseeds)	215	1,000	215,000	10.0	21.5	21,500
2.Semi-perishables (Potato, onion, sweet potato, tapioca)	40	3,000	12,000	20.0	8.0	2,400
3. Perishables (Fruits, vegetables, milk, meat, fish and eggs)	140	15,000	210,000	25.0	35.0	52,500
Total/Average	395	11,063	437,000	17.5	64.5	76,400

Mt = Million tons, Cr = Crore (10 million)
One US dollar = Rs. 50 (Rs=Indian Rupee)
Source: Ali, 1998.

Post-harvest food losses to pests in India (Pimentel and Raman, 2003)

Pre- and post-harvest losses vary greatly by crop, by country and by climatic region, partly because there is no universally applied method of measuring losses. As a consequence, estimates of total postharvest food loss are controversial and range widely – generally from about 10% to as high as 40%. Pre-harvest food losses to pests are estimated to be more than 40% worldwide, despite the application of more than 2.5 billion kg of pesticides (Pimentel and Greiner, 1997). In India, the estimate is that about 50% of potential food production is lost to pests before harvest, with insects destroying 20%, weeds 15% and plant pathogens 15% (Pimentel and Hart, 2001).

The total losses of fruits and vegetables vary by crop and region. Those due to inadequate postharvest handling, transport and storage of fruits and vegetables vary from 20-40% (Maini, 1997; Mehrotra et al., 1998). Major postharvest diseases of fruits and vegetables in India have now been identified and control measures are being developed (Roy, 1989). To reduce postharvest losses, fruits and vegetables require treatments such as curing, pre-cooling, washing, grading, sorting, packaging, transport, storage and irradiation. Maturity indices including harvesting techniques are now descried for many vegetables.

Estimates of post-harvest losses from Assam

The North – Eastern Region of India is considered suitable for growing a large number of tropical, subtropical and temperate fruits and vegetables. In Assam, fruits like banana, citrus, pineapple, papaya, jack fruits; vegetables like tomato, brinjal, cole crops, cucurbits and spices like ginger and turmeric are cultivated in commercial scale besides growing some minor fruits and vegetables indigenous to his region. Horticultural crops cover in area of 5.43 lakh hectares, which accounts for 15.97 percent of the total cultivable area of 34.00 lakh hectares in the state. Despite having all the favorable factors, the desired level of development in horticulture has not been achieved because of a number of constraints. However the productivity of many fruits and vegetables is far below the national averages. Moreover, due to absence of proper post-harvest management system a bulk quantity of our produce gets damaged during the process of handling, transportation and marketing; resulting in 10-25 per cent annual losses. The post-harvest losses varied from crop to crop and within different stages (Table 9.6). Among the crops, the highest total loss was recorded in tomato (25.25 %) followed by Banana (22.00%). The highest post-harvest losses were recorded during transportation in tomato and banana. Maximum loss during marketing was recorded in banana (12.00%) followed by tomato (9.75 %).

Table 9.6 PHL of horticultural crops in different stages of marketing in Assam

Crops	Harvesting	Grading	Transportation	Marketing/ Storage Wholesaler	Retailer	Total loss(%)
Orange	3.25	0.75	1.25	1.20	7.50	13.95
Pineapple	1.73	0.54	1.95	2.66	2.37	9.25
Banana	Nil	Nil	10.00	5.00	7.00	22.00
Ginger	1.5	2.25	1.50	2.75	2.50	10.50
Tomato	0.75	3.75	11.00	2.50	7.25	10.50
Cauliflower	Nil	2.75	7.50	1.75	3.75	15.75
Spine Gourd	Nil	8.30	4.30	1.80	2.70	17.10
Pointed Gourd	Nil	5.40	7.50	1.90	2.10	16.90

Source: Director of Research, Assam Agricultural University, Jorhat, 2005

Banana recorded the highest monetary loss of Rs. 128.34 crores per year due to losses during handling and marketing as against the lowest monetary loss of Rs. 4.33 crores in oranges (Table 9.7). This has reflected the drainage of hard earn revenues due to non-adoption of appropriate post-harvest management practices and lack of storage facilities in the state.

Table 9.7 Post-harvest monetary loss of horticultural crops in Assam

Crops	Production (' 000t)	Monetary loss (Crores/ Year)
Banana	583.38	128.34
Orange	62.07	4.33
Pineapple	209.00	19.33
Ginger	111.08	11.66
Tomato	332.00	41.99
Cauliflower	232.80	11.03

Source: Director of Research, Assam Agricultural University, Jorhat, 2005

PHL of fruits/vegetable estimates from Andhra Pradesh

Table 9.8 Post-harvest losses of fruits and vegetables in Andhra Pradesh

Stage	Extent of post-harvest losses
Field level	10
Transport	5
Packing	2
Storage	9
Processing	4
Total	30

Source: GoAP (2003c).

The details of post-harvest losses in different fruits and vegetables in Andhra Pradesh are summarized in tables 9.8 and 9.9. The losses are alarming and as high as 30 per cent in different stages of marketing. Papaya and citrus fruits have showed maximum losses when compared with other fruits. It is followed up banana and mango crops.

Table 9.9 Post-harvest losses of fruits and vegetables at all India level

Crop	Extent of post-harvest losses
Banana	20–80
Mango	17–36
Citrus	20–95
Guava	10–15
Papaya	40–100
Apple	14
Grape	20–25
Tomato	5–50
Onion	25

Source: National Horticultural Board, 2004.

Source: P P Rao, 2008

Post-harvest losses in food grains in Karnataka (Basavaraja et al., 2006)

Considerable quantity of post-harvest losses is observed in food grains due to improper post-harvest handling. Basavaraja *et al* (2006) made an attempt to estimate the post-harvest losses in rice and wheat in Karnataka using the survey data. In all, for each crop 100 farmers, 20 wholesalers, 20 processors, 20 retailers were randomly interviewed for elicited data during 2003-04. The post-harvest losses at farm level were estimated to be 3.82 kg per quintal for rice and 3.28 kg per quintal for wheat. The storage losses were observed to be the highest in both the crops, which added up to 35.80 per cent and 33.52 per cent of total post-harvest losses in rice and wheat respectively. About 0.29 kg per quintal of rice and 0.20 kg per quintal of wheat were lost at wholesaler level and 1.06 kg per quintal of rice and 0.82 kg per quintal of wheat were lost at retail level. The factors that influenced the post-harvest losses significantly at farm level were education level of farmers, bad weather conditions, inadequate labor availability and faulty storage method.

PHL of fruits/vegetable estimates from Bihar and U.P (ASET, New Delhi)

Horticulture producers of both states are in a very bad shape because of excess production. Both centre and state governments should act in resonance and make urgent efforts to export surplus produce. Whole orientation of farmers in both states is towards production. Their negligent attitude towards post-harvest losses, lack of quality consciousness and absence of food processing units and unavailability of modern cold storages are responsible of huge post-harvest losses (see tables 9.10 & 9.11).

Cold storages of both states have been built primarily for preservation of potato only. Therefore, other horticulture products can't be kept there. Therefore, modern cold storages should be built and old one should be upgraded, so that other products also can be kept there. Most of the cold storages of both states are of a big size and generally located in a city centre, therefore, small sized cold storages should be built near agriculture field itself. This will reduce transportation cost and as a result more farmers will be encouraged to use this facility.

Post-harvest losses of horticulture produce vary between 5-39 per cent of total production. In case of brinjal, cauliflower, guava, chilly and papaya post-harvest loss was found lower. Main reason behind this phenomenon was lower level of production. On the contrary in case of mango, onion, tomato and potato, loss was too high.

Lack of quality consciousness on the part of horticulture producers increase post-harvest losses, on the other hand lack of the same, saves many produce from complete wastage because consumers purchase them on a relatively lower price. Thus, though it reduces quantitative loss of horticulture produce, it is hazardous for human health. Biggest obstacle in the proper functioning and development of cold storages and food processing industries is poor power supply in states. Therefore both governments should increase power supply.

Table 9.10 Estimates of PHL from six districts of Bihar state

Name of Fruits & Vegetables	Total Estimated Production (in ton)	Total Estimated Wastage (in Per cent)	Total Estimated Wastage (in lac Rs)
Mango	508740	39	8639
Banana	273250	18	2125
Litchi	53679	22	2309
Papaya	23901	10	136
Guava	67689	15	322
Cauliflower	119645	18	592
Brinjal	112931	14	247
Chilli	78781	5	676
Onion	116665	25	908
Tomato	82457	39	140
Potato	448691	24	2091
Total Estimated Post-Harvest Wastage			18191

Table 9.11 Estimates of PHL from six districts of Uttar Pradesh state

Name of Fruits & Vegetables	Total Estimated Production (in ton)	Total Estimated Wastage (in Per cent)	Total Estimated Wastage (in lac Rs)
Mango	187070	22	1556
Banana	25765	14	141
Litchi	3621	15	69
Papaya	9146	11	61
Guava	28512	14	94
Cauliflower	128542	18	264
Brinjal	52531	12	126
Chilli	97538	5	723
Onion	88443	17	406
Tomato	50703	35	259
Potato	1109753	21	29868
Total Estimated Post-Harvest Wastage			33576

Post-harvest losses in horticultural crops – An Appraisal *(K.V Subrahmanyam, 1986)*

The horticultural crops differ from other food crops like cereals with respect to certain natural characteristics like moisture content (70-95%) as against 10-20% in case of cereals), texture (soft as against hard texture), unit size etc which makes them highly perishable resulting in huge post-harvest losses. The post-harvest losses obviously have an impact both at macro and micro levels of the economy and hence there is need to study them. The post-harvest losses of horticultural crops in developing countries have been reported to vary between 15 to 50 per cent with an estimated minimum of 20 per cent. Regarding individual commodities, it was reported that it varies from a minimum of 14 per cent in case of apples to 100 per cent in case of papaya and for vegetables it varies from as low as 5 per cent in case of potato to as high as 100 per cent in case of plantain.

In India, the working group sponsored jointly by the Indian National Science Academy, New Delhi and United States of America National Academy of Science, Washington, 1979, have estimated the post-harvest losses in fruits and vegetables at 30 per cent or more. It also felt that there is lack of information and the group was inclined to believe that losses would be in the range of 25 to 40 per cent depending up on the commodity, area, storage and quality etc. The studies conducted by the U.P Government on Mango, Guava and Potato have put the post-harvest losses at 25-40 per cent. The study conducted by NAFED on onion has shown that the post-marketing losses at 25 per cent and between post-harvesting and pre-marketing at 5 per cent.

The study found the following impacts and gave some recommendations:

1. Economy: The production of fruits and vegetables during 1982-83 was estimated at 52.6 m tons consisting of 22.6 m tons of fruits and 30.0 m tons of vegetables. The monetary value of this was Rs.5200 crores at that point of time.
2. Per capita availability: Because of the estimated 30 per cent post-harvest losses, the per capita availability will be reduced by around 25 gm per day in case of fruits and vegetables by 34 gms per day.

3. Marketing cost: the studies have shown that the transportation cost to be the most important item of marketing cost. The losses in transit have an important bearing on the ultimate consumer prices

Recommendations:

1. Post-harvest treatment with chemicals would minimize some these losses occurring in different fruits and vegetables
2. Improved method packing – the improved method or technology will reduce these losses
3. There is a need to conduct systematic/pilot studies or experiments for better understanding of the post- harvest losses in fruit and vegetables

PHL in different fruits/vegetables in the World

Postharvest losses of potatoes, tomatoes, and grapes in Egypt based on sampling

	Percentage loss of commodity		
Marketing system level	Potatoes	Tomatoes	Grapes
Farm	11.9	9.0	15.1
Wholesale	1.5	17.9	6.9
Retail	4.2	16.3	6.0
Total	17.6	43.2	28.0

Source: University of California - Egypt, Agricultural Development Systems Project Final Report (edited by Blond, 1984)

Postharvest losses of potatoes, tomatoes, and grapes in Egypt based on interviews

	Physical (economic) losses %		
Marketing system level	Potatoes	Tomatoes	Grapes
Farm	5.2 (5.2)	10.8 (10.8)	4.5 (4.5)
Wholesale	2.2 (2.8)	5.2 (11.4)	0 (2.5)
Retail	1.4 (3.6)	11.6 (13.0)	7.4 (10.0)
Total	8.8 (11.6)	27.6 (35.2)	11.9 (17.0)

Source: University of California - Egypt, Agricultural Development Systems Project Final Report (edited by Blond, 1984)

Estimated Losses of Selected Vegetables in Cambodia, Laos, and Vietnam based on Questionnaires (558 respondents)

Country	Tomato	Yardlong bean	Cucumber	Chinese kale	Chili pepper
Cambodia	24.6	21.8	19.7	16.4	___
Laos	16.9	12.2	8.7	___	10.7
Vietnam	19.1	___	___	___	16.9
Average	20.5	16.7	14.7	16.4	12.6

Source: Weinberger et al, 2008 Overall Mean = 17%

Estimated Postharvest Losses of Fruits & Vegetables in Ethiopia based on Interviews (Tadesse, 1991)

Fruits	Losses (%)	Vegetables	Losses (%)
Guava	49.2	Tomato	19.4
Pineapple	28.2	Melon	16.7
Mango	26.3	Onion	10.7
Mandarin	17.4	Potato	6.0
Papaya	11.5	Sweet potato	2.9
Orange	9.0	Beet root	2.7
Banana	8.1	Green beans	2.2
Grape	4.3	Sweet pepper	2.0
Grapefruit	1.9	Carrot	1.1
Lemon	1.3	Cabbage	1.1

Source: Kader, 2009

Postharvest Losses of Fruits and Vegetables in Some Developing Countries

Country	Commodity	Method used	Losses (%)	Reference
Ghana	Tomato	Interviews	20	Bani et al, 2006
Kenya	Banana (imported from Uganda)	Sampling	18.2 – 45.8	George & Mwangangi, 1994
Nigeria	Yam	Survey	12.4 (economic loss = 10.5)	Okoh, 1997
Pakistan	Tomato Tomato, potato, onion	Survey	20 22, 12, 9	Mujib et al, 2007 Zulfiqar et al, 2005
Vietnam	Plum	Survey	28	Newman et al, 2008
Oman	Fresh produce	Survey	3 - 19	Opara, 2003
Jordan	Tomato, eggplant, pepper, squash	Sampling	18, 19.4, 23, 21.9	El-Assi, 2002

Source: Kader, 2009

Postharvest Losses of Fruits & Vegetables in India

Commodity	Method used	Losses (%)	Reference
Potato	Sampling	18	Roy, 1993
	Interviews	19.8	Gauraha, 1999
	Sampling	F12.8 +W12.4 + R9.5 (econ. Loss= 5.7)	Pandyet al, 2003
	Sampling	29.4 (econ. Loss= 16.2)	Kumar et al, 2004
	Sampling	10.5	Kumar et al, 2006
Onion	Sampling	30	Roy, 1993
	Sampling	12.9	Kumar et al, 2006
	Sampling	15.7	Chaugule et al, 2004
Tomato	Sampling	13	Roy, 1993
	Sampling	30.3 – 39.6	Pal et al, 2002
	Sampling	11.9 – 21.4	Sharma et al, 2005
	Interviews	20	Ajay et al, 2003&2004
	Interviews	32.6	Gauraha, 1999
	Interviews	35	Gajbhiye et al, 2008

Source: Kader, 2009

Postharvest Losses of Fruits & Vegetables in India (cont'd)

Commodity	Method used	Losses (%)	Reference
Cauliflower	Interviews	22.4	Gauraha, 1999
	Sampling	28.6 – 35.1	Pal et al, 2002
	Sampling	12.9	Wadhwani & Brogal, 2003
	Interviews	15 - 20	Gajbhiye et al, 2008
Cabbage	Sampling	24.9 – 30.4	Pal et al, 2002
	Sampling	9.4	Wadhwanj & Brogal, 2003
	Interviews	15 - 20	Gajbhiye et al, 2008
Bell pepper	Sampling	6.7 – 17.1	Sharma et al, 2005
Citrus	Sampling	27	Roy, 1993
Mango	Sampling	26	Roy, 1993
Guava	Sampling	20	Roy, 1993

Source: Kader, 2009

Postharvest Losses of Vegetables in China

Commodity	Method used	Losses (%)	Reference
Chinese cabbage Broccoli Oriental bunching onion	Interviews	10 – 15 10 – 15 10 - 12	Zheng et al, 2001
Pak Choi Chinese cabbage	Sampling	27.2 - 34.5 22.7 - 61.6	Wang & Bagshaw, 2001
Fruits & vegetables	Interviews	15 - 35	Feng, 2001

Source: Kader, 2009

Postharvest Losses of Selected Vegetables in Northern Thailand based on Sampling at the Collection Center (Boonyakiat, 1999)

Vegetable	Range of Losses (%) due to: Bruises	Pests & Disorders	Total
Head lettuce	21.3 – 27.4	20.7 – 40.1	48 - 61
Red leaf lettuce	19.0 – 26.5	16.6 – 28.9	43 – 48
Butterhead lettuce	23.5 – 36.0	20.9 – 36.8	57 – 60
Cos lettuce	23.3 – 30.0	19.5 – 35.9	50 - 60
Spinach	17.5 – 24.8	17.6 – 30.0	35 – 52
Cabbage	13.8 – 19.2	10.9 -18.5	28 – 32
Celery	21.9 – 24.5	17.5 – 35.9	42 - 58

Source: Kader, 2009

Postharvest Losses of Fruits and Vegetables in Central & South America

Country & Commodity	Method used	Losses (%)	Reference
Dominican Republic (DR): Cassava	Sampling	17.4	Tejada, 1977
DR: Potato	Sampling	14.2	Mansfield, 1977
DR: Tomato	Sampling	14.8	Mendoza, 1977
Brazil: Tomato Bell pepper Carrot	Interviews	30 30 12	Vilela et al, 2003
Brazil: Pineapple, banana, orange, papaya & passion fruit	Sampling	Wholesale =11.6 Retail = 7.7 Total = 19.3	Carvalho et al, 2003
Brazil: Plum, peach & nectarine	Sampling	10.9 – 23.5	Amorim et al, 2008
Brazil: Fruits & Vegetables	Interviews	16.6 (marketing chain) + 3.4 (consumer home)	Fehr & Romao, 2001
Uruguay: Onion	Sampling	21.7	Zaccari et al, 1995

Source: Kader, 2009

Postharvest Losses of Vegetables in Nepal based on sampling (Udas et al, 2005)

Vegetable	Farm (% loss)	Retail (% loss)	Total (% loss)
Cauliflower	6	41	47
Cabbage	9	34	43
Radish	6	4.5	10.5
Tomato	3	7	10

Source: Kader, 2009

Postharvest Losses of Vegetables in Venezuela based on Sampling (Guerra et al, 1998)

Vegetable	% losses from harvest to consumer	Vegetable	% losses from harvest to consumer
Beet	17	Celey	48
Broccoli	49	Leek	20
Cabbage	28	Lettuce	35
Carrot	28	Potato	21
Cauliflower	37		

Source: Kader, 2009

Postharvest Losses of Tropical Fruits in Costa Rica using a Questionnaire (Arauz and Mora, 1983)

Fruit	Estimated losses (%)
Soursop	75.8
Mango	44.3
Avocado	35.0
Melon	32.0
Papaya	29.8
Pineapple	18.8

Source: Kader, 2009

Estimates from USA

Postharvest losses vary greatly among commodities and production areas and seasons. In the United States, the losses of fresh fruits and vegetables are estimated to range from 2% to 23%, depending on the commodity, with an overall average of about 12% losses between production and consumption sites (Cappellini and Ceponis, 1984; Harvey, 1978). Kantor et al (1997) estimated the U.S. total retail, foodservice, and consumer food losses in 1995 to be 23% of fruits and 25% of vegetables. Fresh fruits and vegetables accounted for nearly 20% of consumer and foodservice losses, which are due to product deterioration, excess perishable products that are discarded, and plate waste (food not consumed by the purchaser). The latter is often due to consumer dissatisfaction with product quality, especially flavour *(Kadar, 2005).*

Based on the limited data available and experience, estimates collected so far concludes that worldwide about one third of all fruits and vegetables produced are never consumed by humans. The general difference between developed and developing countries is that more of the losses occur between production and retail sites in developing than in developed countries (see below).

Estimated Postharvest Losses (%) of Fresh Produce

Locations	Developed countries		Developing countries	
	Range	Mean	Range	Mean
From production to retail sites	2-23	12	5-50	22
At retail, foodservice, and consumer sites	5-30	20	2-20	10
Cumulative total		32		32

Source: Kader, 2009

9.3 Estimation of post-harvest losses of fruits

PHL in Mango var. Totapuri in Karnataka (Gajanana et al, 2002)

India produces many varieties of mango suitable for table and processing purposes. Totapuri is an important variety of mango used mainly for processing purposes especially for the preparation of intermediate products like mango pulp which is one of the major items of export of processed fruits and vegetables from India. Mango pulp accounted for 19 per cent of the total quantity and 20 per cent of the total value of processed fruits and vegetables exported from India in 1999-2000[2]. Though Totapuri is grown in substantial quantity, processors are not found to procure their raw material directly from the producer but from the wholesale market. In the process, the fruits are subject to more losses due to multiple handling of the produce at different stages after harvest. Earlier studies have reported losses varying from 17.82 per cent to 36.7 per cent (Srinivas, 1997; Madan and Ullasa, 1993) in Totapuri mango from harvest to retail level. However, losses at the processor's level were not estimated in Totapuri variety, which is mainly grown for processing purpose. Thus, it is imperative to study the losses at different stages of marketing after harvest including at the processor's level, which would help to know the correct estimation of losses and their causes so as to suggest measures for reducing the same. Gajanana et al (2002) made an attempt to estimate the post harvest losses at different stages of marketing in Karnataka. For collection of information on post harvest loss at field

[2] APEDA, 2001.

level, 30 mango orchards were selected in Kolar and Srinivaspur talukas randomly. The results are summarized in tables 9.12, 9.13, 9.14 and 9.15.

Table 9.12 PHL in Totapuri variety of Mango at field level

Sl.No	Sample particulars/ types of losses	Post-harvest losses quantity(kg) percentages	
1	Average size of the sample	78.93	100.00
2	No. of good fruits	77.20	97.80
3	Types of PHL		
3.1	Bird damage	0.95	1.20
3.2	Rotting	0.70	0.89
3.3	Mechanical injury	0.05	0.06
3.4	Overripe	0.02	0.03
3.5	Insect attack	0.01	0.02
	Total PHL	1.73	2.20

Table 9.13 PHL in Totapuri variety of Mango at market level

Sl.No	Particulars	Quantity (kg)	Percentage (%)
1	Average size of the sample	3648.00	100.00
2	Good fruits	3460.86	94.87
3	Damaged fruits (PHL)		
a	Keel	149.20	4.09
b	Waste	37.94	1.04
	Total physical loss	187.14	5.13

Table 9.14 Total economic loss in Mango var. Totapuri at the market level

Sl. No	Particulars	Quantity (kg)	Value (Rs)	
1	Total value realization if there is no loss (PHL)	3648.00		36844.80*
2	Actual value realized 1) Good fruits 2) 2) Keel	 3460.86 149.20	 34954.69* 373.00**	35327.69
3	Value loss due to PHL			1517.11
4	Percentage economic loss (%)			4.12

* Valued @ Rs.10.10/kg ** Valued @ Rs.2.50/kg

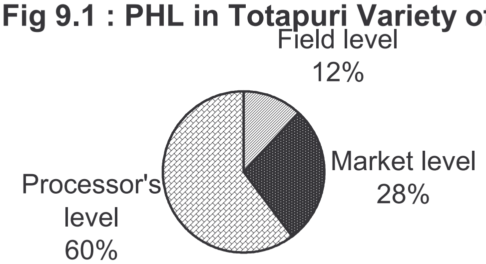
Table 9.15 PHL at Processor's Level

No. of sorting*	Fully damaged fruits		Half damaged fruits		Total PHL**	
	Quantity (kg)	Percentage (%)	Quantity (kg)	Percentage (%)	Quantity (kg)	Percentage (%)
I	64.71	0.70	206.47	2.22	271.18	2.92
II	57.65	0.62	225.49	2.42	282.94	3.04
III	37.65	0.41	179.41	1.93	217.06	2.34
IV	30.59	0.33	154.12	1.66	184.76	1.99
V	9.40	0.10	57.65	0.62	67.06	0.72
VI	3.53	0.03	7.65	0.08	11.18	0.12
Total	203.54	2.19	830.59	8.95	1034.12	11.14

* The first sorting is done after 3-4 days of heaping and subsequently once in 2-3 days

** The average size of the lot at processor level was 9284.71 kg purchased at Rs. 93775.57.

Fig 9.1 : PHL in Totapuri Variety of Mango



PHL in Mango in different countries

Postharvest Losses in Mango

Country	Method used	Losses (%)	Reference
Benin	Sampling	17(early April) 70 (mid June) Due to fruit flies	Vayssieres et al, 2008
Brazil	Survey	28	Choudhury & Costa, 2004
Costa Rica	Sampling at wholesale market	14.1 (dry season) 84.4 (rainy season) Due to Anthracnose	Arauz et al, 1994
Mexico	Interviewing consumers	< 10 at home	Baez-Sanudo et al, 1994
Pakistan	Survey Sampling	31 36.1	Mushtaq et al, 2005 Malik, 2008

The average size of the lot drawn for estimation of PHL at market level is 3648 kg. The physical loss at the market level is around 5.13 per cent. The immature and malformed fruits (Keel) account for about four per cent and the total waste form about one per cent of the total physical loss. However, the 'Keel', which is sorted out in the market, also fetches a price of around Rs.2.50/kg, which necessitates the estimation of economic loss. The economic loss works out to around 4 per cent, which is one per cent less than the physical loss. Economic loss becomes all the more important to the producers because the actual value realized by selling is the motivation factor for the farmers.

The loss in Totapuri variety of mango during ripening is around 11.14 per cent. The half damaged fruits account for nearly 80 per cent of the total loss at the processor's level. The losses are mainly due to damage caused by pressing of fruits during transit and secondary infection of diseases leading to rotting of fruits. Thus, the total PHL at different stages of handling of Totapuri mango worked out to around 18.5 per cent. About 60 percent of the loss occurs at the processor's level during ripening of mango. Further, if the half damaged fruits, which account for about 80 per cent of PHL at the processor's level, are not used for processing purposes, then the losses during ripening would have been much higher i.e. 20.09 per cent at the processor's level resulting in the total PHL of 27.42 per cent.

Marketing and PHL in Sapota of Karnataka (Gajanana et al., 2006)

Sapota is an important fruit crop accounting for about 2 per cent each of area and production of fruits in the country (Anon, 2004). The production at national level has been increasing at a compound rate of 6.14 per cent annually. Karnataka is one of the major sapota growing states with an area of 21,274 ha. and a production of 2,26,512 tonnes (Anon, 2005) accounting for about 25 per cent each of area and production of sapota in India. Very few studies, mainly under experimental conditions, reported the PHL in sapota (Jagtap and Katrodia, 1998). Keeping in view the lack of extensive studies on post harvest loss assessment and marketing in sapota, especially in a major sapota growing state like Karnataka, a study was undertaken in the Kolar district of Karnataka. The analysis of data collected at the field level, market level, procurement centre of HOPCOMS and at the retail level indicated post harvest loss (PHL) of about 15.98 per cent in the wholesale marketing channel (WSM) and about 14.07 per cent in the HOPCOMS channel. Marketing system for sapota was found to be inefficient as the efficiency index was found to be less than 1. However, between WSM and HOPCOMS, the latter was found to be efficient in terms of lower marketing cost, higher price realization by farmers and lower margin of the intermediaries. Use of mechanical harvester, pre harvest management of fruits against fruit borer, opening of procurement centers of HOPCOMS in the producing region (to reduce the cost and margin of the intermediaries) are suggested in order to reduce the PHL and also to improve the efficiency of the marketing system (see tables 9.16, 9.17 and 9.18).

Table 9.16 Post Harvest Loss assessment at field level

Sl.No.	Particulars	Quantity (kg)	Percentage (%)
1	Total quantity of sample fruits	422.65	100.00
2	Quantity of Good fruits	398.46	94.27
3	Damaged fruits		
(i)	Mechanical injury	17.55	4.15
(ii)	Borer attack	5.69	1.35
(iii)	Bird attack	0.95	0.23
	Total PHL	24.19	5.73

Table 9.17 Post Harvest Loss (PHL) at the market level

SlNo	Particulars	PHL (kg)	
		WS Market	HOPCOMS
1	Total quantity of sample fruits	1330.00 (100)	153.00 (100)
2	Good fruits	1228.16 (96.85)	146.99 (96.08)
3	Damaged fruits		
(i)	Small/immature fruits	18.00 (1.35)	1.50 (1.02)
(ii)	Bruises	10.87 (0.82)	1.74 (1.14)
(iii)	Broken fruits	6.55 (0.49)	-
(iv)	Crushed fruits	4.86 (0.37)	0.85 (0.55)
(v)	Ripe fruits	1.56 (0.12)	0.63 (0.41)
(vi)	Borer attack	-	0.49 (0.32)
(vii)	Malformation	-	0.80 (0.52)
	Total	**41.84 (3.15)**	**6.01(3.92)**

Note: Figures in parentheses are percentages to total

Table 9.18 Total Post Harvest Loss in Sapota

Particulars	WSM		HOPCOMS	
	PHL (%)	Share in total	PHL (%)	Share in total
Field level	5.73	35.79	5.73	40.65
Market level	3.15	19.71	3.92	27.86
Retail level	7.10	44.43	4.42	31.41
Total	15.98	100.00	14.07	100.00

Assessment of PHL and marketing losses in papaya (Gajanan et al., 2009)

Papaya (*Carica papaya* L.) is an important nutritious fruit which has been traditionally grown in the country. It is grown on an area of 73000 ha with a production of 2568.2 thousand tons. Papaya accounts for about 2 per cent of the total fruit area and 5 per cent of the total fruit production in the country. During the period from 1991-92 to 2004-05, production of papaya has grown at a rate of 7.92 per cent per annum. Area and yield growth during this period were 2.7 per cent and 5.08 per cent respectively.

Andhra Pradesh ranks first in the production of papaya with a production of 875000 tons (34.07%) from an area of 11400 ha (15.6%).

Keeping in view the importance of papaya (*Carica papaya* L.) and also the non-availability of studies on marketing and assessment of post harvest losses, a study was taken up on papaya *var*. Taiwan 786 grown in the major papaya producing state of Andhra Pradesh and marketed in Bangalore of Karnataka state. The results revealed that the total post harvest loss (PHL) worked out to 25.49 per cent consisting of 1.66 per cent at filed level, transit loss of 4.12 per cent and ripening loss of 8.22 per cent at the market level and 11.49 per cent at the retail level. At the filed level, the losses were mainly due to immature and small size of fruits, malformation and harvesting injury. At the market level, bruises and pressing injury caused transit loss. Anthracnose and fruit rot due to *alternaria* and *phytophthora* were the main causes of loss during ripening. Rotting of fruits was the main cause of loss during retailing. Marketing system for papaya was not found to be efficient. Inclusion of PHL as another component of marketing cost would add to inefficiency of the marketing system as it reduced the efficiency index. There is a need to reduce the PHL through the recommended pre and post harvest treatments and better handling and storage to improve the marketing efficiency in papaya.

Estimation of PHL at field, wholesale market and retail levels

The PHL at the field level was estimated from 27 lots of papaya from harvesting fields in the selected papaya growing areas in Ananthpur district. The losses at the market level were studied from 15 truck loads arriving from Ananthpur to K.R. Market, Bangalore. The transit loss was assessed by taking a sample of 15 lots with an average weight of 65 kg each. Ripening loss at the wholesale market was assessed from 8 lots of 1100 kg each. Retail level loss was estimated from the details collected from 23 retailers in Bangalore. Simple averages and percentages are used for PHL estimation (see tables 9.19, 9.20 and 9.21).

Causes of loss

As the losses occurred at both wholesale and retail levels, the samples of such papaya fruits were collected from the wholesale and retail markets and these were incubated for the association of post harvest pathogens causing diseases leading to rotting and loss.

Table 9.19 Post-harvest loss in papaya at field level

Sl. No	Particulars	Post harvest loss	
		Physical PHL (kg)	PHL (%)
1	Total sample fruits	553.07	-
2	Good fruits	543.87	-
3	Damaged fruits		
3.1	Immature and small	5.30	0.96
3.2	Malformation	2.90	0.52
3.3	Bird attack	0.50	0.09
3.4	Physical (harvesting) injury	0.50	0.09
	Total PHL	9.20	1.66

Table 9.20 Post harvest loss in papaya var. Taiwan 786

Sl. No	Stages	PHL (%)	Value loss (Rs/kg)
1	Field level	1.66	0.04
2	Wholesale market level -Transit loss -Ripening loss	 4.12 8.22	 0.21 0.43
3	Retail level	11.49	1.25
	Total PHL	25.49	1.93

Table 9.21 Causes of loss due to diseases during ripening and retailing

A. Fruits from wholesaler		
Disease	Pathogen	Fruit rot (%)
Anthracnose	*Colletotrichum gloeosporoides*	80
Fruit rot	*Alternaria alternate*	40
Fruit rot	*Phytophthora nicotinae var. parasitica*	30
Association of *Aspergillus niger* was recorded on three fruits which might have developed minute cracks		
B. Fruits from retailer		
Anthracnose	*Colletotrichum gloeosporoides*	90
Fruit rot	*Alternaria alternate*	60
Fruit rot	*Phytophthora nicotinae var. parasitica*	30
Association of *Aspergillus niger* was recorded on four fruits which might have develop minute cracks		

Total PHL in papaya

Total post harvest loss in Papaya *var*. Taiwan 786 was 25.49 per cent consisting of a field level loss of 1.66 percent, transit loss of 4.12 per cent, ripening loss of 8.22 per cent and retail level loss of 11.49 per cent.

It may be concluded from the results that the total post harvest loss (PHL) worked out to 25.49 per cent consisting of 1.66 per cent at filed level, transit loss of 4.12 per cent and ripening loss of 8.22 per cent at the market level and 11.49 per cent at the retail level. At the field level, the losses were mainly due to immature and small size of fruits, malformation and harvesting injury. At the market level, pressing injury and bruises during transportation caused transit loss to the tune of 4 per cent. Improved packing and specialized transport vehicles would reduce the loss during transit. Anthracnose due to *Colletotrichum* and fruit rot due to *Alternaria* and *Phytophthora* were the main causes of loss during ripening. Rotting of fruits was the main cause of loss during retailing. Marketing system for papaya was not found to be efficient. The inefficiency further deteriorated once PHL was treated as a component of marketing cost as the inclusion of PHL reduced the efficiency index. There is a need to reduce the PHL through pre and post harvest treatments and better handling and storage to improve the marketing efficiency in papaya.

PHL of Mosambi sweet orange in Maharashtra (Ladaniya and Vinod, 2003)

Mosambi is the major sweet orange variety grown on large scale in Maharashtra especially in Marathwada region. Major sweet orange growing districts are Jalna, Aurangabad, Beed, Nanded and Parbhani. The total area in Maharashtra under this crop is 41, 018 ha with 3.69 lakh tons of annual production. Prices received by the growers vary in self-marketing and pre-harvest contracting. Price variation thus creates an uncertainty with respect to income and production level of Mosambi crop. The post-harvest losses in Ambia crop season (Sept – Nov) were 1.2 per cent and this concluded fruits damaged by insects, overripe fruits and very small sized fruits. If farmers wait for better market prices then fruits over-ripen and losses increase due to insect damage and rotting. Losses due to harvesting practice are negligible. At distant wholesale marketing like Pune and Nagpur, the losses were 1 per cent mostly pressed, ruptured, bruised and very small fruits. At retail level, losses were mainly in the form of rotting. Losses due to rotting are higher at retail level because fruits are de-greened with calcium carbide. Loss was 5 per cent due to rot at retail level. Hence, total loss of Mosambi fruit in this season at farm+ wholesale + retail level was 7.2 per cent. Shrivelling does not lead to complete loss as in case of rotting.

‘Hast’ crop season (July –Aug): During sorting of Mosambi sweet orange at wholesale level at Nagpur market, the losses were 7.5 per cent. The losses included mostly culled / very small fruits (50 per cent), damage due to insects (20%), rotting (15%), injury /bruising (10%) and sunburn /over size (5%). At retail level (Nagpur), the losses were 12.5 per cent of the lost fruit, rotted fruit comprised 40%, culled/small fruits 40%, insect damaged 15%, oversize and sunburn 5%. Rotting was caused by stem-end rot, mechanical injury and injury caused by the sucking moth. The farm level loss was not ascertained in this season. The loss at wholesale + retail level was 20 percent which was considered higher than Ambia season and could be attributed to rains in July-Aug. The losses may increase at further upcountry markets like Delhi.

PHL of Alphonso Mango in Konkan Region of Maharashtra (Talathi J M *et al*, 1999)

The present study was undertaken to know the methods of packing, their economics, to workout economics of transportation and to estimate post harvest losses at farmer's level. A sample of 120 mango growers were selected randomly from the South Konkan Coastal Zone and data were collected by survey method for the year: 1994-95. The marketed surplus was 242 crates (15 kg each) and remaining production was kept for home consumption, gifts, friends and relatives. Most of the farmers were found to transport mangoes by motor truck during night time to avoid damage. To maximum fruit losses (8.15%) were at trader's level and minimum fruit losses (2.28%) were in sorting and storage level. The total fruit losses were 21.82 per cent of the marketed surplus including 4.36 per cent fruit losses during harvesting. To minimize fruit losses, mango growers suggested harvesting of fruits with pedicel at proper maturity (93.33%), harvesting during cooler part of the day (86.66%), dropping of fruits be avoided (82.50%), proper and protective containers and their careful handling (94.16%) and transportation during night hours (91.66%).

PHL of Mango in U.P (Singh R.K and Yadav S, 1999)

The study was conducted in Malihabad mango belt with a sample of 44 mango orchardists during 1999 with an objective to know the post-harvest key information relevant issues. The study found that on an average, 90 per cent of produce was destined to market as marketed surplus and remaining are consumed either by households or by local people/village market. It also attempted to estimate the post-harvest losses in mango with follow-up survey of marketing. The study found nearly 18 per cent of mango fruits were lost at mandi level and 8 per cent at retailer' level when transported to largest absorbing market Kanpur. The value of this lost amount of 26 per cent was estimated at Rs.4000 of fruits. This loss was 25 per cent of the total produce. This calls for evolvement of suitable technologies impact in marketing of mango to avoid losses.

PHL of watermelon in Allahabad district (D.K Singh and Hasib Ahamad, 1999)

Twenty watermelon growers were selected at random from a list of growers belonging to a belt ranging between one and two kms. This data pertain to 1999. The cultivation of watermelon was based on traditional and primitive manners. Being highly perishable and concentration of trade in few hands, the growers are much deprived of adequate return from this crop. In addition to these adverse factors, about 16 per cent losses of total production occurred during the picking, assembling, grading and transporting of watermelon. The study finally concludes that the overall post-harvest losses in Radhey variety were 16.26% and 14.28% in Bibi sugar varieties. The maximum loss occurred in transportation being 7.53 per cent followed by 1.68 %, 1.68%, 1.56% and 1.26% during loading, unloading, assembling and grading respectively in Radhey variety.

Post-harvest loss and its impact: A study of Grapes in Karnataka (Sreenivasa Murthy D et al., 2004)

Grape (Vitis vinifera) is one of the major fruit crops grown in India and accounts for about 2.5 per cent of the total fruit production. A substantial quantity of production is subjected to post-harvest loss at various stages of marketing. The quantum of loss is influenced by several factors like perishable nature, method of harvesting and packing, transportation, etc. Grapes, being a high value commercial crop, any loss could result in significant revenue loss and deprives its availability to a large population and causes huge economic loss to the nation. Though many studies have attempted in the estimation of post-harvest loss in other fruits (Madan and Ullasa, 1993; Gajanana *et al.,* 2002; Sreenivasa Murthy *et al.,* 2002; Sudha *et al*., 2002) little information is available regarding the post-harvest loss in grapes especially at different stages of marketing and its impact on marketing efficiency.

Another area of research in marketing and post-harvest loss, which requires more attention, is the estimation procedures of margins, costs and efficiency after taking into account the marketing loss. The present procedures for estimating the marketing margins and efficiency do not explicitly include the loss during marketing as a separate item, which could significantly alter the profit margins and thereby the efficiency of marketing. An attempt is made in this paper to develop a methodology for quantifying the post-harvest loss both in physical and value terms at various stages of marketing and compare the same with that of conventional methods while estimating the marketing margins and efficiency. Further, the extent of impact of post-harvest loss on producers' net share, marketing margins and marketing efficiency due to separating out the marketing loss are also quantified.

Multi-purpose random sampling techniques were used for the selection of study regions and sampling units in the state of Karnataka and primary data was collected during 2001. The study concluded that the aggregate post-harvest loss in grapes ranges from 14.4 per cent in the local market sale to 21.3 per cent in distant market sale. Improper packing and transportation are the major causes of post-harvest loss and efforts should be initiated to reduce the loss by developing efficient packing material to reduce injury to the berried during transportation. In addition, it is also important to develop appropriate cushioning material to absorb the shocks and reduce the detachments of berries during transportation. Standard pre-harvest practices and harvest methods need to be developed and given to the farmers to reduce the loss at field level.

Market intermediaries especially the wholesalers are actively involved in procuring grapes directly from the farm gate and supplying to distant markets, as there is a substantial profit margin. Mobile procurement units either by the farmers' co-operative societies or the Government organizations would bring down price spread and benefit for both the producers and consumers. In addition, this process could also reduce the post-harvest loss due to specialized transport vehicles and less number of handling of produce. By including marketing loss, which so far has been ignored in the estimating procedures of marketing margins and efficiency, it is found that the existing methods have unduly over-stated the farmers' net price and marketing margins of intermediaries. Further, it is demonstrated that the marketing loss is inversely proportional to the marketing efficiency. It is appropriate to use the correct measure of estimation for calculating the marketing margins and market efficiency (see tables 9.22 and 9.23).

Table 9.22 PHL at field level in grapes var. Thomson seedless in Karnataka

Sl .No	Particulars	Qty (gms)	% to total
1.	Avg. qty of grapes drawn	4148	100.00
2.	Good fruits in the sample	3845	92.70
3.	Damaged /injured grape berries		
3.1	Mummies/water berries	131	3.17
3.2	Small berries	8	0.19
3.3	Damage due to insects and pests	75	1.81
3.4	Berry drops and loose berries	76	1.83
3.5	Others	13	0.31
		303	7.31

Table 9.23 Aggregate post-harvest loss in Grapes var. Thomson seedless in Karnataka

Sl. No	Stages of handling	Loss at local market*			Loss at distant market**		
		Per cent	Absolute (kg) @	Share in total	Per cent	Absolute (kg) @	Share in total
1.	Field level	7.31	7.31	50.76	7.31	7.31	34.27
2.	Transit and wholesale market level	4.24	3.93	29.45	10.80	10.01	50.63
3.	Retail market level	2.85	2.53	19.79	3.22	2.66	15.10
4.	Total loss	14.40	13.77	100.00	21.33	19.98	100.00

* Bijapur market ** Bangalore market @ for a quantity of 100 kg produced and marketed

Post-harvest handling and marketing of Banana in Rajahmundry Region of Andhra Pradesh (Sudha et al., 2005)

Institutional facilities in the form of wholesale/retail market yards closer to the production centers can influence on the post-harvest loss, marketing practices and marketing efficiency of perishable commodities like fruits. An attempt has been made in this study to assess the influence of such an institutional support on the post-harvest losses and marketing efficiency in Banana cultivation. Results indicated that self-marketing at the wholesale/retail market fetched banana grower's higher share up to 64 to 76.2 per cent in the consumer's rupee. A comparison of sale through two channels was assessed. The post-harvest losses assessed at the field, market and retail sales levels worked out to be lower at 4 and 3.56 per cent in channels I and II. The marketing efficiency worked out to be 1.41 in channel I and 2.04 in channel II. Further details are summarized below in table 9.24.

Table 9.24 Post harvest loss assessment in TCK Banana

Items	Channel -1	Channel -2
a. Physical/mechanical reasons	0.59	0.26
b. Diseases	0.05	0.18
c. Physiological	0.03	0.23
d. Rodents/squirrels	0.42	0.17
e. Immature fruits	-	0.13
Total at field to market level loss	1.09	0.97
Wholesale/retail market level loss	2.32	2.00
Total PHL (up to market sales)	3.41	2.97
Retailers level	0.59	0.59
Total loss	4.00	3.56

The estimation of PHL at field, market and retail levels in marketing of TCK indicates that the overall PHL was around 4.00 per cent and this much lower compared to that for other cultivars.

9.4 Estimation of post-harvest losses of vegetables

PHL of onion in Karnataka (Gajanana, 2010)

Onion is one of the steady export earners among vegetables in India accounting for over 70 per cent of horticultural export volumes contributing to over Rs.1163 crores annually. During 2006-07, 13.78 lakh tonnes i.e., 12.94 per cent of the total onion production were exported. Onion with an area of 757.2 thousand hectares and a production of 10655.5 thousand tones, is the second largest in the country in terms of area and production. Though the area and production show 27-40 per cent fluctuation annually, it is the periodical ban on export and market intervention by NAFED which is of significance. With the domestic market for onion growing over the years, the demand and supply gap is widening thereby leading to frequent distress sales by the producers. Defective pre and post harvest handling also adds to this growing gap by way of post harvest loss. Estimates in the past suggest a loss up to 10-13 per cent in the market chain starting from harvest till final consumption. (Atibudhi, 1997; Kishor Kumar *et al*, 2006).

Onion has been traditionally grown in India and is the highest export earner among fruits and vegetables with about Rs.1163 crore. Like other vegetables, onion is also subject to losses at different stages of handling after harvest and these losses will have implications on the efficiency of the marketing system. Keeping in view the losses that occur at different stages of handling, a study was taken up in one of the major onion growing states of Karnataka with an objective of identifying the channels used for marketing of onion, the losses occurring in these channels and their implications on efficiency of marketing system. Data collected from Gadag district of Karnataka was analyzed using simple averages, percentages, modified formula of marketing efficiency etc. The results of the study indicated that the total post harvest loss (PHL) worked out to 12.55 per cent consisting of 10.43 per cent at filed level, and 2.12 per cent at the retail market level. At the field level, the losses were mainly due to rotting of bulbs and occurrence of doubles/splits. At the retail market level rotting of bulbs, skin out bulbs and to some extent sprouting are the main causes of loss.

Estimation of PHL at field and retail levels

The PHL at the field level was estimated from 47 harvesting/harvested fields of onion in Gadag district. Since the onion transported from Gadag to Bangalore is immediately auctioned to retailers, losses occurring at the retail level were assessed from 27 retailers of onion in Bangalore. Simple averages and percentages are used for PHL estimation. The samples of rotten onions at the field level were collected from the fields and these were incubated for the association of post harvest pathogens causing diseases leading to rotting and loss (see tables 9.25 and 9.26).

It may be concluded from the foregoing discussion that the total post harvest loss (PHL) worked out to 12.55 per cent consisting of 10.43 per cent at filed level, and 2.12 per cent at the retail market level. At the field level, the losses were mainly due to rotting of bulbs and occurrence of doubles/splits. At the retail market level also rotting of bulbs, skin out bulbs and to some extent sprouting are the main causes of loss. As the PHL also has financial implications on the farmers' economy some suggestions for the management of these losses are made below:

Management of post harvest diseases in onion: Curing of the harvested onions in the field for two days and then further drying in shade for 10-15 days should be taken up before transportation. Care should be taken to avoid injury to the bulbs during post harvest handling. For the control of diseases like different types of rots, the recommended treatments should be followed.

Development of varieties/hybrids resistant to diseases: Research has been initiated in this direction at institutes like Indian Institute of Horticultural Research (IIHR), Bangalore, National Research Centre on Onion and Garlic (NRC on Onion & Garlic), Pune and National Horticultural Research and Development Foundation (NHRDF), Nasik. Many varieties of onions have been released from these institutes for cultivation. For example, '*Arka Kalyan'* and *'Arka Pragathi'* varieties of onion developed at IIHR, Bangalore were found to be superior to local varieties and are less susceptible to rots. By adoption of these varieties, the loss due to rotting of bulbs can be reduced to a great extent thereby making available more number of bulbs for market[3]. In its impact analysis of *Arka Kalyan* variety of onion, KVK, Hulkoti (2008) observed that *Arka Kalyan* ranks first in bulb colour and shape, keeping quality, resistance to purple blotch disease, marketability and yield. However, the only problem with this variety is the longer duration of 10-12 days.

Adoption of better production and post harvest practices: Adoption of better production and post harvest practices developed at the above research institutes would help the producers to bring better quality produce to the market and thereby earn them higher returns.

Infrastructure facilities: Bad condition of roads, inadequate and improper storage, inadequate transport, etc. need to be addressed to minimize the losses during post harvest handling of onion. Improved storage facilities, packing and transportation facilities would reduce the loss to a considerable extent.

Table 9.25 Field level loss in onion

Sl. No	Causes of loss	Filed level loss (%)
1	Rotten bulbs	7.50
2	Skin out bulbs	0.17
3	Doubles/splits	2.99
4	Sprouts	0.11
	Total	10.43

[3] The authors thank Dr. Veere Gowda, Principal Scientist (Hort), IIHR, Bangalore for the valuable personal discussion on the onion varieties and hybrids developed at the Institute.

Table 9.26 Retail level loss in onion

Sl. No	Causes of loss	Retail level loss (%)
1	Rotten bulbs	1.52
2	Peel	0.49
3	Sprouts	0.11
	Total	2.12

Economic assessment of Post-harvest losses in vegetable crops (Gauraha, 1997)

The study was conducted in Bilaspur district of Chhattisgarh region of M.P. For estimating the post-harvest losses at market and consumer level, few market functionaries and consumers of Mungeli city were also interviewed. The overall post-harvest loss for vegetable crops towards the consumption end of the post harvest distribution system was around 17.26 per cent of the total harvest quantity. The estimated loss varied from 5.86, 10.59 and 0.81 per cent at farm, market and consumer level respectively. Maximum post-harvest loss was observed in tomato (32.64%) followed by cauliflower (22.36%) and potato (19.79%). Minimum loss was observed in bottlegourd (5.42%) followed by radish (9.80%) and lady's finger (11.71%). At farm level maximum loss was observed in tomato followed by cabbage and cauliflower and minimum in bottlegourd and similar trend was observed at market and consumer level. The causes of losses are the practices currently used in post-harvest handling and the standards of material facilities used for storage, packing and transport are outdated and contribute directly to post-harvest loss. Finally, the study made conclusion that the post-harvest loss in vegetable to be minimized by adopting numerous pre and post harvest practices such as improved cultural operations, harvesting and transportation and protective treatment. Marketing cooperative should be encouraged among the vegetable growers to minimize these losses. There is also an imperative need of developing consumer preferences to processed vegetable products such as tomato, and to encourage processing industry so that surplus can be used for processing.

PHL of onion in Nawapada district of Orissa, (Atibudhi, 1997)

Onion represents the only item of vegetable crops where India figures prominently in the World production and export. The country has highest acreage under the crop accounting 0.32 m.ha and accounting for 16.04 per cent World area. The study summarized that in terms of area under Orissa occupied third position next to

Maharashtra and Karnataka with 12.5 per cent of the total area in the country. It was also estimated that 13.56 per cent of the total production was used for home consumption and 86.44 per cent was marketable surplus. But, actually 72.69 per cent could be marketed since 13.75 were reported to be post harvest loss. The loss was very high due to non adoption of post-harvest management practices by all categories of farmers. The adoption index for post-harvest management practices was found to be only 36.6 per cent. So, the study suggested to give proper attention by the extension workers of horticulture department to increase productivity of onions in the state as well as increase net income from crop.

PHL of Tomato crop in Karnataka (Gajanana, 2006)

Tomato is an important vegetable in India and the production has been increasing over the years. Being perishable it is subject to losses at different stages of handling. Keeping in view the non-availability of systematic studies on post-harvest loss assessment and also the increased production of tomato, a study was undertaken in the major tomato growing state of Karnataka to assess the post harvest loss (PHL) at different levels of handling. Total PHL was observed to be about 19 per cent consisting of 9.43 per cent at field level, 4-5 per cent at market level and about 5 per cent at the retail level. Pest and diseases were the major causal factors of loss at the field level and physical injury and pressing and crushing of fruits at the market level. At the retail level, diseases caused by secondary infection, over ripe and rotten fruits and injury to fruits due to pressing were the major causes of loss. Since the transit loss was not much different from the local market, selling in the distant market is desirable to take advantage of higher price prevalent in the distant market. Harvesting of tomato at firm breaker stage, pre harvest management of crop using integrated pest management (IPM), strengthening of extension net work, establishment of processing units in the production area are suggested to minimize the loss and do benefit the farmers.

PHL of major vegetable crops in Himachal Pradesh (Sharma *et al*, 1999)

Vegetable crops being perishable, loose much in quality and quantity during various operations like harvesting/assembling, storage, grading and transportation etc. the present study was under taken to estimate these losses at various stages to find out the problems faced by them in minimizing those losses. The study was conducted in four parts i.e., Kamgra, Mandi, Kullu and Solan regions. The study found that the extent of loss was found to be highest in case of large farms. The extent of loss in case of cauliflower was found to be 15 per cent in Kangra district and 5% in Kullu district. In case of cabbage also the minimum loss was found to be in Kullu district. On all-farm situation, the minimum losses were found to be in Mandi. The losses in Okra were estimated to highest on large farms in Kangra district while these were minimum in Kullu area on these farms. Among all the crops, the post harvest losses were found to be minimum in case of radish crop.

PHL of onion in Bolangir district of Orissa (Atibudhi, 1999)

An attempt has been made the post harvest losses of onion and to identify the efficient post-harvest management strategies which can reduce them. Bolangir district was purposively chosen as it has highest acreage of onion crop in the state. The total estimated post harvest loss was estimated as 39.17 per cent of which 22.60 per cent is lost at farmer's level. This loss is huge quantity which reduces the net incomes of the farmers substantially. The adoption index is only 32.2 per cent. The study further indicates that adoption of post harvest management practices can give an incremental net income of 24.2 per cent.

An Economic Analysis of post-harvest losses in vegetables in Karnataka (Kishore Kumar D et al., 2006)

Outputs of all agricultural commodities produced in the field have to undergo a series of operations such as threshing, transportations, processing, storage and exchange before they reach the consumer, and there are appreciable losses of outputs during these stages of their handling. The sum quantity of outputs lost in these operations at all of these stages is referred to as 'post-harvest losses'. However, the importance of post-harvest losses in agricultural commodities is not fully recognized in developing countries where agricultural production is not fully linked with marketing. The number of scientists involved in production research in these countries is significantly higher than those concerned with post-harvest losses in agricultural commodities. The wastage of agricultural commodities would mean not only monetary loss but also destabilization of the economy and a decline in the nutritional standards that is already low in developing countries (FAO, 1980). The estimated post-harvest losses in case of Onion and Potato in Karnataka are summarized in table 9.27.

Table 9.27 PHL in case of onion and potato in Karnataka at different stages

Different stages	Onion		Potato	
	Loss in kg/qtl	Per cent loss	Loss in kg/qtl	Per cent loss
1. Harvesting injuries	0.23	2.21	0.19	1.46
2. Drying	0.95	9.12	1.06	8.17
3. De-topping	0.50	4.80	-	-
4. Packing	0.12	1.15	0.15	1.16
5. Storage	3.02	28.98	4.28	33.00
6. Transportation	1.22	11.71	1.48	11.41
7. Marketing	0.17	1.63	0.18	1.39
Loss at farm level	6.21	59.60	7.34	56.59
1. Storage	0.55	5.28	0.70	5.40
2. Transit	1.30	12.47	1.52	11.72
Loss at wholesale level	1.85	17.75	2.22	17.12
1. Transit and storage	0.88	8.45	0.97	7.48
2. Bad weather and foreign matter content	0.76	7.29	1.23	9.48
3. Spoilage and multiple handling loss at retailer level	0.72	6.91	1.21	9.33
Loss at retailer level	2.36	22.65	3.41	26.29
Total loss	10.42	100.00	12.97	100.00

The post-harvest losses occur due to faulty methods of harvesting, threshing, cleaning, drying, storage, transportation, processing, packaging and distribution of agricultural commodities. The total post-harvest loss in onion and potato at the field level was estimated to be respectively 6.21kg/qtl and 7.43 kg/qtl. About 60 per cent of total post-harvest losses occur at the farm level and about 25 per cent losses are observed at retailing level. The storage loss at different stages added up to about 38 per cent of the total loss while on farm harvest operations accounted for about 71 per cent of the total losses. Transit loss was another important component of post-harvest loss contributing about 25 per cent of the total loss. The functional analysis revealed that inadequate storage and inadequate transportation activities coupled with bad weather conditions positively and significantly influenced the post-harvest losses at the farm level. The establishment of small sized cold storage units in the production centers would help in reducing the storage losses in vegetables. In this direction the zero energy cool chambers technology developed by the Indian Council of Agricultural Research needs to be popularized.

9.5 Estimation of post-harvest losses of other perishable commodities

9.5.1 Milk / other dairy products

Case of Ethiopia

Dairy production and utilization in Ethiopia is mostly traditional. Consumption of whole fresh milk and dairy products are traditional recipe in the form of Butter/ghee, Ayib and Irgo. Technologies employed to produce these products vary from place to place depending on culture and agro-ecology. Absence of organized marketing network has made the produced milk unable to reach the consumer. Together with the perishable nature of milk, post-harvest losses are high due to spillages and spoilage. The instances that enhance post harvest spillage and spoilage of milk are either resultants of low technology used and/or lack of market outlet for the produce.

The Rapid Appraisal indicated values of 44.1% of the milk produced as home retained and 55.1% as sale from the total milk produced on the farms surveyed, the remaining 0.8% considered as loss. In explicit terms it was 11.9%, 32.2% and 55.1% of the milk produced is for home use, processed at home and sold as fresh milk to consumers and processors respectively. Rural farmers marketed on average the lowest amount and less frequent through out the year. The Peri-urban farmers sell 61.0% to 75.2% of their milk through co-operatives and self-help groups. Urban dairy farmers sell 56% to 71.6% to consumers. Smallholders with indigenous stock use most of the milk for home consumption and processing only. Even those farms with both local and improved stock the milk obtained from local cows collected separately and were used for home consumption.

Causes of losses in milk from milking to consumption take routes in every transaction from production to consumption. Losses being in terms of spillages, spoilages, forced feeding (above requirement) and conversion losses when processing. Though it is a common practice to let the calf with the cow when milking local cows, results indicate that on average about 3.7% farmers practiced bucket feeding. With the majority letting the calf to suckle the over all amount that would be lost as unaccounted is high, losses of milk in transportation, utensil used for milking, transporting and storing, preservation methods used, hygienic practices are major factors among the rural producers.

The type and level of post harvest milk losses was assessed on producer-seller, milk collector-seller (individual and cooperatives or user groups), processors and retailers levels. Generally the reasons given for milk losses were either due to spillage during milking, milk transferring and transportation at premises; adulteration of milk; use of poor containers liable for pathogenic bacteria to foster and poor hygiene that causes continuous deterioration of the milk quality At producer level spillage losses range from 0.2% to 2.4% of the produce with average of 0.6%. Higher spillage losses reported with farmers with large herd size. However, the proportion of losses to that of the quantity of milk produced is not high. There is no significant difference of losses as spillage when we consider breed differences. Losses due to consumption of milk above requirement ranged from 0 (zero) in case of smallholder farmers who had few local cows to 5.4% with average of 2.3% with average total loses at household level being 2.9%.

Spillage of milk is reported to be high by retailers when they transfer milk from producers premises to collecting containers and then when retailing, the large amount being reported when transporting. Milk left is very occasional mainly reported during the lent season. Spillage is high in causing milk loss during transport. It amounted to 1.5% of the milk transported along the informal channel with children carrying the milk in inappropriate containers. The formal channels also record spillage losses during transportation. Wastage of milk at collecting centers was attributed to spillages, poor handling and spoilage resulting in contamination of milk while still at the farm. Pooling of milk from different sources and delays also contribute to milk spoilage at the primary collecting and processing units. Losses due to spillage amounted less than 2% due to measurement differences, in every user group visited. The group could not notice losses since they accept milk by volume the farmer losing up to 3-5% during pouring milk to the collection centers. Losses due to spillage and over consumption increased with increasing number of milking cows and handlers along marketing channels.

Overall up to 0.9% (0.6% rural and 0.9% peri-urban dairy) of milk is wasted at farm level while along the marketing chain there is a 2.8% on spillage and 2% undergoing spoilage. As indicated in the result of the RA transaction losses due to mishandling, type of container used to transport, store and process, accidental losses have to be considered for the cumulative lose of 6.11%. Taking 14.6% marketable milk, not including the dairy products marketed from rural areas as butter, the overall daily loss is approximately 6.2% of the marketable milk including consumption above requirement valued at 34.644 million Ethiopian Birr (US $ 4.028 million).

9.5.2 Fish sector

Marine fish production in the country increased from a meagre 0.5 million tones in the 1950's to 2.66 million tones during 2003 which is mainly based on multicraft, multigear and multispecies. The means of production include mechanized boats (46,918), motorized boats (31.726) and artisanal craft (1,59,481) all in excess by 55, 60 and 81 % respectively. There are 2.271 landing centres, 6 major and 33 minor fishing harbours. In the year 2000, of the total production of 2 .7 million tonnes, 64% was contributed by the mechanized sector, 8% by the artisanal sector and 1% by the deep-sea sector. The increase in capture fisheries production over the years was attributed mostly to improvements in craft and gear, increase in fishing intensity, multi day fishing extending to deeper areas with better communication and fish finding facilities, post-harvest handling, on board processing, preservation, storage and value addition of products. While these developments were positive, negative trends soon set in the form of declining total catch and catch per unit of effort, decrease in recruitment and un-economical fishing etc.

The National Academy of Sciences (1978) noted that the figures for actual post-harvest losses, due to various causes, were highly speculative. This observation is probably still valid. Clearly, substantial losses occur in certain fishery operations, such as the non-selective shrimp trawl. However, loss figures on which research is based tends to be global or generalised for a region. Moreover, there are wide variations in estimates. Even when extensive, systematic loss studies are undertaken, as was the case with Mexican shrimp by-catch, the main conclusion is the considerable variability in amounts of discarded fish per vessel because of environmental and logistical factors (Perez Mellado *et al*, 1982).

According to the 1995 strategy for post-harvest fisheries research in Asia report (NRI/SIFR 1995) "fish catches are stable or declining and therefore losses must be reduced and the utilization of landings must be increased, primarily in order to increase the consumption of fish protein by the populations of the countries concerned". In order to maintain the quantity of fish available for human consumption at present levels despite a stagnant or declining supply, it becomes necessary to increase the percentage of the current catch which can be made available for consumption purposes. One way to do this is to reduce the losses occurring in the fish processing sector, especially during the monsoon season when fish drying is particularly difficult. By doing this, the consequences of a declining fish catch can be tackled, as well as improvements made to the economic status of those persons involved in drying activities. If the problem of fish loss is to be addressed, a full understanding of the current situation is needed detailing the size and nature of the losses, the reasons for losses and the perceptions of those affected. Thus rather than physical loss, it is the financial loss, where the catch does not earn the revenue which it could as a result of poor handling and a lack of effective means of preservation and storage, which is significant for further research. While the researchers may define a loss as the difference between the maximum potential revenue and revenue actually received, the processor may not recognize that a "loss" has been made so long as the fish has been sold and some revenue has been received.

Quantification of post-harvest fish losses and these methods were developed by NRI. By using these methodologies Ward et al (1996) calculated the marketing chain for fish between Visakhapatnam and Madras. They found, for example, that approximately 90 per cent of fish arriving at the Visakhapatnam auction market is of good quality. The remaining 10 per cent is of poor quality. Of the seer fish arriving at the market, 30 per cent is in poor condition and is sold for between 45 and 75 per cent of the price of good quality fish. This is salted and sundried.

The study also found in Chatrapathi Shivaji market in Bombay they were informed that out of the total amount of fish brought to the market, 5-6 % is downgraded for salting. In general terms, the fish that is downgraded for salting is sold for 50 per cent of the best quality price. The degree of downgrading varies according to season, with a higher percentage of downgrading occurring in the summer months. The season-specific data to demonstrate the significance of losses would be more useful. The information on losses from processors should be collected at different times of the year.

Estimations from Andhra Pradesh

The need for assessment of such losses has become all the more important to know the magnitude of loss and underlying causes and to plan the loss reduction strategies. Hence, a pilot study was undertaken with the objective of assessing the post-harvest losses at various stages in aquaculture sector. The study was conducted in East Godavari and West Godavari districts in Andhra Pradesh. The samples of respondents were selected using two-stage sampling, simple random sampling without replacement and stratified random sampling methods. Data from the selected respondents were collected at weekly intervals through interview method, using structured interview schedules (Jeeva *et al*., 2008).

At harvest stages, the extent of losses was found to be 2.40% in freshwater aquaculture and 1.86% in brackish water aquaculture sectors. At various marketing channels, the percentage losses were found to be 0.29 at fish godowns / packing centers, 0.19 to 1.57 at pre-processing units, 0.15 to 0.54 at processing units, 1.42 to 10.98 at wholesale markets, 2.96 at retail markets, 4.10 to 5.52 at the level of vendors and 2.22 at live fish transportation centers. The possible causes were found to be faulty handling practices, inordinate delay in timing from harvest to packing and transportation, spoilages due to inadequate usage of ice, discarding of juveniles and un-economical sized fishes, adverse weather conditions, physical losses, discarding due to lack of demand, spoilage due to improper packing and inefficient containers, unreliable transportation, spoilage due to delay in transportation, spoilage due to lack of storage facilities, and prolonged duration of marketing. Avoiding the delay in duration of harvest, avoiding the catches of juveniles and un-economical sized species, adequate use of ice, strengthening of infrastructural facilities in markets, good storage and hygiene conditions, improved handling practices and training and demonstration on proper handling and transportation methods are some of the managerial measures required to minimize the losses. The technological requirements are the development of improved packaging materials and efficient containers and improved handling, preservation and processing techniques, especially for cultured fishes. If such losses are avoided, then it would help in not only meeting the nutritional requirements of the people, but also in earning foreign exchange by exporting the surplus. This study may be helpful to create awareness regarding the losses among the fisherpersons, planners, policy makers and administrators for planning and implementing the programmes related to these areas. More such studies covering the actual economic losses, at each stage of handling, transportation and marketing are required.

Estimations from Bangladesh

With a total land area of 147, 570 sq.km Bangladesh is characterized by high population, rapid population growth, high population density and low per capita income per year. During the study, the farmers were asked to report for the production losses occurred due to various factors. The different broad factors were water quality, water quantity, diseases, soil and temperature. Production loss was estimated using three pieces of information namely, (a) probability of occurring of a constraint (hazard), (b) Proportion of fish affected and (c) Actual production loss for the affected species in the pond *(Arjuman A et al., 2004).*

The farmers were asked to report on the frequency of occurrence of a hazard during the last five years. Thus the probability of occurrence was defined as the number of occurrences divided by number of years under consideration. Farmers provide the information on the proportion of fish affected and actual quantity of fish affected in the year under consideration. Normalized production loss was then calculated by multiplying a, b and c (per hectare converted production loss). High turbidity was a problem for each of the last five years. So, a probability of 1 was assigned against the fish farmers.

The normalized production losses were estimated to be 63.41 kg per ha for TR fish farmers, 87.44 kg for the CTR fish farmers and 110.0 kg for the TCNR fish farmers. Water quality and disease were the important parameters that caused most production loss. Taking all the categories of farmers together, the average per hectare production loss was estimated to be 86.95 kg normalized production loss (per cent) of TCNR, CTR and TR fish farmers.

Although these production losses are very significant, proper management and care can help reduce production losses. The farmers should be made aware of the importance of water quality for fish production and necessary practical demonstrations in the rural areas should be carried out to make farmers aware of the water quality management and other aspects of aquaculture practice. Likewise, specialist services should be made available to take proper care of the production losses causing due to diseases.

Estimation from SSA

Similarly, the estimation of post-harvest losses in Sub-Sharan Africa (SSA) was on an average of 30 per cent of the catch is lost due to bacterial and fungal diseases. Usage of improved processing technologies such as screens can reduce these losses significantly, resulting in food security for consumers. This sector also generates more employment especially for rural women. There is also a strong gender aspect to fish-based livelihood activities.

Some of the reasons for losses

It will be important during the exploratory survey to identify the reasons why losses are occurring in the monsoon season in the individual sites. This understanding in needed to judge whether anything can in fact be done to help alleviate the losses.

One reason for losses is the case of the small-scale processor who purchases fish which she is then unable to sun dry because of the rain. Some estimate of the frequency of this event should be made during the exploratory research. It could be that loss on some days is a part of the coping strategy during the monsoon season, and that loss is compensated for on days when the weather is suitable for drying.

Another reason for losses during the monsoon season referred to during a visit to SIFFS and in personal communication with researchers, is the case of bulk landings of anchovy. When this happens, landed quantities are so large that there is neither the market for fresh consumption nor the capacity for processing before the fish begins to deteriorate. The fishermen are adversely affected if they are unable to sell everything that is landed and a physical loss may result if some of the fish has to be discarded.

Although a serious problem when it happens, bulk landings of anchovy may only occur three or four times during the monsoon season. Any proposal for intervention to alleviate the problem would need to compare the costs of intervening with the expected gain from processing a larger quantity of fish three to four times in the season. If a technical intervention was being considered, the sheer size of a bulk catch would necessitate a large throughput capacity, and it is unlikely that it would be economically efficient to invest in a large piece of equipment which can only be used to full capacity on a very limited number of days in the year. This demonstrate the importance of gaining a full understanding of the reasons why losses are occurring, the frequency with which they are occurring, and an estimate of the size and their financial value of losses.

Appropriate technical / non-technical interventions for reduction of PHL

An intervention to reduce losses will function by either improving the quality of current output, and/or increasing the quantity produced. A quality improvement is normally associated with a price increase and perhaps the most significant question is that of who is ultimately going to bear this price increase. "Quality of fish is a highly subjective concept and there are not absolute measures". If fish does not represent a public health risk and is eaten by consumers it is surely of acceptable quality. The question therefore remains as to what extent development projects should become involved in upgrading the quality of fish thereby pricing them out of the market for the low income consumer (Poulter *et al*, 1988).

Regarding potential market expansion, the evidence is not wholly encouraging. Gray (1996) concluded that it seems to be the case that where fresh fish is available, dried and salted fish is not appreciated by consumers. Because of this, there is a possibility that demand for fresh fish will increase at the expense of dried fish, as infrastructure improves and its availability increases. Also, dried fish is seen in India as a low value product and is consumed by low income households. Higher income groups are not generally interested in dried fish.

"In the absence of state compulsion or subsidy, demand for technology comes from operators who expect to profit by using it …if the apparatus would not profit its potential users, artisanal fish processors, then it would not be adopted" (Fegan, 1994). Cost benefit analysis should be undertaken at the start of technology development to avoid wasting time and money on equipment which is not likely to be taken up for financial reasons. Costs of technology can be estimated at the design stage, likely throughput and costs of any inputs given, and potential revenue estimated.

Similarly, the market conditions have to be sufficiently favorable to allow the up-take of a new technology, in particular if the latter is going to be capital intensive and comparatively large-scale. Hence an assessment of the market should include points such as, prices and how they will be affected by the new technology, and the size of the market segment potentially benefitting from reduced post-harvest losses.

Research should also look at the availability of credit for small scale processors, firstly for the initial capital investment, but also if the technology allows a greater throughput, for purchase of a greater quantity of fresh fish for processing. If credit is not available to small processors, it is more likely that they will lose out to larger processors who are able to afford the new technology and through buying fish in bulk, universally push up the raw material price.

In general, research programs to address the concern for reducing post-harvest losses in fisheries have almost exclusively been designed from a technological viewpoint. There is now a wealth of information on technologies formulated to overcome the wastage occurring in large-scale fisheries, such as shrimp trawling, and also that resulting from small-scale, traditional processing operations. Actual implementation of these technologies for the benefit of traditional fisheries and developing country consumers has, however, been minimal. This lack of success in the adoption of technology may be related to the conventional, mono-disciplinary nature of fish processing research.

Research is often conducted on the basis of assumptions regarding the existing post-harvest system. Loss assessment in specific situations may be inaccurate and the effects of variations in fish supplies unappreciated. Moreover, until recently, inadequate consideration had been devoted to consumer demand, buying capacity, food habits and economic incentives for processors. Interventions aimed at improving the quality of fish products are not usually generated from analytical evaluations of market perceptions and pricing systems in particular localities. It is argued that a systems approach to post-harvest fisheries research, involving collaboration between the biological, social and management sciences will provide a more viable framework for the development and adoption of improvements.

9.6 Factors responsible for post-harvest losses at different stages of marketing

Fruits and vegetables are valuable components of human diet. These are also a rich source of vitamins, minerals, energy and fibre. Their production, packing, transportation, storage and distribution and retailing are a big business. Although post-harvest systems have gradually improved, there is still huge physical and quality loss. Consumers get low value for their money and growers get low revenue. Consumers in India have long been used to purchasing poor quality produce and it is unclear if they would be readily willing to pay for improved quality. There is neither a clear goal that one can set for quality improvement, nor reliable benchmarks of the existing quality being sold in the market. With this view Sharan G. and Kishore, 2003 has decided to assess the quality of produce sold in Ahmedabad city. The summary of results is briefed below by crop:

Physical Dimensions and Quality Aspects

	Physical dimensions	Visual inspection done for
Okra	Pod weight, diameter of base end and tip, length of pod and stem, bulk density, shape	Colour, tenderness, cleanliness and defects (blemishes, disease, insect and pest infestation, and mechanical injury)
Eggplant	Fruit weight, diameter, length of stem, bulk density, shape	Colour of the fruit and calyx, firmness, cleanliness, freshness, and defects
Cabbage	Weight of head, diameter, bulk density, shape	Color, solidity, cleanliness, freshness of head, no of wrapper leaves, and defects
Cauliflower	Weight of head, longest diameter, bulk density, shape	Curd: Colour, compactness, cleanliness, and defects Jacket leaves: number of jacket leaves, cleanliness, freshness, and defects
Bottle gourd	Weight, length, maximum diameter, bulk density, shape	Colour, texture, cleanliness, freshness, and defects
Cow pea	Weight, length, maximum diameter, bulk density, shape	Colour, tenderness, cleanliness, and defects
Flat bean	Weight, length, maximum width, bulk density	Color, tenderness, cleanliness, and defects
Spinach	Length of leaf and leaf stem, width of leaf, bulk density	Colour, tenderness, cleanliness, freshness of leaf, and defects
Tomato	Weight, diameter, bulk density, shape	Defects

Visible defects

Bruising	Damage to plant tissue/fruit or vegetable by external forces causing physical change in texture and/or eventual chemical alteration of colour, flavour, and texture but does not break the skin
Distortion	A change in the shape of an intact fruit or vegetable which is not characteristic of the variety
Crack	A cleavage without complete separation of the parts
Cut	Penetration or division by the sharp edge of an object
Puncture	A small hole or wound on the surface of the fruit or vegetable made by a pointed object or stem of other fruit or vegetable
Skinbreak	Crack limited to the skin

Case of Okra

They analyzed the following two grades of Okra in and around Ahmedabad. The grades are:

- Grade 1 consists of pods with uniform green color, tender and without visible damage. Proportion of grade 1 pods is about 75 per cent.
- Grade 2 consists of what is left. Pods in this grade are usually over-matured, yellowish green in color, and have insect damage. Proportion of pod of this grade is usually about 25 per cent.

They took 500 gm samples of each from Grade 1 and Grade 2 (Mahyco Hybrid Bhinda 10) were taken for inspection. The visual observations noted before and after reaching APMC were tabulated below:

Grade -1		Grade -2	
Before	After	Before	After
Proportion of pods with no visual defects was 88 per cent and slightly bruised at one to three places, 12 per cent.	On arrival to APMC, no visual defects have reduced to 76 per cent. Damages occur in transport, loading and unloading and fruit to fruit collision inside the package.	Proportion of pods with no visual defects was 86 per cent and slightly insect infested and bruised 9 per cent.	Similarly, pods with no visual defects got reduced to 77 per cent. Pods with slight defect were 11 per cent.
There were no pods with serious damage	Proportion of seriously damaged pods rose to 10 per cent from zero.	Proportion of pods with serious damage was five per cent.	Proportion of pods with serious damage was 13 per cent.

Table 9.28 Post-harvest losses in Okra and consumer preferred traits

On farm before packing	On arrival at APMC (in transit for 8 h and travelled up to 200 km)	On arrival in retail shop (in transit for 12 h and travelled up to 210 km)	Desired by consumer
All pods are tender	All pods tender	All pods tender	Pods should be tender
All pods are bright and uniformly dark green, fresh in appearance	All pods are uniformly dark green, 14% appear dull	Pods dark green, 16% appear dull	Pods should be bright and uniformly dark green, fresh in appearance
Stem length not uniform, 70 % have greater than 10 mm	As packed	As packed	Stem trimmed to 10 mm
12 % pods have visually observable defects, others are fine	24 % pods have visually observable defects	26 % pods have visually observable defects	Pods should be free from visually observable defects (such as bruise, blemishes, tip break, mechanical injury discoloration, insect, pest infestation, bore hole, etc.)
Some pods have sap on body	As packed at farm	As packed at farm	Pods should be clean, free from sap, dirt, and other foreign matter
Pod length not uniform (60 to 135 mm)	As packed at farm	As packed at farm	(a) Most consumers find variation in length acceptable (b) Some want uniform size pods
			(a) Some consumer want packed in consumer packs (b) Other do not mind weighing and packing at sale point as now
Note: factors that lead to loss of quality are as follows: - Inexperienced workers may fail to judge maturity, tenderness, etc. - Exposure of produce to direct sun for several hours before packing at farm leads to moisture loss and dull appearance - Packing in chalakha in heavy lots leads to excessive bruising. Okra on floor of a carrier may have 250 kg of load above it due to 7 to 8 tier stacking. Chalakhas cannot prevent pod to pod collisions - Handling abuse, dropping produce in container carelessly, dragging packages on rough surfaces people sitting on packages - Failure to use proper tools for harvest			

Case of egg plant

Sever insect and pest infested (bore hole) and injured fruits are removed. The remaining lot is divided in to the following two grades:

	Grade 1	Grade 2
Horizontal-Maximum diameter of dominant size fruits in the lot	25-40 mm	40-50 mm
Longitudinal diameter (mean)	41 - 43mm	57 mm
Mean weight of fruit	18 gm	43 - 46 gm
Shape	Elliptical regular	Elliptical regular
Bulk density	501 kg/m^3	295 kg/m^3

Table 9.29 Changes in the quality aspects of post-harvest transit

	Grade 1	Grade 2
At farm when packed	87% bright dark green 100% firm 85% have no defects 13% have slight defects 2% have serious defects	No fruit bright dark green. 100% have firm 82% have no defects 9% c slight defects 4% have serious defects
On arrival at APMC after in transit up to 8 hours and 200 km travels	94% dark green 99% firm 71% have no defects 23% have slight defects 6% have serious defects	No fruit dark green 100% firm 82% have no defects 14% have slight defects 9% have serious defects
No defect	Absolutely free from any visual defect	
Slight defect	Slightly bruised, blackened and or shriveled, slightly insect infested (black spots) which may or may not detract the appearance of the fruit	
Serious defects	Severely bruised, blackened, shriveled and/or insect eaten or bore hole, growth stains that may seriously detract the appearance of the fruit and may not be fit for consumption	

Table 9.30 Post-harvest losses in eggplant and consumer preferred traits (grade-1)

As observed on farm before packing	On arrival at APMC (in transit for 8 h and travelled up to 200 km)	On arrival in retail shop (in transit for 12 h and travelled up to 210 km)	Desired by consumer
All fruits firm	All fruits firm	All fruits firm	Fruit should be firm
All fruits are bright and uniformly dark green, calyx green, fresh in appearance	94% fruit are uniformly dark green, calyx green, but 6% have white strakes on lower portion	As at APMC	Fruit should be bright and uniformly dark green, fresh in appearance, calyx should be green
15% fruits have visually observable defects, others are fine	29% fruits have visually observable defects	31 % fruits have visually observable defects	Fruits should be free from visually observable defects (such as bruise, blemishes, wilted calyx, mechanical injury discoloration, insect, pest infestation, black or brown spot, bore hole, etc.)
Fruits are unwashed	As packed at farm	As packed at farm	Fruit should be clean, free from dirt, dust, and other foreign matters
Fruit size not uniform (28 to 55 mm)	As packed at farm	As packed at farm	(c) Most consumers find variation in size acceptable (d) Some want uniform size fruits
			(c) Some consumer want packed in consumer packs (d) Other do not mind weighing and packing at sale point as now

Note: Factors that lead to loss of quality are as follows:

- Inexperienced workers may fail to judge maturity, firmness, colour
- Exposure of produce to direct sun for several hours before packing at farm leads to moisture loss
- Packing in chalakha in heavy lots leads to excessive bruising, eggplant at floor of a carrier may have 250 kg of load above it due to 7 to 8 tier stacking. Chalakhas cannot prevent fruit to fruit collisions
- Handling abuse, dropping produce in containers carelessly, dragging packages on rough surfaces, people sitting on packages

Case of Cabbage

The physical dimension of Cabbage (grade-1) (Sungro-621-T) has been standardized with the following features:

Longitudinal diameter of dominant size head in the lot	120-140 mm
Horizontal-Max diameter (mean)	108 mm
Mean weight per head	447 gm
Shape	Elliptical regular
Bulk density	362 kg/m^3

Table 9.31 Post-harvest losses in Cabbage and consumer preferred traits (grade-1)

As observed on farm before packing	On arrival at APMC (in transit for 8 h and travelled up to 200 km)	On arrival in retail shop (in transit for 12 h and travelled up to 210 km)	Desired by consumer
All heads are firm	All heads firm	All heads firm	Head should be firm
All heads are uniformly dark green, fresh in appearance	As packed at farm	As at APMC	Head should be uniformly dark green, fresh in appearance
21% heads have visually observable defects, others are fine	45 % heads have visually observable defects	47 % head have visually observable defects	Head should be free from visually observable defects (such as bruises, wilted wrapper leaves, mechanical injuries discoloration, insect eaten, pest infestation (bore hole)
Heads have soil debris on the surface	As packed at farm	As packed at farm	Head should be clean, free from dirt, dust, soil and other foreign matter
All heads have at least four wrapper leaves extending above the head	As packed at farm	as packed at farm	Head should be well trimmed
Head size not uniform (106 to 138 mm)	As packed at farm	as packed at farm	a) Most consumers find variation in size acceptable
			b) Some want uniform size heads c) Some consumer want packed in consumer packs d) Other do not mind weighing and packing at sale point as now

Note: Factors that lead to loss of quality are as follows

- Inexperienced workers may fail to judge maturity, firmness, colour
- Exposure of produce to direct sun for several hours before packing at farm leads to moisture loss
- Packing in chalakha in heavy lots leads to excessive bruising, egg plant at floor of a carrier may have 350 kg of load above it due to 7 to 8 tier stacks. Chalakhas also cannot prevent head to head collisions
- Handling abuse, throwing, dropping produce in container carelessly, dragging packages on rough surfaces, people sitting on packages
- Careless use of harvesting tool

Case of Cauliflower

Dimensions of different Cauliflower grades

	Grade 1	Grade 2
Largest diameter of dominant size curds in the lot	100 - 140 mm	100 - 140 mm
Mean weight per curd	220 - 235 gm	170 - 180 gm
Shape	Unequal irregular	Unequal irregular
Bulk density	269 kg/m^3	201 kg/m^3

Table 9.32 Changes in quality aspects of Cauliflower in post-harvest transit

	Grade-1	Grade-2
At farm when packed	95% creamy white and compact 81% no defect 14% slight defect 5% serious defects	30% creamy white 15% compact 70% no defects 19% slight defects 11% serious defects
On arrival at APMC after in transit up to 8 hours and 200 km travel	91% creamy white and compact 61% no defects 35% slight defects 4% serious defects	21% creamy white 18% compact 50% no defects 39% slight defects 11% serious defects
No defect visual	Curd is compact, white to creamy white, and free from any defect.	
Slight defect	Curd is compact, slightly bruised, some part of clusters is broken and some clusters turning yellowish, which may or may not detract the appearance of curd	
Serious defects	Curd is compact but completely yellow or insect eaten or mould developed or ricey, clusters broken or severely bruised that may detract the appearance and may not be fit for consumption	

Table 9.33 Post-harvest losses in Cauliflower and consumer preferred traits

As observed on farm before packing	On arrival at APMC (in transit for 8 h and travelled up to 200 km)	On arrival in retail shop (in transit for 12 h and travelled up to 210 km)	Desired by Consumers
95% curds are compact	91% curds compact	As at APMC	Curd should be compact
95 % curds are white to creamy white, fresh in appearance	As packed at farm	As at APMC	Curd should be white to creamy white, fresh in appearance
19 % curds have visually observable defects, others are fine	39 % curds have visually observable defects	41 % curds have visually observable defects	Curd should be free from visually observable defects (such as bruise, wilted bracket leaves, broken part or clusters, riceness, mechanical injury discoloration, insect eaten, pest infestation
Heads have soil attached on the jacket leaves	As packed at farm	As packed at farm	Head should be clean, free from dirt, dust, soil, and other foreign matter
Heads have jacket leaves extending above the curd, insect eaten and broken (in 40% heads)	As packed at farm	As packed at farm	Head should be well trimmed, free from insect infestation
Jacket leaves are green and fresh	Jacket leaves are green but 25% were wilted	As at APMC	Jacket leaves should be green and fresh
Curd size not uniform (87 to 143 mm)	As packed at farm	As packed at farm	a) Most consumers find variation in size acceptable b) Some want uniform size heads
			a) Some consumers want packed in consumer packs b) Others do not mind weighing and packing at sale point as now

Note: Factors that lead to loss of quality:

- Inexperienced workers may fail to judge maturity, compactness, and colour
- Exposure of produce to direct sun for several hours before packing at farm leads to moisture loss
- Packing in chalakha in heavy lots leads to excessive bruising, cauliflower on floor of a carrier, there may be 350 kg of load above it due to stacking. Chalakhas also cannot prevent fruit to fruit collision
- Handling abuses, throwing, dropping the produce in containers carelessly, dragging packages on rough surfaces, people sitting on packages
- Careless use of harvesting tools

Case of Spinach

The grade-1 standardized features summarized below:

	Grade 1
Length of dominant size leaves in the lot	80 - 130 mm
Max. width of leaf (mean)	63 mm
Length of leaf stem (mean)	90 mm
Mean weight per leaf	2 - 3 g
Bulk density	118 kg/m^3

Table 9.34 Post-harvest losses in Spinach and consumer preferred traits

As observed on farm before packing	On arrival at APMC (in transit for 8 h and travelled up to 200 km)	On arrival in retail shop (in transit for 12 h and travelled up to 210 km)	Desired by consumer
All leaves are tender	All leaves tender	All leaves tender	Leaves should be tender
80% of the leaves are bright and uniformly dark green, 95% leaves are fresh in appearance	As packed at farm, 8% leaves are wilted	As packed at farm, 8% leaves are wilted	Leaves should be bright and uniformly dark green, fresh in appearance
Stem not trimmed, length varies from 49 to 137 mm	As packed at farm	As packed at farm	Stem should be trimmed so that its length is shorter than the leaf.
26% leaves have visually observable defects, others are fine	42% leaves have visually observable defects	44% leaves have visually observable defects	Leaves should be free from visually observable defects (such as leaf break, cut, crack, mechanical injury discoloration, insect, pest infestation, bore hole, etc.)
Leaves are clean but unwashed	As packed at farm	As packed at farm	Leaves should be clean, free from dirt and other foreign matters
			a) Some consumer want packed in consumer packs b) Other do not mind weighing and packing at sale point as now
Note: Factors that lead to loss of quality are as follows: Inexperienced workers may fail to judge maturity, color Exposure of produce to direct sun for several hours before packing at farm leads to moisture loss and wilted appearance Packing in chalakha in heavy lots leads to excessive damage, spinach at floor of a carrier may have 100 kilogram of load above it due to 6 to 7 tier stacks. Chalakha also cannot prevent package to package collisions Handling abuse, dropping produce at packing place carelessly, dragging packages on rough surfaces, people sitting on packages Unwillingness to use proper tools for harvest			

Case of Tomato

Important varieties of Tomato grown in Gujarat are Pusa Ruby, Rupali, Vaishali, Rashmi, Shivaji, and Avinash-2. These varieties attain optimum maturity in 65-70 days after transplanting. Readiness to harvest is judged by fruit color. For distant markets, transport fruits are picked at the breaker stage. For nearby markets, fruits are picked when attain red color.

Physical dimensions of Tomato

Longitudinal diameter of the dominant size fruit in the lot	41 - 60 mm
Maximum horizontal diameter (mean)	46 mm
Minimum horizontal diameter (mean)	44 mm
Mean weight	54 g
Shape	Elliptical regular
Bulk density	694 kg/m^3

Table 9.35 Visual defects in Tomato

Inspected	Layer in peti	Proportion of fruits (%)			
		Perfect	Acceptable	Not acceptable	Rejects
On arrival at APMC	Upper	45	51	3	1
	Lower	32	62	4.5	1.5

Case of Banana

Table 9.36 Post-harvest losses in Banana and desired traits by consumer

On arrival at APMC (in transit up to 8 h and travelled up to 200km)	**On arrival in retail shop** (in transit up to 60 h and travelled up to 210km)	**As desired by consumer**
Bananas are green to yellowish	Bananas are ripe	Bananas should be ripe with uniform yellow colour and aroma
Six per cent bananas have visually observable defects	Eight per cent banana have visually observable defects	Bananas should be free from visually observable defects (such as bruises, blemishes, split, scar, decay, and mechanical injuries)
Note: Factors that lead to loss of quality are as follows: - Inexperienced workers may fail to judge maturity, and angularity of finger - Loading in bulk in heavy lots leads to excessive bruising - Handling abuse, drooping, dragging produce on rough surfaces.		

Case of Mango

Important varieties of Mango grown in Gujarat are Kesar, Rajapuri, Totapuri, Safeda and Langra. Readiness for harvest is judged from the fullness of cheeks, when one or two ripe fruit drop from the tree, and when the skin color changes from dark green to light green to yellow.

Table 9.37 Post-harvest losses and consumer preferred traits

As observed on farm	On arrival at APMC (in transit up to 12 h and travelled up to 300km)	On arrival in retail shop (in transit up to 60 h and travelled up to 310km)	As desired by consumer
All fruits are green (unripe) and firm	Fruits are ripened , some are soft	As at APMC	Fruit should be uniformly ripe and firm
Fruits have sap over the surface	As at farm	As at farm	Fruit should be clean, free from sap, dirt, and other foreign matter
Fruits have visually observable defects	Proportion of visually observable defects has increased	As at APMC	Fruit should be free from defects such as sunburn, bruising, burst, blemishes, and mechanical injuries
Pedicle length not uniform	As packed at farm	As packed at farm	Pedicle attached to the fruit should not be more than 10 mm
Fruit size not uniform	As packed at farm	As packed at farm	a) Most consumers find variation in size acceptable b) Some want uniform sized fruits
			a) Some consumers want packed in consumer packs b) Other do not mind weighing and packing at sale point as now
Note: Factors that lead to loss of quality are as follows: - Inexperienced workers may fail to judge the maturity - Harvesting with Bedi leads to fruits with non-uniform pedicle or even without it. - Produce is not protected against mechanical hazards in transit and handling. - Loading in bulk in heavy lots leads to excessive bruising - Handling abuse, dropping produce in containers carelessly, dragging/dropping packages on rough surfaces - Non-uniform ripening			

9.7 Marketing and post-harvest losses – implications on availability and economy

Fruits are important sources of vitamins and minerals and their role in improving nutritional status needs no emphasis. Fruit production in India, which is the second largest in the World (9 per cent), is growing at a significant growth of 3.74 per cent per annum from 28.63 million tons in 1991-92 to 63.50 million tons in 2007-08. The per capita availability of fruits even with this increase is lower at 107g/day than the recommended level of 120 g. One of the main reasons attributed to lower availability is the large quantity of post-harvest losses that occurs at various stages of marketing, which ranged from 15 to 50 per cent (FAO, 1981; Roy, 1989). There have been very few systematic attempts to estimate the losses at each stage of handling and its causal factors. Many studies have been conducted on post-harvest losses of fruits and vegetables based on small-scale experiments but do not reflect the real situations (Ratnam and Nema, 1967; Biswas, 1969; FAO, 1981; Waheed *et al*., 1986; GOI, 1985; Madan and Ullasa, 1993). A few studies also estimated losses at each stage of marketing but had not estimated the total value of losses at the macro level which could have provided a scientific basis for valuation (Krishna, 1976;

Senthilnathan and Srinivasan, 1994; Srinivas et al., 1997; Gajanana et al., 2002; Sreenivasa Murthy *et al*., 2004).

The post-harvest losses not only reduce the availability of fruits but also result in increase in per unit cost of transport and marketing (Subrahmanyam, 1986). This affects both the producers (reduction in share in consumers' price) and the consumers (reduced availability and higher prices). At the macro level, rough estimate indicates that India annually loses fruits worth about Rs.13569 crores (based on 30 per cent loss). The reduction in post-harvest losses is a complementary means for increasing the production i.e., the cost of preventing losses is less than producing the same additional quantity of fruits. The assessment of post-harvest losses of fruits at various stages of handling would help in identifying the factors responsible for losses. This in turn would help in developing proper measures required at different stages to prevent/reduce such losses and to increase the availability of fruits for domestic consumption and for export purposes. Sreenivasa Murthy *et al* (2009) assessed the post-harvest losses in major fruits both in physical and economic terms at different stages of handling and to develop strategies to reduce these losses. The summary of the findings are highlighted below:

Table 9.38 Post-harvest losses in selected fruits in India

(per cent)

Sr. No. (1)	Crops ⇒ Markets ⇒ Stages of Marketing ⇓ (2)	Mango Local marketing (3)	Grapes Local marketing (4)	 Distant marketing (5)	Banana Wholesale marketing (6)	 Co-operative marketing (7)	Pomegranate Distant marketing (8)
1.	Field and assembly marketing	15.59	7.31	7.31	5.53	7.82	9.86
		(52.44)	(50.76)	(34.27)	(19.17)	(42.71)	(27.82)
2.	Wholesale marketing	8.89	4.24	10.80	6.65	1.77	10.10
		(29.90)	(29.44)	(50.63)	(23.06)	(9.67)	(28.50)
3.	Retail marketing	5.25	2.85	3.22	16.66	8.72	15.48
		(17.66)	(19.80)	(15.10)	(57.77)	(47.63)	(43.68)
	Total losses	29.73	14.40	21.33	28.84	18.31	35.44
		(100)	(100)	(100)	(100)	(100)	(100)

Note: Figures in parentheses indicate percentage to the total in the column.

Table 9.39 Aggregate value of post-harvest losses in major fruits in India during 2002-03

Sr. No. (1)	Particulars (2)	Mango (3)	Banana (4)	Grapes (5)	Fruits (6)
1.	Total production (lakh tonnes)	127.33	133.04	12.48	272.85
2.	Total subjected to handling (lakh tonnes)	124.78	133.04	10.61	268.43
3.	Total quantity of post-harvest losses (lakh tonnes)				
3.1	Field level loss	19.45	7.36	0.78	27.59
3.2	Loss during wholesale marketing	9.36	8.36	1.06	18.78
3.3	Loss during retail marketing	5.04	19.55	0.28	24.87
3.4	Sub-total	33.85	35.26	2.12	71.24
4.	Total value of post-harvest losses (Rs. crores)				
4.1	Field level loss	1887.01 (1416.17)	540.75	89.02	2516.78 (2045.94)
4.2	Losses during wholesale marketing	1123.66 (735.15)	767.26	148.03	2038.94 (1650.43)
4.3	Losses during retail marketing	881.69 (812.17)	2135.05	46.32	3063.05 (2993.53)
4.4	Sub-total	3892.36 (2963.48)	3443.05	283.37	7618.77 (6689.90)

Note: Figures in parentheses indicate the value of post-harvest losses after taking into account income realised by selling the damaged fruits.

Mango is the most important fruit crop in the country accounting for about 28.2 per cent total fruit production (GOI, 2004). Except for about 0.8 per cent, which is used for processing, the entire production is subjected to PHL at various stages of marketing. At present level of production, the total PHL, based on variety Banganapalli, worked out to be 33.85 lakh tons comprising 19.45 lakh tons in the field itself after harvest, 9.36 lakh tons during wholesale marketing, both at assembly and wholesale markets and 5.04 lakh tons during retail marketing. The total PHL in mango in India is likely to be about Rs.3,892.36 crores comprising Rs.1,887.01 crores in the field immediately after harvest, Rs.1,123.66 crores in the wholesale market and Rs.881.69 crores in the retail market.

Banana is the second most important fruit crop in India, accounting for 29.43 per cent of the total fruit production during 2002-03. Almost the entire production is used as fresh and hence, the entire production is subjected to the post-harvest losses of 17.87 per cent as estimated in the study. The aggregate PHL in the country is likely to be around 35.26 lakh tons comprising 7.36, 8.36 and 19.55 lakh tons respectively in the field after harvest, wholesale marketing and retail marketing. Thus, the total PHL in banana is likely to be Rs.3443.05 crores comprising Rs.540.75 crores at the field, Rs.767.26 crore at wholesale market and Rs.2135.05 crores at retail market levels. Unlike in mango wherein the discards used to fetch a nominal income, in banana the discards are not marketed further.

In case of grape, approximately 85 per cent of the total production of 12.48 lakh tons is consumed as fresh grape (Shikhamany, 2000). Based on the present estimates of losses, the total PHL in the country is likely to be about 2.12 lakh tons. The break-up of losses at three stages of handling, viz., field level, wholesale market level and retail market level are 0.78, 1.06 and 0.28 lakh tons, respectively. Nearly 64 per cent of grape produced in India is seedless and Thompson Seedless is the major variety. Calculating the total losses in the same proportion valuating at actual prices at different stages of handling, the aggregate PHL in grape in India is valued at Rs.283.37 crores.

Due to the non-availability of exact data on area and production of pomegranate at the national level, the extrapolation of total losses in pomegranate could not be done. Thus, in India, about 7.12 million tons of mango, banana and grape are lost before reaching the consumers. In terms of value, the losses in these fruits together amount to Rs.7169 crores. The loss in terms of agriculture GDP is about 1.2 per cent, which is quite alarming.

Impact of post harvest losses (PHL)

Per capita availability: Despite a phenomenal increase, the per capita availability is still about 104 g/day for fruits and 207 g/day for vegetables which is far less than the recommended levels of 120 g and 280 g, respectively. The main reason attributed was enormous losses ranging from 15 to 50 per cent occurring at different stages of marketing [FAO, 1981; Roy, 1989].

Efficiency of marketing system: PHL affects both producers (by reducing their share in the consumer's price) and consumers (by reducing the availability of FV and higher prices due to increased transport cost etc.). Studies at IIHR, Bangalore indicated that the PHL reduces the efficiency of the marketing system (grapes, banana, papaya, sapota, onion).

Economy: At the macro level, the economy would be losing huge amount due to PHL. India annually loses fruits worth Rs.12700 - 15876 crores (at 20-25% loss) and vegetables worth Rs.12588 crores (at 20% loss). Sreenivasa Murthy *et al*, (2009) reported that an amount equivalent to 1.2 per cent of agricultural GDP goes as losses due to losses in mango, banana and grapes (Rs. 7619 crores).

Estimation procedure: Earlier attempts of estimation of losses were mostly based on small scale experiments and extrapolated. A few studies estimated only at one stage or the other and had not taken into account causal factors. Further, the implications of PHL on marketing cost and the margins which in turn reflect on the efficiency of the marketing system need to be studied.

Valuation of PHL: Earlier studies included only physical loss in the estimation of PHL. For correct valuation, there is a need to work out the economic loss. The method of estimation should also take in to account the actual price received at different stages instead of a single price and variation across grades.

Systematic attempts on PHL estimation

A modest attempt was made in ICAR Network project on marketing and assessment of PHL in FV in India [Feb 2000- July 2002] and "Economics of PHL and marketing in FV (2009)" at IIHR, Bangalore. In mango [Sreenivasa Murthy *et al* 2002; Gajanana et al 2002]; pineapple [Sudha *et al*, 2002] and pomegranate [Gajanana *et al,* 2002], the losses were estimated in the main marketing channels both in physical and economic terms. In case of banana [Gajanana *et al*, 2002; Sreenivasa Murthy *et al* 2002 and Sudha *et al*, 2002] and tomato [Gajanana *et al* 2003, 2006] the efficiency of different marketing channels like local and distant market sales, wholesale and cooperative marketing, etc. were studied and suggestions were made for policy interventions to reduce the PHL. Refinements were made in the marketing margin analysis to include PHL as an item of marketing cost in grapes [Sreenivasa Murthy *et al*, 2004]. Further, the modified formula of Marketing Efficiency was validated in banana [Sudha *et al*, 2005; Sreenivasa Murthy *et al*, 2007], sapota [Gajanana *et al*, 2006], and papaya [Gajanana *et al,* 2009]. From these, it was observed that the efficiency index declined after inclusion of PHL, thereby indicating the importance of minimizing PHL in the supply chain.

9.8 Suggestions/strategies for minimization of post-harvest losses in India

The reduction in PHL is a complementary means for increasing the production and studies indicated that PHL will have a significant impact on the marketing efficiency.

This necessitates a need to address the causes of losses at different levels of handling. This would help in developing proper measures required at different stages to prevent such losses and improve availability of FV both for domestic consumption and export. The generally quoted figure of 30 per cent no longer holds and estimates vary across regions, crops and varieties.

Transformation is taking place in marketing of high value commodities like FV due to globalization and liberalization. Accordingly procurement and distribution system is also witnessing institutional innovations in the form of contract farming, growers' associations, cooperative marketing and integration of production and marketing through processing. Of late, 'Retail Supply Chains' are entering the FV marketing in a big way. On one hand these transformations are creating opportunities to the farmers in terms of increased access to markets, quality inputs, technology, information and services which eventually lead to improvement in productivity and reduction in marketing and transaction costs [Birthal *et al*, 2007]. There is also apprehension as to whether these innovations would benefit the small holders. Studies at IIHR, Bangalore [Gajanana, *et al*, 2003; Subrahmanyam, 2000; Subrahmanyam and Gajanana, 2000; Sudha and Gajanana, 2003] have brought out the beneficial role played by cooperative marketing of FV, growers' associations, distant market sale, integrating production with marketing through processing and contract farming.

Strategies to reduce the Post-harvest losses

- Pre harvest practices to reduce PHL
    - Use of harvester can reduce loss considerably
    - IPM – tomato, mango (fruit fly trap), cabbage
    - Pre harvest sprays to reduce post harvest loss
    - Follow optimum maturity standards for harvest to reduce loss at the farm level.
      - Firm breaker & semi ripe stage harvest to reduce transit loss (Tomato)
- Hot water treatment in mango
- Packaging of fruits - CFB cartons, plastic crates to reduce loss, individual shrink wrapping (pomegranate and capsicum)
- Specialized transport vehicles (cushioning and cooling) to reduce transit losses
- Sorting immediately after unloading at processing unit

- Conversion of FV into processed products would reduce glut in the market and reduce the losses, besides enhancing income prospects of the producers.
- Establish processing unit in the production area – reduce handlings, infection, backward - forward linkages, minimize price fluctuations.
- Efficiency of the marketing system to be studied using PHL as an item of cost
- Strengthening marketing infrastructure at the local and distant market levels would help reduce the losses and also increase the returns to the producers.
- Irradiation and VHT for export of mangoes to USA and Japan

9.9 Policy Implications

The policy implications emanated from the study are follows:

9.9.1 Creation of adequate post-harvest infrastructure and processing facilities

Horticulture and Plantation crops are both perishable and non-perishable in nature. Perishability alone contributes to heavy losses in the availability and quality after harvest of crops and makes investment risk oriented. The post-harvest handling accounts for 20 to 40 per cent of the losses at different stages of grading, packing, storage, transport and finally marketing of both fresh and processed products. Such losses have proved a great handicap in exploiting the full production potential of these crops and thereby improve the rural income, employment and nutrition of the masses. The production and marketing of these commodities also suffer from the crippling uncertainty and instability of the domestic as well as export market conditions. Since most of these are grown by small and marginal farmers, and handled at the retail level by poor sections, the effect is all the more devastating. Very often these commodities have to be sold through distress sales. To meet the domestic as well as international quality standards, up-gradation, post-harvest marketing operations e.g., harvesting, pre-cooled grading (cool chain), packing and transportation have to be improved. For international regulations it is also essential to have ISO systems of certification.

The weak processing infrastructure, as it exists today, has been one of the contributing factors for ineffective utilization of the raw materials resulting in huge post-harvest losses. Further, price fluctuations commonly observed in the Indian horticulture scenario lead to glut situation in individual commodities and opens opportunities for exploitation of the small and marginal farmers by the traders and commission agents. Insufficient technologies for commercial utilization of by-products/ value added products also act as a damper for handling horticulture produce. Lack of sufficient processing units for production of quality output is a major bottleneck for these crops. Lack of adequate standards for quality produce also hinders the export prospects of these crops. As small and marginal growers predominate the production sector, individual processing facilities are not available due to lack of skill as well as investment capability

9.9.2 Development of marketing infrastructure

Marketing of horticultural produce is a major constraint in the production and disposal system and has a major role to play in making the industry viable. Fruits and vegetables are mostly marketed through commission agents. A very small portion is handled by cooperative marketing societies. In some case fruits, the owners to the pre-harvest contractors also auction vegetables and flowers. The pre-harvest contract could be for one or even three years in perennial crops. The returns from such arrangements are very low. Such sales also result in poor upkeep of the plantation / orchards and the contractors hesitate to make further investment in the upkeep of such plantations / orchards.

9.9.3 Flexible credit policies

The high capital cost involved in establishing an orchard/ a plantation, or rejuvenation of existing old unproductive plantation poses serious constraint in area expansion under these crops. The situation becomes all the more difficult in view of the large number of small holdings devoted to these crops which are essentially owned by weaker section, who have no means to invest, nor can afford to stand the burden of credit even if available. Added to this is the long gestation period that the perennial horticultural crops like mango, sapota, citrus and apple coming to the economic bearing age. This calls for liberalized credit facilities in easy installments for repayment in the form of soft loans to small and marginal farmers to be introduced if the benefits of the horticulture industry are to be fully exploited. High cost of inputs and lack of enough incentives for production of quality varieties /species, product diversification, value addition, etc. also hinder crops development.

9.9.4 Minimization of Post Harvest Losses (PHL)

The horticulture produce suffers heavy post-harvest losses in the absence of adequate post-harvest and marketing infrastructure viz; pre-cooling units, packing and grading sheds, short and long term cold storage facilities, refrigerated containers, storage and phyto-sanitary facilities at airports. There is considerable loss in the amount of fruits & vegetables produced in India due to improper post-harvest operations, these results in a wide gap between the gross production and net availability. Assuming an average loss of 25 per cent (range varies between 8 to 37 per cent in various crops during different stages after harvest) in all the horticultural crops together, the losses are phenomenal. To minimize these losses, it is essential to analyze the contributing factors which result into these losses. The losses occur at the following stages:

- Harvesting and pre-harvesting: - due to spoilage, spoilage and trimming.
- Transport: - due to bruising, breakage and infection as a result of dust, heat, rain and humidity.
- Storage: - due to over ripening or under ripening.
- Processing and packing: - due to inefficiency and contamination.
- Marketing: - due to loss of weight and quality with multi-level handling.
- The problem is further complicated due to the fact that there are no storage facilities at the farm level and the farmers are forced to dispose off the entire produce immediately on harvesting. This creates a glut situation in the market. Thus, the margins of the wholesalers and retailers are much higher than in the advanced countries.

9.9.5 Removal of marketing bottlenecks/intermediaries

The horticulture marketing practices lack systems approach. The trading and marketing structure is very traditional and consists of a long chain of intermediaries. The farm-gate price available to the farmers is only 25 per cent of the retail price under Indian conditions whereas the same is 70 per cent in case of Dutch and US farmers, where more efficient marketing system is in place.

Chapter 10

Summary and Conclusions

Indian Agriculture is characterized by small holdings, limited off-farm employment opportunities and inadequate institutional and infrastructure support. Therefore, farmers are unable to withstand major structural shifts if required. Any adverse impact on their income and or increase in risk will have significant impact on their livelihood. Farmers do respond to market prices and adjust to market requirements by changing cropping patterns and input use. However, this is all right as long as these crops are remunerative in each region. If all crops suitable in an area are not competitive in the international market, then the very livelihood of the farmers will be adversely affected. Even if there is a remunerative crop, farmers may not be able to take advantage of the crop if they are exposed completely to the volatility of the international market, as their risk bearing ability is poor. In the absence of efficient futures and options market which are prevalent in developed countries and some newly emerging economies, our farmers/agribusiness are at a disadvantage in managing volatility in world market prices. Therefore it is essential that the AoA implications in terms of both profitability and volatility are not too drastic for farmers to cope up with.

In early 1990s India has emphasized the need for exports. Till then there was no consistent policy towards exports. The country's export basket in the past was heavily dependent on items such as tea and mates and coffee, which only recently has widened to include other commodities like rice, marine products, fruits and vegetables etc. However, dedicated systems to cater to the export market are yet to develop. Exporters have to take special care in maintaining the quality at all stages of exports. Still, our current information flow along the value chain is very weak. These often lead to additional costs. Therefore there are asymmetric trade opportunities for Indian exporters which constraining our exports. In addition, the importers in other countries are also putting additional restrictions or raise quality issue to prevent imports from certain countries. There are likely to affect Indian exports to a large extent.

Although India enjoys advantages in exporting some commodities, in the post-GATT period international trade has become highly competitive and the competitive advantages of some of these commodities would be lost due to the infrastructural advantages prevalent in the competing countries. Therefore, infrastructure development for efficient movement, handling, grading, packing, processing, trade network and information dissemination systems is needs to be developed on a priority basis. So, building of these backward / forward linkages is also important to improve production efficiency.

However, past studies conducted by some researchers on the impact of globalization and liberalization on Indian agriculture concluded that agriculture sector witnessed sharp improvement in terms of trade during initial years of reforms. In the post WTO period though TOT remained favourable compared to the period before reforms but there is decline in them. Growth rate in GDP of agriculture sector showed almost no change during the pre-reform decade and post reform period. But, the advantage India has in production of labour intensive crops such as fruits and vegetables, and other crops such as basmati rice may not be adequate to compensate for the likely imports of other commodities and larger fluctuations in prices.

Nevertheless, the demands and trends in world markets will increasingly influence both the patterns of production and price expectations. On the other hand, the price could be the best incentive to give a strong boost to investment in agriculture as well as adoption of modern technologies and thereby to the raising of agricultural production and productivity. Similarly, the rise in domestic prices could put pressure on the public distribution system and accentuate the problem of food subsidy. The nature and character of state intervention and state support will have to undergo qualitative changes in order not only to realize the opportunities for exports, but also to cope with the implications of our agriculture coming into increasing alignment with the international market place.

With this background, the current study made a humble attempt to highlight the following researchable issues:

1. How to widen India's trade base in international markets? (As India has remained a marginal player in world agricultural trade despite being a big country, major producer of several agricultural commodities).
2. Is India able to influence the world market in terms of price, quantity and quality?
3. Whether Indian farmers and exports benefit out of any rise in international prices or able to cope up the price shocks/volatility?
4. How to improve the farmers' knowledge and organizational capabilities to benefit from trade opportunities?

For addressing the above issues in the context of growing global competition, it is crucial to assess the trade competitiveness of Indian agricultural commodities in terms price, quantity and quality in comparison with major global payers; and understanding the market integration and price transmission between markets so as to build the capacity of Indian farmers who lacks knowledge & technology, financial and organization capacity in order to gain from trade opportunities.

Objectives of the study

Broadly, the present study has been planned to cover four major objectives:

1. Understanding the structure of India's major agricultural exports and imports in comparing with major global players.
2. Assessing trade competitiveness of selected agricultural commodities in terms of price, quantity and quality.
3. Examining the price realization of farmers and assessing the influence of price changes on domestic and international markets.
4. Understanding the existing institutional support and suggestions for building the capacity of farmers for better price realization and improving the competitiveness.

10.1 Main findings of the study

- Despite the degree of competitiveness; export and import of rice is largely influenced by policy (export ban on non-basmati rice) and participation of large export firms. Fluctuations in world prices; especially export price found to influence the producer price and vice-versa. Export firms aim to bring quality produce (organic or untraceable level of chemicals) and they promote such activities by providing technical and input support to farmers. Linking rice farmers with these firms would benefit both the parties. Basmati rice is a special product and its export is not affected by price advantage or quality.

- India is the second largest producer groundnut in the world and it is the largest oilseed in India in terms of production. The trade competitiveness of groundnut has been declining over the period last six years. But, still it is competitive in the international market. The export prices are influencing the producer prices and the vice versa was not significant. International prices are slightly influenced by our major wholesale markets in the country. All the three major domestic markets (Junagadh, Rajkot and Gondel) are well integrated.

- India is the largest producer of Castor in the world. India faces stiff competition from exporting countries, primarily from Brazil and China. At the moment the NPC value of castor was more than one. We are less competitive in the international market under exportable hypothesis. But, still India has a strong comparative advantage in the production of castor beans. Just like groundnut, export prices are influencing the producer prices and the vice versa was not significant. Our domestic whole markets like Mumbai, Rajkot and Unjha have a little influence in on the international market prices. All major markets in Gujarat (Junagadh, Rajkot, Gondel, Unjha) showed significant integration in price transmission between them.

- Sugar in highly a controlled commodity and prices showed totally disintegration among them. Policy support towards increasing the efficiency of the sugar mills is the immediate need and strategies of successful sugar mills (Warnanagar sugar mill) can be replicated. It is necessity for a dramatic change in sugar policy and efficiency promotion is the need of this hour.

- India is the largest producer of Cumin in the world and accounts for 70 per cent of world's production followed by Syria, Iran and Turkey. India also consumes 66 per cent of total world's production. Production of Cumin is highly competitive in international market. The calculated NPC value was less than one under exportable hypothesis. Our major wholesale markets (Unjha, Rajkot and Gondel) were able to slightly influence the international prices. But, the vice versa was not significant. The price transmission mechanism is functioning well among the all domestic markets along with Mumbai market.

- Cashewnut is the important plantation crop in India. India is the second largest producer of cashewnuts in the world after Vietnam. Brazil, Nigeria, Tanzania, Indonesia and Mozambique are other major producers in the world. The degree of competitiveness in cashewnut was low under importable hypothesis for raw cashewnuts. India has strong competitive and comparative advantage in case of cashewnut kernel exports in the international market. Our producer prices are independent with import prices. The domestic wholesale market prices were not integrated with international prices. However, significant integration was observed among domestic markets (Kerala, A.P, Goa and Karnataka).

- Tea producers in southern part of the country face the problem of less price realization and a little share in consumer rupee. Farmers' price realization is only 10-12 per cent of the market price. Various blends of tea may be introduced to win the consumers choice. Export of tea from India is declining over the years due to competitors like Sri Lanka. However, introduction of new blends, tea products (ice tea, lemon tea etc.) and promotional measures are needed to increase / keep India's market share in world market. Geographical indication like "Darjeeling Tea" would help to boost the performance of Indian tea sector. Encouraging domestic consumption of tea through tie ups with Amul / other dairy outlets may also be attempted.

- Supply of mango is largely influenced by the bearing habit of the (variety) trees and climatic fluctuations. Existing processing unit provides a strong forward linkage to the mango growers and price fluctuations are also brought under control. Gandevi Model may be replicated for establishing strong forward linkage to the mango producers in the state / country. Kesar variety is highly preferable for export both as fruit and pulp not only because of the price competitiveness but also due to its taste and consumers' preference. HACCP system may be advocated to the processing units in order to get premium prices and to have a significant share in European Markets.

- India has enhanced its annual production level of horticultural crops, touching over 214 million tons during 2008-09 and thus, it is the second largest producer of fruits (68 million tons) and vegetables (129 million tons) contributing nearly 12 per cent and 15 per cent, respectively of the total global production. It is estimated that between 30 and 35% of India's total perishable production is lost owing to poor post-harvest practices. Less than 2% of the total vegetable production in the country is commercially processed as compared to 70% in Brazil and 65% in the USA. Various researchers and studies conducted across different states and India have supported the same. But, there were slight fluctuations in PHL levels based on type of perishable commodity and location. However, the level of processing was much lower in case of fruits and vegetables when compared to any other perishable commodities. The post-harvest losses were higher in developing countries than in the developed countries because post-harvest process facilities were less accessible to small and medium farmers or absent. Rich evidences of these losses were already documented by various researchers in case of fruits and vegetables. But, the no. of studies or these evidences in case of milk, meat and fish are scanty. There is an immediate need for scientific conduct of these assessments in milk, meat and fish in different parts of country. The factors influencing the post-harvest losses are more or less common across different perishable commodities. The need of the hour is further strengthening of marketing and post-harvest facilities in the places of origin/production. Post-harvest losses of perishable has severe impacts on per capita availability, incomes per ha and finally on country's economy as a whole. There is a need for development of appropriate post-harvest loss assessment technologies by commodity- wise. Current methods of assessment by different researchers are vague or very general. Similarly, there were also reports about pre-harvest losses in different food crops due to various pests, diseases and weeds etc. Studies have also documented and concluded that these losses were in the range of between 20 – 30 per cent in India in various crops. So, there is an immediate need for development of suitable scientific methods / technologies to arrest both these pre and post-harvest losses in the country.

10.2 Policy Implications

- Growing internal demand due to increase in population and income, India will have to strive hard to meet their domestic consumption. Among the different commodities analyzed, India has trade competitiveness only in case of Cumin followed by Groundnut. All the eight commodities covered in the study have huge domestic demands. So, Government of India has to develop a comprehensive plan and strategy while dealing with these commodities to export to international markets.

- The price transmission analysis concluded that the influence of major wholesale markets on international prices is to a small extent. However, integration between the domestic markets was observed only in few commodities. Modernization of agricultural marketing system will fill-up these gaps and enhance the price transmission process.

- The real impact of future's markets/ future trading needs to be analyzed critically. Many traders, processors and farmers have high negative perceptions about that system.

- Huge fluctuations in currency exchanges between rupees and dollars creating lot of impact on the export business. There should be some stability mechanism for certain period of transactions (at least a week) for smoothening of the agricultural trade.

- Institutional agencies and banks have to play an important role in extending credit and other support to agriculture and in the promotion of exports. Nationalized commercial banks have been providing credit support by way of pre-shipment and post-shipment. Other support facilities may include foreign exchange transactions including forward cover, provision of cross-currency options, weekly trends in forex markets etc. would really boosts morale of exporters and importers.

- Protection or insulation in many developed markets remains high and allowable export subsidies and domestic support still threaten the stability of agricultural markets in the developing countries like India. This issue needs to be addressed well in forth coming deliberations of WTO.

- Concerted efforts would be needed to increase the production through productivity enhancement technologies as well as post-harvest handling of commodities. All the commodities covered in the study showed that the productivity levels in India are far below when compared with key global players.

- Within the country, there are wide variations in productivity levels. Punjab, Haryana, Andhra Pradesh, Tamil Nadu and Kerala may have attained productivity levels of a world standard. But other regions are way behind. Thus the issue of competitiveness is also region specific. A regionally differentiated strategy, taking into accounts the agronomic, climatic and environmental conditions is, therefore, sought to be pursued to realize the full potential of yield in every region.

- Not only productivity of the crop, quality of products/commodities are equally important to compete in the international market. Much of the produce taken up for processing which is devoid of the quality attributes is meaningless. Therefore, creating awareness among farmers about the commodity specific quality parameters is really important for improving the trade competitiveness of our commodities.

- Due to high tariffs and other non-tariff barriers were not able to allow us to enter in to developed country markets. It has clear impacts on populations of developing countries whose dependency on agriculture is very high. These issues should be resolved in future negotiations.
- Commodity-wise improved and safe package of practices, networking of processing facilities, creation of supply and value chains, quality testing labs should be developed to boost the exports further in that specific region/state.
- Capacity building of farmers in production and processing aspects, improved way of extension communication system and well-integrated marketing system will play a key role in promotion of agricultural exports.
- Lack of proper transportation is an important market constraint that effects market integration. The existing infrastructure is highly inadequate, outdated and inefficient. Therefore, there is a need to introduce integrated system of bulk handling and transportation of agricultural commodities.
- The important bottle neck is lack sufficient storage and warehousing facilities especially cold storage for perishable commodities. Reforms are needed in the functioning of Agricultural Produce and Marketing Committee (APMC) markets to hasten up the process of marketing and trading.
- Flow of information in real time across various markets that are interlinked throughout the country will create tremendous demand and efficiency in the system.
- Additional and innovative social-safety nets needs to be designed to cover and cushion the farmers' risks against price and market volatility for their products.

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Appendix

A1. Price Transmission between Producer price and export price (Rice)

Parameter Alpha * Beta' Estimates		
Variable	Producer Price	Export Price
Producer Price	-0.12145	0.05460
Export Price	0.95497	-0.42933

AR Coefficients of Differenced Lag			
DIF Lag	Variable	Producer Price	Export Price
1	Producer Price	-0.06265	-0.07612
	Export Price	2.86834	0.20682

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
D_PPR	CONST1	75.50352	89.37508	0.84	0.4049	1
	AR1_1_1	-0.12145	0.06074			PPR (t-1)
	AR1_1_2	0.05460	0.02731			EXPR (t-1)
	AR2_1_1	-0.06265	0.15546	-0.40	0.6898	D_PPR (t-1)
	AR2_1_2	-0.07612	0.03070	-2.48	0.0190	D_EXPR (t-1)
D_EXPR	CONST2	797.16580	392.97116	2.03	0.0515	1
	AR1_2_1	0.95497	0.26707			PPR (t-1)
	AR1_2_2	-0.42933	0.12007			EXPR (t-1)
	AR2_2_1	2.86834	0.68353	4.20	0.0002	D_PPR (t-1)
	AR2_2_2	0.20682	0.13496	1.53	0.1359	D_EXPR (t-1)

A2. Price Transmission between Producer price and import price (Rice)

Parameter Alpha * Beta' Estimates		
Variable	Producer Price	Import Price
Producer Price	-0.30672	0.12415
Import Price	1.44605	-0.58531

AR Coefficients of Differenced Lag			
DIF Lag	**Variable**	Producer Price	Import Price
1	Producer Price	-0.05696	-0.04996
	Import Price	0.72102	-0.38120

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
D_PPR	CONST1	366.09956	105.86672	3.46	0.0017	1
	AR1_1_1	-0.30672	0.12398			PPR (t-1)
	AR1_1_2	0.12415	0.05018			IMPR (t-1)
	AR2_1_1	-0.05696	0.15755	-0.36	0.7202	D_PPR (t-1)
	AR2_1_2	-0.04996	0.03317	-1.51	0.1425	D_IMPR (t-1)
D_IMPR	CONST2	-155.85426	779.32074	-0.20	0.8428	1
	AR1_2_1	1.44605	0.91268			PPR (t-1)
	AR1_2_2	-0.58531	0.36942			IMPR (t-1)
	AR2_2_1	0.72102	1.15980	0.62	0.5389	D_PPR (t-1)
	AR2_2_2	-0.38120	0.24419	-1.56	0.1290	D_IMPR (t-1)

A3. Price Transmission between export price and import price (Rice)

Parameter Alpha * Beta' Estimates		
Variable	Export Price	Import Price
Export Price	-0.41988	0.35975
Import Price	0.22631	-0.19390

AR Coefficients of Differenced Lag			
DIF Lag	**Variable**	Export Price	Import Price
1	Export Price	0.26577	-0.06982
	Import Price	-0.00813	-0.59841

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
D_EXPR	CONST1	1895.32760	692.55453	2.74	0.0103	1
	AR1_1_1	-0.41988	0.15662			EXPR (t-1)
	AR1_1_2	0.35975	0.13419			IMPR (t-1)
	AR2_1_1	0.26577	0.17189	1.55	0.1326	D_EXPR (t-1)
	AR2_1_2	-0.06982	0.13213	-0.53	0.6011	D_IMPR (t-1)
D_IMPR	CONST2	61.76386	940.50404	0.07	0.9481	1
	AR1_2_1	0.22631	0.21269			EXPR (t-1)
	AR1_2_2	-0.19390	0.18223			IMPR (t-1)
	AR2_2_1	-0.00813	0.23343	-0.03	0.9724	D_EXPR (t-1)
	AR2_2_2	-0.59841	0.17943	-3.34	0.0023	D_IMPR (t-1)

A4. Price Transmission between Producer price and export price (Rice)

Parameter Alpha * Beta' Estimates		
Variable	Bangkok Price	WSP_India
Bangkok Price	-0.06825	0.20367
WSP_India	0.11507	-0.34340

AR Coefficients of Differenced Lag			
DIF Lag	**Variable**	Bangkok Price	WSP_India
1	Bangkok Price	0.58857	-0.17604
	WSP_India	0.02088	-0.34737

Model Parameter Estimates						
Equation	**Parameter**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**	**Variable**
D_INTPR	**CONST1**	-1691.76708	880.57935	-1.92	0.0578	1
	AR1_1_1	-0.06825	0.03329			INTPR (t-1)
	AR1_1_2	0.20367	0.09934			WSPIn (t-1)
	AR2_1_1	0.58857	0.09124	6.45	0.0001	D_INTPR (t-1)
	AR2_1_2	-0.17604	0.10071	-1.75	0.0838	D_WSPIn (t-1)
D_WSPIn	**CONST2**	3156.46492	801.61129	3.94	0.0002	1
	AR1_2_1	0.11507	0.03030			INTPR (t-1)
	AR1_2_2	-0.34340	0.09043			WSPIn (t-1)
	AR2_2_1	0.02088	0.08306	0.25	0.8020	D_INTPR (t-1)
	AR2_2_2	-0.34737	0.09168	-3.79	0.0003	D_WSPIn (t-1)

A5. Price Transmission between Producer price and export price (Rice)

Parameter Alpha * Beta' Estimates		
Variable	Bangkok Price	WSP_Kanpur
Bangkok Price	-0.12255	0.56368
WSP_Kanpur	0.02809	-0.12921

AR Coefficients of Differenced Lag			
DIF Lag	**Variable**	Bangkok Price	WSP_Kanpur
1	Bangkok Price	0.59721	0.33702
	WSP_Kanpur	-0.07084	0.00225

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
D_INTPR	CONST1	-3649.40919	1147.37826	-3.18	0.0021	1
	AR1_1_1	-0.12255	0.03758			INTPR (t-1)
	AR1_1_2	0.56368	0.17285			WSPKan (t-1)
	AR2_1_1	0.59721	0.09293	6.43	0.0001	D_INTPR (t-1)
	AR2_1_2	0.33702	0.39702	0.85	0.3987	D_WSPKan (t-1)
D_WSPKan	CONST2	932.86303	299.01400	3.12	0.0026	1
	AR1_2_1	0.02809	0.00979			INTPR (t-1)
	AR1_2_2	-0.12921	0.04505			WSPKan (t-1)
	AR2_2_1	-0.07084	0.02422	-2.93	0.0046	D_INTPR (t-1)
	AR2_2_2	0.00225	0.10347	0.02	0.9827	D_WSPKan (t-1)

A6. Price Transmission between Producer price and export price (Rice)

Parameter Alpha * Beta' Estimates		
Variable	Bangkok Price	WSP_Bankura
Bangkok Price	-0.07128	0.43556
WSP_Bankura	0.00591	-0.03613

AR Coefficients of Differenced Lag			
DIF Lag	**Variable**	Bangkok Price	WSP_Bankura
1	Bangkok Price	0.54057	-0.15813
	WSP_Bankura	-0.03762	-0.03599

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
D_INTPR	CONST1	-3928.36884	1271.83781	-3.09	0.0027	1
	AR1_1_1	-0.07128	0.02249			INTPR (t-1)
	AR1_1_2	0.43556	0.13746			WSPBank (t-1)
	AR2_1_1	0.54057	0.08858	6.10	0.0001	D_INTPR (t-1)
	AR2_1_2	-0.15813	0.45154	-0.35	0.7271	D_WSPBank (t-1)
D_WSPBank	CONST2	382.31745	301.72281	1.27	0.2086	1
	AR1_2_1	0.00591	0.00534			INTPR(t-1)
	AR1_2_2	-0.03613	0.03261			WSPBank (t-1)
	AR2_2_1	-0.03762	0.02101	-1.79	0.0770	D_INTPR (t-1)
	AR2_2_2	-0.03599	0.10712	-0.34	0.7377	D_WSPBank (t-1)

A7. Price Transmission between Producer price and export price (Rice)

Parameter Alpha * Beta' Estimates		
Variable	Bangkok Price	WSP_Sambalpur
Bangkok Price	-0.16402	0.56985
WSP_Sambalpur	0.11610	-0.40335

AR Coefficients of Differenced Lag			
DIF Lag	**Variable**	Bangkok Price	WSP_Sambalpur
1	Bangkok Price	0.68971	-0.13580
	WSP_Sambalpur	-0.12748	-0.24253

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
D_INTPR	CONST1	-3093.58979	932.58658	-3.32	0.0015	1
	AR1_1_1	-0.16402	0.04712			INTPR (t-1)
	AR1_1_2	0.56985	0.16369			WSPSambal (t-1)
	AR2_1_1	0.68971	0.10748	6.42	0.0001	D_INTPR (t-1)
	AR2_1_2	-0.13580	0.20100	-0.68	0.5016	D_WSPSambal (t-1)
D_WSPSambal	CONST2	2394.34149	460.13099	5.20	0.0001	1
	AR1_2_1	0.11610	0.02325			INTPR (t-1)
	AR1_2_2	-0.40335	0.08076			WSPSambal (t-1)
	AR2_2_1	-0.12748	0.05303	-2.40	0.0190	D_INTPR (t-1)
	AR2_2_2	-0.24253	0.09917	-2.45	0.0171	D_WSPSambal (t-1)

A8. Price Transmission between Producer price and export price (Rice)

Parameter Alpha * Beta' Estimates		
Variable	WSP_India	WSP_Kanpur
WSP_India	-0.31442	0.55661
WSP_Kanpur	0.16022	-0.28364

AR Coefficients of Differenced Lag			
DIF Lag	**Variable**	WSP_India	WSP_Kanpur
1	WSP_India	-0.18900	-0.33755
	WSP_Kanpur	-0.12943	0.11715

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
D_WSPIn	CONST1	-1100.58426	437.59809	-2.52	0.0140	1
	AR1_1_1	-0.31442	0.10577			WSPIn (t-1)
	AR1_1_2	0.55661	0.18724			WSPKan (t-1)
	AR2_1_1	-0.18900	0.11641	-1.62	0.1087	D_WSPIn (t-1)
	AR2_1_2	-0.33755	0.26895	-1.26	0.2134	D_WSPKan (t-1)
D_WSPKan	CONST2	715.15553	176.08314	4.06	0.0001	1
	AR1_2_1	0.16022	0.04256			WSPIn (t-1)
	AR1_2_2	-0.28364	0.07534			WSPKan (t-1)
	AR2_2_1	-0.12943	0.04684	-2.76	0.0072	D_WSPIn (t-1)
	AR2_2_2	0.11715	0.10822	1.08	0.2825	D_WSPKan (t-1)

A9. Price Transmission between Producer price and export price (Rice)

Parameter Alpha * Beta' Estimates		
Variable	WSP_India	WSP_Bankura
WSP_India	-0.05261	0.19323
WSP_Bankura	0.01847	-0.06785

AR Coefficients of Differenced Lag			
DIF Lag	**Variable**	WSP_India	WSP_Bankura
1	WSP_India	-0.21987	-0.13814
	WSP_Bankura	-0.01198	-0.00505

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
D_WSPIn	CONST1	-1401.04447	913.95930	-1.53	0.1290	1
	AR1_1_1	-0.05261	0.03107			WSPIn (t-1)
	AR1_1_2	0.19323	0.11413			WSPBank (t-1)
	AR2_1_1	-0.21987	0.08762	-2.51	0.0140	D_WSPIn (t-1)
	AR2_1_2	-0.13814	0.32722	-0.42	0.6740	D_WSPBank (t-1)
D_WSPBank	CONST2	580.31163	295.44297	1.96	0.0528	1
	AR1_2_1	0.01847	0.01004			WSPIn (t-1)
	AR1_2_2	-0.06785	0.03689			WSPBank (t-1)
	AR2_2_1	-0.01198	0.02832	-0.42	0.6733	D_WSPIn (t-1)
	AR2_2_2	-0.00505	0.10578	-0.05	0.9620	D_WSPBank (t-1)

A10. Price Transmission between Producer price and export price (Rice)

Parameter Alpha * Beta' Estimates		
Variable	WSP_India	WSP_Sambalpur
WSP_India	-0.30513	0.34751
WSP_Sambalpur	0.62113	-0.70741

AR Coefficients of Differenced Lag			
DIF Lag	**Variable**	WSP_India	WSP_Sambalpur
1	WSP_India	-0.18707	-0.16069
	WSP_Sambalpur	-0.28558	-0.04268

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
D_WSPIn	CONST1	880.72579	307.99365	2.86	0.0057	1
	AR1_1_1	-0.30513	0.12742			WSPIn (t-1)
	AR1_1_2	0.34751	0.14512			WSPSambal (t-1)
	AR2_1_1	-0.18707	0.13259	-1.41	0.1630	D_WSPIn (t-1)
	AR2_1_2	-0.16069	0.12258	-1.31	0.1944	D_WSPSambal (t-1)
D_WSPSambal	CONST2	-1288.69486	277.20651	-4.65	0.0001	1
	AR1_2_1	0.62113	0.11468			WSPIn (t-1)
	AR1_2_2	-0.70741	0.13061			WSPSambal (t-1)
	AR2_2_1	-0.28558	0.11934	-2.39	0.0196	D_WSPIn (t-1)
	AR2_2_2	-0.04268	0.11032	-0.39	0.7001	D_WSPSambal(t-1)

A11. Price Transmission between Producer price and export price (Rice)

Parameter Alpha * Beta' Estimates		
Variable	WSP_Kanpur	WSP_Bankura
WSP_Kanpur	-0.06904	0.11530
WSP_Bankura	0.04774	-0.07974

AR Coefficients of Differenced Lag			
DIF Lag	**Variable**	WSP_Kanpur	WSP_Bankura
1	WSP_Kanpur	-0.01222	0.10275
	WSP_Bankura	-0.19298	-0.02719

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
D_WSPKan	CONST1	-615.99302	343.34485	-1.79	0.0768	1
	AR1_1_1	-0.06904	0.03463			WSPKan (t-1)
	AR1_1_2	0.11530	0.05784			WSPBank (t-1)
	AR2_1_1	-0.01222	0.10662	-0.11	0.9091	D_WSPKan (t-1)
	AR2_1_2	0.10275	0.13185	0.78	0.4382	D_WSPBank (t-1)
D_WSPBank	CONST2	511.69805	295.65960	1.73	0.0876	1
	AR1_2_1	0.04774	0.02982			WSPKan (t-1)
	AR1_2_2	-0.07974	0.04981			WSPBank (t-1)
	AR2_2_1	-0.19298	0.09181	-2.10	0.0389	D_WSPKan (t-1)
	AR2_2_2	-0.02719	0.11354	-0.24	0.8114	D_WSPBank (t-1)

A12. Price Transmission between Producer price and export price (Rice)

Parameter Alpha * Beta' Estimates		
Variable	WSP_Kanpur	WSP_Sambalpur
WSP_Kanpur	-0.47486	0.31958
WSP_Sambalpur	0.54365	-0.36588

AR Coefficients of Differenced Lag			
DIF Lag	**Variable**	WSP_Kanpur	WSP_Sambalpur
1	WSP_Kanpur	0.06489	-0.11869
	WSP_Sambalpur	-0.47985	-0.12565

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
D_WSPKan	CONST1	1627.94336	353.55212	4.60	0.0001	1
	AR1_1_1	-0.47486	0.10646			WSPKan (t-1)
	AR1_1_2	0.31958	0.07165			WSPSambal (t-1)
	AR2_1_1	0.06489	0.11065	0.59	0.5596	D_WSPKan (t-1)
	AR2_1_2	-0.11869	0.06374	-1.86	0.0670	D_WSPSambal (t-1)
D_WSPSambal	CONST2	-1634.11148	782.19594	-2.09	0.0406	1
	AR1_2_1	0.54365	0.23552			WSPKan (t-1)
	AR1_2_2	-0.36588	0.15851			WSPSambal (t-1)
	AR2_2_1	-0.47985	0.24481	-1.96	0.0542	D_WSPKan (t-1)
	AR2_2_2	-0.12565	0.14101	-0.89	0.3761	D_WSPSambal (t-1)

A13. Price Transmission between Producer price and export price (Rice)

Parameter Alpha * Beta' Estimates		
Variable	WSP_Bankura	WSP_Sambalpur
WSP_Bankura	-0.07678	0.02592
WSP_Sambalpur	0.12902	-0.04355

AR Coefficients of Differenced Lag			
DIF Lag	**Variable**	WSP_Bankura	WSP_Sambalpur
1	WSP_Bankura	0.02666	-0.02728
	WSP_Sambalpur	0.05952	-0.35136

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
D_WSPBank	CONST1	687.37537	436.84284	1.57	0.1204	1
	AR1_1_1	-0.07678	0.05092			WSPBank (t-1)
	AR1_1_2	0.02592	0.01719			WSPSambal (t-1)
	AR2_1_1	0.02666	0.11998	0.22	0.8248	D_WSPBank (t-1)
	AR2_1_2	-0.02728	0.04543	-0.60	0.5504	D_WSPSambal (t-1)
D_WSPSambal	CONST2	-965.90433	1078.61815	-0.90	0.3738	1
	AR1_2_1	0.12902	0.12572			WSPBank (t-1)
	AR1_2_2	-0.04355	0.04243			WSPSambal (t-1)
	AR2_2_1	0.05952	0.29624	0.20	0.8414	D_WSPBank (t-1)
	AR2_2_2	-0.35136	0.11218	-3.13	0.0026	D_WSPSambal (t-1)

A14. Price transmission between export price to producer price (GNUT)

Parameter Alpha * Beta' Estimates		
Variable	Producer Price	Export Price
Producer Price	-0.69138	0.35324
Export Price	0.57679	-0.29470

AR Coefficients of Differenced Lag			
DIF Lag	Variable	Producer Price	Export Price
1	Producer Price	0.2963	-0.10595
	Export Price	-0.23249	-0.14993

Model Parameter Estimates

Equation	Parameter	Estimate	Standard Error	t Value	Pr> |t|	Variable
D_GPP	CONST1	884.79930	200.88759	4.40	0.0001	1
	AR1_1_1	-0.69138	0.17351			GPP (t-1)
	AR1_1_2	0.35324	0.08865			GEP(t-1)
	AR2_1_1	0.29635	0.20336	1.46	0.1537	D_GPP (t-1)
	AR2_1_2	-0.10595	0.07938	-1.33	0.1903	D_GEP (t-1)
D_GEP	CONST2	756.62707	526.35793	1.44	0.1592	1
	AR1_2_1	0.57679	0.45463			GPP (t-1)
	AR1_2_2	-0.29470	0.23228			GEP (t-1)
	AR2_2_1	-0.23249	0.53285	-0.44	0.6652	D_GPP (t-1)
	AR2_2_2	-0.14993	0.20798	-0.72	0.4756	D_GEP (t-1)

A.15. Price transmission between international price to junagadh price (GNUT)

Parameter Alpha * Beta' Estimates		
Variable	International Price	Junagadh Price
International Price	-0.08398	0.16874
Junagadh Price	0.02113	-0.04246

AR Coefficients of Differenced Lag			
DIF Lag	Variable	International Price	Junagadh Price
1	International Price	0.28856	0.37105
	Junagadh Price	-0.00310	0.08726

Model Parameter Estimates						
			Standard			
Equation	Parameter	Estimate	Error	t Value	Pr> |t|	Variable
D_IPR_	CONST1	449.73409	181.56855	2.48	0.0140	1
	AR1_1_1	-0.08398	0.02470			IPR_(t-1)
	AR1_1_2	0.16874	0.04962			JNPR (t-1)
	AR2_1_1	0.28856	0.06222	4.64	0.0001	D_IPR_(t-1)
	AR2_1_2	0.37105	0.16127	2.30	0.0223	D_JNPR (t-1)
D_JNPR	CONST2	-29.43103	73.82325	-0.40	0.6905	1
	AR1_2_1	0.02113	0.01004			IPR_(t-1)
	AR1_2_2	-0.04246	0.02018			JNPR (t-1)
	AR2_2_1	-0.00310	0.02530	-0.12	0.9024	D_IPR_(t-1)
	AR2_2_2	0.08726	0.06557	1.33	0.1846	D_JNPR (t-1)

A16. Price transmission between international price to gondel price (GNUT)

Parameter Alpha * Beta' Estimates		
Variable	International price	Gondel price
International price	-0.1222	0.24652
Gondel price	0.01501	-0.03028

AR Coefficients of Differenced Lag			
DIF Lag	Variable	International price	Gondel price
1	International price	0.30008	0.26143
	Gondel price	-0.00397	0.09998

Model Parameter Estimates						
			Standard			
Equation	Parameter	Estimate	Error	t Value	Pr> |t|	Variable
D_IPR_	CONST1	460.29984	159.57851	2.88	0.0043	1
	AR1_1_1	-0.12222	0.02549			IPR_(t-1)
	AR1_1_2	0.24652	0.05140			GOPR (t-1)
	AR2_1_1	0.30008	0.05925	5.06	0.0001	D_IPR_(t-1)
	AR2_1_2	0.26143	0.14951	1.75	0.0817	D_GOPR (t-1)
D_GOPR	CONST2	21.22582	71.37501	0.30	0.7664	1
	AR1_2_1	0.01501	0.01140			IPR_(t-1)
	AR1_2_2	-0.03028	0.02299			GOPR (t-1)
	AR2_2_1	-0.00397	0.02650	-0.15	0.8809	D_IPR_(t-1)
	AR2_2_2	0.09998	0.06687	1.50	0.1363	D_GOPR (t-1)

A17. Price transmission between international price to rajkot price (GNUT)

Parameter Alpha * Beta' Estimates		
Variable	International price	Rajkot price
International price	-0.12139	0.23309
Rajkot price	0.00702	-0.01348

AR Coefficients of Differenced Lag			
DIF Lag	Variable	International price	Rajkot price
1	International price	0.30909	-0.02782
	Rajkot price	0.00345	-0.03378

Model Parameter Estimates						
			Standard			
Equation	Parameter	Estimate	Error	t Value	Pr> |t|	Variable
D_IPR_	CONST1	785.97053	203.02884	3.87	0.0001	1
	AR1_1_1	-0.12139	0.02549			IPR_(t-1)
	AR1_1_2	0.23309	0.04895			RJPR (t-1)
	AR2_1_1	0.30909	0.06089	5.08	0.0001	D_IPR_(t-1)
	AR2_1_2	-0.02782	0.14907	-0.19	0.8521	D_RJPR (t-1)
D_RJPR	CONST2	41.60773	91.68180	0.45	0.6504	1
	AR1_2_1	0.00702	0.01151			IPR_(t-1)
	AR1_2_2	-0.01348	0.02210			RJPR (t-1)
	AR2_2_1	0.00345	0.02750	0.13	0.9001	D_IPR_(t-1)
	AR2_2_2	-0.03378	0.06732	-0.50	0.6162	D_RJPR(t-1)

A18. Price transmission among different domestic markets (GNUT)

Parameter Alpha * Beta' Estimates			
Variable	JNPR	GOPR	RJPR
JNPR	0.00007	-0.00354	0.00332
GOPR	0.00686	-0.34436	0.32270
RJPR	-0.00289	0.14530	-0.13616

AR Coefficients of Differenced Lag				
DIF Lag	Variable	JNPR	GOPR	RJPR
1	JNPR	0.09120	0.03084	-0.09738
	GOPR	0.05313	0.21395	-0.10132
	RJPR	0.18877	0.32854	-0.23375

Model Parameter Estimates

Equation	Parameter	Estimate	Standard Error	t Value	Pr> |t|	Variable
D_JNPR	CONST1	80.04601	106.59603	0.75	0.4535	1
	AR1_1_1	0.00007	0.00154			JNPR (t-1)
	AR1_1_2	-0.00354	0.07755			GOPR (t-1)
	AR1_1_3	0.00332	0.07267			RJPR (t-1)
	AR2_1_1	0.09120	0.07221	1.26	0.2079	D_JNPR (t-1)
	AR2_1_2	0.03084	0.08372	0.37	0.7129	D_GOPR (t-1)
	AR2_1_3	-0.09738	0.07699	-1.26	0.2072	D_RJPR (t-1)
D_GOPR	CONST2	470.41959	109.80733	4.28	0.0001	1
	AR1_2_1	0.00686	0.00159			JNPR (t-1)
	AR1_2_2	-0.34436	0.07988			GOPR (t-1)
	AR1_2_3	0.32270	0.07486			RJPR (t-1)
	AR2_2_1	0.05313	0.07439	0.71	0.4759	D_JNPR (t-1)
	AR2_2_2	0.21395	0.08624	2.48	0.0138	D_GOPR (t-1)
	AR2_2_3	-0.10132	0.07931	-1.28	0.2027	D_RJPR (t-1)
D_RJPR	CONST3	-113.21932	104.75689	-1.08	0.2809	1
	AR1_3_1	-0.00289	0.00152			JNPR (t-1)
	AR1_3_2	0.14530	0.07621			GOPR (t-1)
	AR1_3_3	-0.13616	0.07142			RJPR (t-1)
	AR2_3_1	0.18877	0.07097	2.66	0.0084	D_JNPR (t-1)
	AR2_3_2	0.32854	0.08228	3.99	0.0001	D_GOPR (t-1)
	AR2_3_3	-0.23375	0.07566	-3.09	0.0023	D_RJPR (t-1)

A19. Price transmission between export price to producer price (Castor)

Parameter Alpha * Beta' Estimates		
Variable	Producer Price	Export Price
Producer Price	-1.16855	0.55836
Export Price	-0.02694	0.01287

AR Coefficients of Differenced Lag			
DIF Lag	Variable	Producer Price	Export Price
1	Producer Price	0.64974	-0.27907
	Export Price	0.14031	-0.17565

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr> |t|	Variable
D_PPR	CONST1	4692.90518	948.24928	4.95	0.0008	1
	AR1_1_1	-1.16855	0.25409			PPR (t-1)
	AR1_1_2	0.55836	0.12141			EXPR (t-1)
	AR2_1_1	0.64974	0.22792	2.85	0.0191	D_PPR (t-1)
	AR2_1_2	-0.27907	0.11219	-2.49	0.0346	D_EXPR (t-1)
D_EXPR	CONST2	1986.86083	3110.06843	0.64	0.5388	1
	AR1_2_1	-0.02694	0.83337			PPR (t-1)
	AR1_2_2	0.01287	0.39820			EXPR (t-1)
	AR2_2_1	0.14031	0.74755	0.19	0.8553	D_PPR (t-1)
	AR2_2_2	-0.17565	0.36796	-0.48	0.6445	D_EXPR (t-1)

A20. Price transmission between International price and domestic prices (Castor)

Parameter Alpha * Beta' Estimates			
Variable	International market	Rajkot market	Unjha market
International market	-0.24909	1.60332	-1.12754
Rajkot market	0.07873	-0.50678	0.35639
Unjha market	-0.06999	0.45052	-0.31683

AR Coefficients of Differenced Lag				
DIF Lag	Variable	International market	Rajkot market	Unjha market
1	International market	-0.03760	-0.69829	0.08197
	Rajkot market	-0.38969	0.46321	-0.15883
	Unjha market	-0.20705	0.32243	-0.13195

Model Parameter Estimates						
			Standard			
Equation	Parameter	Estimate	Error	t Value	Pr> |t|	Variable
D_Ipr	CONST1	-1697.95937	929.37968	-1.83	0.0949	1
	AR1_1_1	-0.24909	0.07702			Ipr (t-1)
	AR1_1_2	1.60332	0.49576			Rjpr (t-1)
	AR1_1_3	-1.12754	0.34865			Unpr (t-1)
	AR2_1_1	-0.03760	0.21479	-0.18	0.8642	D_Ipr (t-1)
	AR2_1_2	-0.69829	0.40655	-1.72	0.1139	D_Rjpr (t-1)
	AR2_1_3	0.08197	0.33307	0.25	0.8101	D_Unpr (t-1)
D_Rjpr	CONST2	1926.38469	1021.74590	1.89	0.0861	1
	AR1_2_1	0.07873	0.08468			Ipr (t-1)
	AR1_2_2	-0.50678	0.54503			Rjpr (t-1)
	AR1_2_3	0.35639	0.38330			Unpr (t-1)
	AR2_2_1	-0.38969	0.23614	-1.65	0.1271	D_Ipr (t-1)
	AR2_2_2	0.46321	0.44696	1.04	0.3223	D_Rjpr (t-1)
	AR2_2_3	-0.15883	0.36618	-0.43	0.6728	D_Unpr (t-1)
D_Unpr	CONST3	154.80917	898.32433	0.17	0.8663	1
	AR1_3_1	-0.06999	0.07445			Ipr (t-1)
	AR1_3_2	0.45052	0.47920			Rjpr (t-1)
	AR1_3_3	-0.31683	0.33700			Unpr (t-1)
	AR2_3_1	-0.20705	0.20761	-1.00	0.3400	D_Ipr (t-1)
	AR2_3_2	0.32243	0.39297	0.82	0.4294	D_Rjpr (t-1)
	AR2_3_3	-0.13195	0.32194	-0.41	0.6898	D_Unpr (t-1)

A21. Price transmission among domestic markets (castor)

Parameter Alpha * Beta' Estimates					
Variable	Mumbai market	Junagadh market	Rajkot market	Gondel market	Unjha market
Mumbai market	-0.80215	-0.34443	-0.08079	1.54061	-0.26934
Junagadh market	1.16921	0.50204	0.11777	-2.24560	0.39260
Rajkot market	-0.97065	-0.41678	-0.09777	1.86424	-0.32592
Gondel market	0.69266	0.29742	0.06977	-1.33033	0.23258
Unjha market	0.19535	0.08388	0.01968	-0.37520	0.06560

AR Coefficients of Differenced Lag						
DIF Lag	Variable	Mumbai market	Junagadh market	Rajkot market	Gondel market	Unjha market
1	Mumbai market	-0.41112	-0.43716	1.09549	1.87923	-1.55215
	Junagadh market	-1.89978	-1.77137	0.74394	1.84359	1.63600
	Rajkot market	-0.36727	-0.43856	0.63844	-0.84872	0.90757
	Gondel market	-1.11082	-0.99220	1.10339	2.05692	-0.42684
	Unjha market	-0.75487	-0.79988	1.10350	1.24731	-0.24354

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr> |t|	Variable
D_Mumpr	CONST1	783.41504	513.63310	1.53	0.1710	1
	AR1_1_1	-0.80215	0.57933			Mumpr (t-1)
	AR1_1_2	-0.34443	0.24876			Jnpr (t-1)
	AR1_1_3	-0.08079	0.05835			Rjpr (t-1)
	AR1_1_4	1.54061	1.11267			Gopr (t-1)
	AR1_1_5	-0.26934	0.19453			Unpr (t-1)
	AR2_1_1	-0.41112	0.31773	-1.29	0.2368	D_Mumpr (t-1)
	AR2_1_2	-0.43716	0.30589	-1.43	0.1960	D_Jnpr (t-1)
	AR2_1_3	1.09549	0.40329	2.72	0.0299	D_Rjpr (t-1)
	AR2_1_4	1.87923	1.34236	1.40	0.2043	D_Gopr (t-1)
	AR2_1_5	-1.55215	1.20659	-1.29	0.2392	D_Unpr (t-1)
D_Jnpr	CONST2	618.57505	506.33431	1.22	0.2614	1
	AR1_2_1	1.16921	0.57110			Mumpr (t-1)
	AR1_2_2	0.50204	0.24522			Jnpr (t-1)
	AR1_2_3	0.11777	0.05752			Rjpr (t-1)
	AR1_2_4	-2.24560	1.09686			Gopr (t-1)
	AR1_2_5	0.39260	0.19176			Unpr (t-1)
	AR2_2_1	-1.89978	0.31322	-6.07	0.0005	D_Mumpr (t-1)
	AR2_2_2	-1.77137	0.30154	-5.87	0.0006	D_Jnpr (t-1)
	AR2_2_3	0.74394	0.39756	1.87	0.1035	D_Rjpr (t-1)
	AR2_2_4	1.84359	1.32329	1.39	0.2062	D_Gopr (t-1)
	AR2_2_5	1.63600	1.18944	1.38	0.2114	D_Unpr (t-1)
D_Rjpr	CONST3	1363.87742	511.09644	2.67	0.0321	1
	AR1_3_1	-0.97065	0.57647			Mumpr (t-1)
	AR1_3_2	-0.41678	0.24753			Jnpr (t-1)
	AR1_3_3	-0.09777	0.05806			Rjpr (t-1)
	AR1_3_4	1.86424	1.10718			Gopr (t-1)
	AR1_3_5	-0.32592	0.19357			Unpr (t-1)
	AR2_3_1	-0.36727	0.31616	-1.16	0.2835	D_Mumpr (t-1)
	AR2_3_2	-0.43856	0.30438	-1.44	0.1928	D_Jnpr (t-1)
	AR2_3_3	0.63844	0.40130	1.59	0.1556	D_Rjpr (t-1)
	AR2_3_4	-0.84872	1.33573	-0.64	0.5454	D_Gopr (t-1)
	AR2_3_5	0.90757	1.20063	0.76	0.4744	D_Unpr (t-1)
D_Gopr	CONST4	538.31127	408.76666	1.32	0.2293	1
	AR1_4_1	0.69266	0.46105			Mumpr (t-1)

	AR1_4_2	0.29742	0.19797			Jnpr (t-1)
	AR1_4_3	0.06977	0.04644			Rjpr (t-1)
	AR1_4_4	-1.33033	0.88550			Gopr (t-1)
	AR1_4_5	0.23258	0.15481			Unpr (t-1)
	AR2_4_1	-1.11082	0.25286	-4.39	0.0032	D_Mumpr (t-1)
	AR2_4_2	-0.99220	0.24343	-4.08	0.0047	D_Jnpr (t-1)
	AR2_4_3	1.10339	0.32095	3.44	0.0109	D_Rjpr (t-1)
	AR2_4_4	2.05692	1.06830	1.93	0.0956	D_Gopr (t-1)
	AR2_4_5	-0.42684	0.96024	-0.44	0.6701	D_Unpr (t-1)
D_Unpr	CONST5	708.43580	414.41436	1.71	0.1311	1
	AR1_5_1	0.19535	0.46742			Mumpr (t-1)
	AR1_5_2	0.08388	0.20071			Jnpr (t-1)
	AR1_5_3	0.01968	0.04708			Rjpr (t-1)
	AR1_5_4	-0.37520	0.89774			Gopr (t-1)
	AR1_5_5	0.06560	0.15695			Unpr (t-1)
	AR2_5_1	-0.75487	0.25636	-2.94	0.0216	D_Mumpr (t-1)
	AR2_5_2	-0.79988	0.24680	-3.24	0.0142	D_Jnpr (t-1)
	AR2_5_3	1.10350	0.32539	3.39	0.0116	D_Rjpr (t-1)
	AR2_5_4	1.24731	1.08306	1.15	0.2873	D_Gopr (t-1)
	AR2_5_5	-0.24354	0.97351	-0.25	0.8096	D_Unpr (t-1)

A22. Price transmission between international market and domestic markets (Cumin)

Parameter Alpha * Beta' Estimates			
Variable	International market	Rajkot market	Gondel market
International market	-0.17973	-0.25870	0.50476
Rajkot market	-0.05428	-0.07814	0.15246
Gondel market	0.00339	0.00488	-0.00952

AR Coefficients of Differenced Lag				
DIF Lag	Variable	International market	Rajkot market	Gondel market
1	International market	0.15456	0.45956	-0.47820
	Rajkot market	-0.34829	0.04516	0.32256
	Gondel market	-0.37052	0.49436	-0.08026

Model Parameter Estimates						
			Standard			
Equation	Parameter	Estimate	Error	t Value	Pr> |t|	Variable
D_IPR	CONST1	756.88641	747.75191	1.01	0.3158	1
	AR1_1_1	-0.17973	0.05579			IPR (t-1)
	AR1_1_2	-0.25870	0.08030			RJPR (t-1)
	AR1_1_3	0.50476	0.15668			GOPR (t-1)
	AR2_1_1	0.15456	0.13042	1.19	0.2410	D_IPR (t-1)
	AR2_1_2	0.45956	0.23596	1.95	0.0565	D_RJPR (t-1)
	AR2_1_3	-0.47820	0.24282	-1.97	0.0539	D_GOPR (t-1)

D_RJPR	CONST2	791.91048	697.41546	1.14	0.2610	1
	AR1_2_1	-0.05428	0.05203			IPR (t-1)
	AR1_2_2	-0.07814	0.07490			RJPR (t-1)
	AR1_2_3	0.15246	0.14613			GOPR (t-1)
	AR2_2_1	-0.34829	0.12164	-2.86	0.0059	D_IPR (t-1)
	AR2_2_2	0.04516	0.22008	0.21	0.8382	D_RJPR (t-1)
	AR2_2_3	0.32256	0.22647	1.42	0.1599	D_GOPR (t-1)
D_GOPR	CONST3	707.72389	702.30135	1.01	0.3179	1
	AR1_3_1	0.00339	0.05240			IPR (t-1)
	AR1_3_2	0.00488	0.07542			RJPR (t-1)
	AR1_3_3	-0.00952	0.14716			GOPR (t-1)
	AR2_3_1	-0.37052	0.12250	-3.02	0.0038	D_IPR (t-1)
	AR2_3_2	0.49436	0.22162	2.23	0.0297	D_RJPR (t-1)
	AR2_3_3	-0.08026	0.22806	-0.35	0.7262	D_GOPR (t-1)

A23. Price transmission among domestic markets (Cumin)

Parameter Alpha * Beta' Estimates					
Variable	Mumbai market	Unjha market	Rajkot market	Gondel market	Junagadh market
Mumbai market	-0.00702	0.05579	0.01518	-0.04138	-0.02647
Unjha market	0.11195	-0.89023	-0.24220	0.66020	0.42238
Rajkot market	0.00017	-0.00132	-0.00036	0.00098	0.00062
Gondel market	-0.01057	0.08402	0.02286	-0.06231	-0.03986
Junagadh market	0.03235	-0.25725	-0.06999	0.19078	0.12205

AR Coefficients of Differenced Lag						
DIF Lag	Variable	Mumbai market	Unjha market	Rajkot market	Gondel market	Junagadh market
1	Mumbai market	-0.08716	-0.00909	-0.06171	0.40549	-0.00200
	Unjha market	-0.13936	0.05737	0.50994	-0.05078	-0.38520
	Rajkot market	-0.03118	0.08546	0.08161	0.36588	-0.26452
	Gondel market	0.00138	-0.06717	0.32696	-0.08759	0.02838
	Junagadh market	0.09285	0.17105	0.86632	-0.39989	-0.58969

Model Parameter Estimates						
			Standard			
Equation	Parameter	Estimate	Error	t Value	Pr> |t|	Variable
D_MUPR	CONST1	1012.96373	964.21065	1.05	0.2983	1
	AR1_1_1	-0.00702	0.02118			MUPR (t-1)
	AR1_1_2	0.05579	0.16840			UNPR (t-1)
	AR1_1_3	0.01518	0.04582			RJPR (t-1)
	AR1_1_4	-0.04138	0.12489			GOPR (t-1)
	AR1_1_5	-0.02647	0.07990			JUPR (t-1)
	AR2_1_1	-0.08716	0.22822	-0.38	0.7041	D_MUPR (t-1)
	AR2_1_2	-0.00909	0.12867	-0.07	0.9439	D_UNPR (t-1)
	AR2_1_3	-0.06171	0.32652	-0.19	0.8508	D_RJPR (t-1)
	AR2_1_4	0.40549	0.27886	1.45	0.1519	D_GOPR (t-1)
	AR2_1_5	-0.00200	0.17290	-0.01	0.9908	D_JUPR (t-1)
D_UNPR	CONST2	-1934.87958	913.77091	-2.12	0.0390	1
	AR1_2_1	0.11195	0.02007			MUPR (t-1)
	AR1_2_2	-0.89023	0.15959			UNPR (t-1)
	AR1_2_3	-0.24220	0.04342			RJPR (t-1)
	AR1_2_4	0.66020	0.11836			GOPR (t-1)
	AR1_2_5	0.42238	0.07572			JUPR (t-1)
	AR2_2_1	-0.13936	0.21628	-0.64	0.5222	D_MUPR (t-1)
	AR2_2_2	0.05737	0.12194	0.47	0.6400	D_UNPR (t-1)
	AR2_2_3	0.50994	0.30944	1.65	0.1054	D_RJPR (t-1)
	AR2_2_4	-0.05078	0.26427	-0.19	0.8484	D_GOPR (t-1)
	AR2_2_5	-0.38520	0.16386	-2.35	0.0226	D_JUPR (t-1)
D_RJPR	CONST3	651.67684	837.99061	0.78	0.4403	1
	AR1_3_1	0.00017	0.01841			MUPR (t-1)
	AR1_3_2	-0.00132	0.14636			UNPR (t-1)
	AR1_3_3	-0.00036	0.03982			RJPR (t-1)
	AR1_3_4	0.00098	0.10854			GOPR (t-1)
	AR1_3_5	0.00062	0.06944			JUPR (t-1)
	AR2_3_1	-0.03118	0.19834	-0.16	0.8757	D_MUPR (t-1)
	AR2_3_2	0.08546	0.11183	0.76	0.4482	D_UNPR (t-1)
	AR2_3_3	0.08161	0.28378	0.29	0.7748	D_RJPR (t-1)
	AR2_3_4	0.36588	0.24235	1.51	0.1372	D_GOPR (t-1)
	AR2_3_5	-0.26452	0.15027	-1.76	0.0842	D_JUPR (t-1)
D_GOPR	CONST4	829.86613	867.54867	0.96	0.3432	1
	AR1_4_1	-0.01057	0.01906			MUPR (t-1)
	AR1_4_2	0.08402	0.15152			UNPR (t-1)
	AR1_4_3	0.02286	0.04122			RJPR (t-1)
	AR1_4_4	-0.06231	0.11237			GOPR (t-1)
	AR1_4_5	-0.03986	0.07189			JUPR (t-1)
	AR2_4_1	0.00138	0.20534	0.01	0.9947	D_MUPR (t-1)
	AR2_4_2	-0.06717	0.11577	-0.58	0.5643	D_UNPR (t-1)
	AR2_4_3	0.32696	0.29379	1.11	0.2709	D_RJPR (t-1)
	AR2_4_4	-0.08759	0.25090	-0.35	0.7284	D_GOPR (t-1)
	AR2_4_5	0.02838	0.15557	0.18	0.8559	D_JUPR (t-1)
D_JUPR	CONST5	102.41285	1007.69420	0.10	0.9194	1
	AR1_5_1	0.03235	0.02213			MUPR (t-1)
	AR1_5_2	-0.25725	0.17600			UNPR (t-1)
	AR1_5_3	-0.06999	0.04788			RJPR (t-1)
	AR1_5_4	0.19078	0.13052			GOPR (t-1)
	AR1_5_5	0.12205	0.08350			JUPR (t-1)
	AR2_5_1	0.09285	0.23851	0.39	0.6987	D_MUPR (t-1)
	AR2_5_2	0.17105	0.13447	1.27	0.2090	D_UNPR (t-1)

AR2_5_3	0.86632	0.34124	2.54	0.0142	D_RJPR (t-1)
AR2_5_4	-0.39989	0.29143	-1.37	0.1759	D_GOPR (t-1)
AR2_5_5	-0.58969	0.18070	-3.26	0.0019	D_JUPR (t-1)

A24. Price transmission between import price to producer price (Cashewnut)

Parameter Alpha * Beta' Estimates		
Variable	Producer Price	Import Price
Producer Price	-0.10404	0.12146
Import Price	0.17284	-0.20178

AR Coefficients of Differenced Lag			
DIF Lag	Variable	Producer Price	Import Price
1	Producer Price	0.03191	0.01387
	Import Price	-0.38561	0.24695

Model Parameter Estimates

Equation	Parameter	Estimate	Standard Error	t Value	Pr> |t|	Variable
D_CWPP	CONST1	227.77183	487.92335	0.47	0.6434	1
	AR1_1_1	-0.10404	0.06075			CWPP (t-1)
	AR1_1_2	0.12146	0.07092			CWIP (t-1)
	AR2_1_1	0.03191	0.16513	0.19	0.8478	D_CWPP (t-1)
	AR2_1_2	0.01387	0.09137	0.15	0.8802	D_CWIP (t-1)
D_CWIP	CONST2	2027.34610	965.64437	2.10	0.0428	1
	AR1_2_1	0.17284	0.12023			CWPP (t-1)
	AR1_2_2	-0.20178	0.14036			CWIP (t-1)
	AR2_2_1	-0.38561	0.32681	-1.18	0.2458	D_CWPP (t-1)
	AR2_2_2	0.24695	0.18084	1.37	0.1805	D_CWIP (t-1)

A25. Price transmission between domestic markets (Cashewnut)

Parameter Alpha * Beta' Estimates		
Variable	Kerala market	Karnataka market
Kerala market	0.72960	-1.47549
Karnataka market	0.73054	-1.47739

AR Coefficients of Differenced Lag			
DIF Lag	Variable	Kerala market	Karnataka market
1	Kerala market	-0.65788	0.60423
	Karnataka market	-0.39669	0.45461

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr> |t|	Variable
D_KEPR	CONST1	22760.08279	5872.44008	3.88	0.0022	1
	AR1_1_1	0.72960	0.19567			KEPR (t-1)
	AR1_1_2	-1.47549	0.39571			KAPR (t-1)
	AR2_1_1	-0.65788	0.43232	-1.52	0.1540	D_KEPR (t-1)
	AR2_1_2	0.60423	0.42367	1.43	0.1793	D_KAPR (t-1)
D_KAPR	CONST2	22332.97462	6115.54786	3.65	0.0033	1
	AR1_2_1	0.73054	0.20377			KEPR (t-1)
	AR1_2_2	-1.47739	0.41209			KAPR (t-1)
	AR2_2_1	-0.39669	0.45022	-0.88	0.3956	D_KEPR (t-1)
	AR2_2_2	0.45461	0.44121	1.03	0.3232	D_KAPR (t-1)

A26. Price transmission between domestic markets (Cashewnut)

Parameter Alpha * Beta' Estimates		
Variable	Kerala market	A.P market
Kerala market	-1.56914	1.59846
A.P market	-0.41272	0.42043

AR Coefficients of Differenced Lag			
DIF Lag	Variable	Kerala market	A.P market
1	Kerala market	0.98624	-1.34703
	A.P market	0.31492	-0.46544

Model Parameter Estimates						
			Standard			
Equation	Parameter	Estimate	Error	t Value	Pr> |t|	Variable
D_KEPR	CONST1	821.15892	1234.87976	0.66	0.5186	1
	AR1_1_1	-1.56914	0.43704			KEPR (t-1)
	AR1_1_2	1.59846	0.44520			APPR (t-1)
	AR2_1_1	0.98624	0.39834	2.48	0.0292	D_KEPR (t-1)
	AR2_1_2	-1.34703	0.60649	-2.22	0.0464	D_APPR (t-1)
D_APPR	CONST2	708.30212	872.84745	0.81	0.4329	1
	AR1_2_1	-0.41272	0.30891			KEPR (t-1)
	AR1_2_2	0.42043	0.31468			APPR (t-1)
	AR2_2_1	0.31492	0.28156	1.12	0.2853	D_KEPR (t-1)
	AR2_2_2	-0.46544	0.42868	-1.09	0.2989	D_APPR (t-1)

A27. Price transmission between domestic markets (Cashewnut)

Parameter Alpha * Beta' Estimates		
Variable	Karnataka market	A.P market
Karnataka market	-1.42108	1.06336
A.P market	-0.40998	0.30678

AR Coefficients of Differenced Lag			
DIF Lag	Variable	Karnataka market	A.P market
1	Karnataka market	0.66336	-0.98597
	A.P market	0.14103	-0.26964

Model Parameter Estimates						
			Standard			
Equation	Parameter	Estimate	Error	t Value	Pr> |t|	Variable
D_KAPR	CONST1	11850.68197	2740.00761	4.33	0.0010	1
	AR1_1_1	-1.42108	0.32301			KAPR (t-1)
	AR1_1_2	1.06336	0.24170			APPR (t-1)
	AR2_1_1	0.66336	0.28584	2.32	0.0387	D_KAPR (t-1)
	AR2_1_2	-0.98597	0.46411	-2.12	0.0551	D_APPR (t-1)
D_APPR	CONST2	3962.45992	1951.84958	2.03	0.0651	1
	AR1_2_1	-0.40998	0.23010			KAPR (t-1)
	AR1_2_2	0.30678	0.17218			APPR (t-1)
	AR2_2_1	0.14103	0.20362	0.69	0.5017	D_KAPR (t-1)
	AR2_2_2	-0.26964	0.33061	-0.82	0.4306	D_APPR (t-1)

A28. Price transmission between domestic markets (Cashew nut)

Parameter Alpha * Beta' Estimates		
Variable	Karnataka market	Goa market
Karnataka market	-1.93881	1.34961
Goa market	-1.72396	1.20005

AR Coefficients of Differenced Lag			
DIF Lag	Variable	Karnataka market	Goa market
1	Karnataka market	0.40828	-0.36531
	Goa market	0.70228	-1.00508

Model Parameter Estimates

Equation	Parameter	Estimate	Standard Error	t Value	Pr> |t|	Variable
D_KAPR	CONST1	9525.49007	2500.85554	3.81	0.0025	1
	AR1_1_1	-1.93881	0.48381			KAPR (t-1)
	AR1_1_2	1.34961	0.33678			GOPR (t-1)
	AR2_1_1	0.40828	0.35287	1.16	0.2698	D_KAPR (t-1)
	AR2_1_2	-0.36531	0.38223	-0.96	0.3581	D_GOPR (t-1)
D_GOPR	CONST2	9719.43103	2852.57751	3.41	0.0052	1
	AR1_2_1	-1.72396	0.55186			KAPR (t-1)
	AR1_2_2	1.20005	0.38415			GOPR (t-1)
	AR2_2_1	0.70228	0.40250	1.74	0.1065	D_KAPR (t-1)
	AR2_2_2	-1.00508	0.43599	-2.31	0.0398	D_GOPR (t-1)

A29. Price transmission between domestic markets (Cashewnut)

Parameter Alpha * Beta' Estimates		
Variable	A.P market	Goa market
A.P market	0.66789	-0.76247
Goa market	1.43985	-1.64375

AR Coefficients of Differenced Lag			
DIF Lag	Variable	A.P market	Goa market
1	A.P market	-0.63820	0.44309
	Goa market	-1.64024	0.98473

Model Parameter Estimates						
			Standard			
Equation	Parameter	Estimate	Error	t Value	Pr> |t|	Variable
D_APPR	CONST1	8427.95199	3052.38432	2.76	0.0172	1
	AR1_1_1	0.66789	0.25990			APPR (t-1)
	AR1_1_2	-0.76247	0.29670			GOPR (t-1)
	AR2_1_1	-0.63820	0.42113	-1.52	0.1555	D_APPR (t-1)
	AR2_1_2	0.44309	0.27869	1.59	0.1378	D_GOPR (t-1)
D_GOPR	CONST2	18226.20344	4575.48641	3.98	0.0018	1
	AR1_2_1	1.43985	0.38958			APPR (t-1)
	AR1_2_2	-1.64375	0.44476			GOPR (t-1)
	AR2_2_1	-1.64024	0.63126	-2.60	0.0233	D_APPR (t-1)
	AR2_2_2	0.98473	0.41776	2.36	0.0362	D_GOPR (t-1)

A30. Price transmission between producer price and export price (Tea)

AR Coefficient Estimates			
Lag	Variable	PP	Xp
1	PP	0.94466	0.00651
	Xp	0.48132	0.51552
2	PP	0.25868	-0.00553
	Xp	-0.40013	-0.11558

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
PP	CONST1	-28.44379	98.79511	-0.29	0.7799	1
	AR1_1_1	0.94466	0.34341	2.75	0.0224	PP (t-1)
	AR1_1_2	0.00651	0.03655	0.18	0.8626	Xp (t-1)
	AR2_1_1	0.25868	0.39594	0.65	0.5299	PP (t-2)
	AR2_1_2	-0.00553	0.03720	-0.15	0.8851	Xp (t-2)
Xp	CONST2	1310.24264	929.95632	1.41	0.1925	1
	AR1_2_1	0.48132	3.23255	0.15	0.8849	PP (t-1)
	AR1_2_2	0.51552	0.34408	1.50	0.1683	Xp (t-1)

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
	AR2_2_1	-0.40013	3.72693	-0.11	0.9169	PP (t-2)
	AR2_2_2	-0.11558	0.35013	-0.33	0.7489	Xp (t-2)

A31. Price transmission between producer price and import price (Tea)

AR Coefficient Estimates			
Lag	Variable	PP	IP
1	PP	0.82370	-0.03648
	IP	-6.30169	0.20640
2	PP	0.17994	-0.03473
	IP	5.22499	-0.22103

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
PP	CONST1	115.81731	106.42902	1.09	0.3048	1
	AR1_1_1	0.82370	0.34261	2.40	0.0396	PP(t-1)
	AR1_1_2	-0.03648	0.03565	-1.02	0.3329	IP(t-1)
	AR2_1_1	0.17994	0.38306	0.47	0.6497	PP(t-2)
	AR2_1_2	-0.03473	0.03721	-0.93	0.3750	IP(t-2)
IP	CONST2	1710.20067	1088.78227	1.57	0.1507	1
	AR1_2_1	-6.30169	3.50490	-1.80	0.1057	PP(t-1)
	AR1_2_2	0.20640	0.36465	0.57	0.5852	IP(t-1)
	AR2_2_1	5.22499	3.91874	1.33	0.2152	PP(t-2)
	AR2_2_2	-0.22103	0.38064	-0.58	0.5757	IP(t-2)

A32. Price transmission between export price and import price (Tea)

AR Coefficient Estimates			
Lag	Variable	Xp	IP
1	Xp	0.49375	0.05205
	IP	-0.04314	0.31017
2	Xp	-0.05575	-0.11248
	IP	0.06834	0.10608

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
Xp	CONST1	1334.89616	798.75193	1.67	0.1290	1
	AR1_1_1	0.49375	0.39751	1.24	0.2456	Xp(t-1)
	AR1_1_2	0.05205	0.34148	0.15	0.8822	IP(t-1)
	AR2_1_1	-0.05575	0.40471	-0.14	0.8935	Xp(t-2)
	AR2_1_2	-0.11248	0.36228	-0.31	0.7633	IP(t-2)
IP	CONST2	765.35559	931.26814	0.82	0.4324	1
	AR1_2_1	-0.04314	0.46346	-0.09	0.9279	Xp(t-1)
	AR1_2_2	0.31017	0.39813	0.78	0.4559	IP(t-1)
	AR2_2_1	0.06834	0.47185	0.14	0.8880	Xp(t-2)
	AR2_2_2	0.10608	0.42238	0.25	0.8073	IP(t-2)

A33. Price transmission between producer price and export price (Sugarcane)

AR Coefficient Estimates			
Lag	Variable	pp	xp
1	pp	0.25784	0.00002
	xp	-3821.25483	1.12976
2	pp	0.05109	-0.00001
	xp	2635.81804	-0.83271

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
pp	CONST1	14.21579	13.24527	1.07	0.3084	1
	AR1_1_1	0.25784	0.42007	0.61	0.5531	pp(t-1)
	AR1_1_2	0.00002	0.00002	0.81	0.4383	xp(t-1)
	AR2_1_1	0.05109	0.47978	0.11	0.9173	pp(t-2)
	AR2_1_2	-0.00001	0.00005	-0.11	0.9152	xp(t-2)
xp	CONST2	123193.15981	207350.14572	0.59	0.5656	1
	AR1_2_1	-3821.25483	6576.12250	-0.58	0.5740	pp(t-1)
	AR1_2_2	1.12976	0.29709	3.80	0.0035	xp(t-1)
	AR2_2_1	2635.81804	7510.78226	0.35	0.7329	pp(t-2)
	AR2_2_2	-0.83271	0.81096	-1.03	0.3287	xp(t-2)

A34. Price transmission between producer price and import price (Sugarcane)

AR Coefficient Estimates			
Lag	Variable	pp	ip
1	pp	0.32017	-0.00000
	ip	-2242.88382	-0.04672
2	pp	-0.03377	-0.00001
	ip	-2687.96362	-0.18984

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
pp	CONST1	16.74109	9.29972	1.80	0.1020	1
	AR1_1_1	0.32017	0.31632	1.01	0.3353	pp(t-1)
	AR1_1_2	-0.00000	0.00001	-0.16	0.8765	ip(t-1)
	AR2_1_1	-0.03377	0.31508	-0.11	0.9168	pp(t-2)
	AR2_1_2	-0.00001	0.00001	-0.40	0.7010	ip(t-2)
ip	CONST2	205506.62209	196063.53745	1.05	0.3192	1
	AR1_2_1	-2242.88382	6668.90788	-0.34	0.7436	pp(t-1)
	AR1_2_2	-0.04672	0.30924	-0.15	0.8829	ip(t-1)
	AR2_2_1	-2687.96362	6642.83743	-0.40	0.6943	pp(t-2)
	AR2_2_2	-0.18984	0.30816	-0.62	0.5516	ip(t-2)

A35. Price transmission between export price and import price (Sugarcane)

AR Coefficient Estimates			
Lag	Variable	xp	ip
1	xp	1.00809	-0.11030
	ip	-0.45014	-0.12715
2	xp	-0.93064	-0.09442
	ip	0.09781	-0.21980

Model Parameter Estimates						
Equation	Parameter	Estimate	Standard Error	t Value	Pr > |t|	Variable
xp	CONST1	135700.81555	77907.75425	1.74	0.1122	1
	AR1_1_1	1.00809	0.29505	3.42	0.0066	xp(t-1)
	AR1_1_2	-0.11030	0.24451	-0.45	0.6615	ip(t-1)
	AR2_1_1	-0.93064	0.44083	-2.11	0.0609	xp(t-2)
	AR2_1_2	-0.09442	0.24188	-0.39	0.7044	ip(t-2)
ip	CONST2	149138.89583	101011.60785	1.48	0.1706	1
	AR1_2_1	-0.45014	0.38255	-1.18	0.2666	xp(t-1)
	AR1_2_2	-0.12715	0.31702	-0.40	0.6968	ip(t-1)
	AR2_2_1	0.09781	0.57155	0.17	0.8675	xp(t-2)
	AR2_2_2	-0.21980	0.31361	-0.70	0.4994	ip(t-2)