Foreword

This publication - “Cashew Handbook 2008 - A Global Perspective” being brought out by Foretell Business Solutions Private Limited is a timely one and is bound to benefit all stakeholders of the cashew industry, namely, raw nut producers, processors, cashew kernel buyers, by-product users, suppliers of technology, logistics, quality systems firms, supplier of capital, Government agencies and retail consumers.

I note that the Handbook contains detailed information on all aspects of cashew production, processing, statistics on export, price trends, etc. which will provide a deep insight into the working of the cashew industry in India and outside. The book also has useful information on the world trade in other treenuts like almonds, pistachios, walnuts, macadamia nuts, etc. The publication contains a section carrying experts’ opinion on the future of the industry and ways and means to achieve greater heights.

A lot of planning and effort has obviously gone into making this publication an exhaustive reference book for any one interested in world cashew trade. I appreciate and congratulate the publishers for bringing out this excellent publication.

I wish the publication all success.

P. Bharathan Pillai
Chairman
The Cashew Export Promotion Council of India
Kochi 682016
Preface

Dear Readers,

There are best of times and there are worst of times. Perhaps we are in the midst of decadal best times when it comes to the cashew industry. This is the time for reflection, for investing into the future to grow and develop the cashew industry to the next level. ‘Cashew Handbook 2008- A Global Perspective’, a sequel to ‘Indian Cashew Handbook – 2002’, is an attempt to focus the attention of the industry on some of the core themes for future, taking into account current and historic trends in production, consumption and global trade.

Last six years have seen major breakthroughs in the cashew industry – formation of global alliance for cashew, spectacular growth of Vietnam cashew industry and lastly, emergence of new demand centres. In the coming years, we believe Global Alliance for Cashew could provide the necessary thrust in branding cashew as a ‘wholesome nutritious food’, while Vietnam’s progress would be emulated by aspirant producers of raw nuts. As rightly emphasized in the India Cashew Vision 2020 document, India’s strong demand for kernel would necessitate a business model based on local production of raw nuts, in an era of unaffordable energy prices and increasing logistics costs. Integration of environment and energy aspects into the cashew industry is another natural step forward for value enhancement.

We thank all the members of the Indian cashew community, especially, the Cashew Export Promotion Council of India (CEPCI) – its Chairman and other office bearers- for readily coming forward and encouraging us in bringing out this handbook. We would be failing in our duty if we do not acknowledge the contribution of experts on special topics.

This project, conceived two years ago, has been executed successfully by Ms. Meena, commodity analyst, with the support of members from research and marketing teams.

Lastly, we have put in our best efforts. We await your feedback and suggestions to take the research effort forward. Your participation and suggestions are valuable to us. Do write to us about the usefulness of this handbook in ‘understanding the present and shaping the future of the cashew industry’.

Best wishes,

G Srivatsava
July 08, 2008
Executive Summary

Cashew is an important tree nut traded worldwide. Long time ago, cashew was largely consumed by the rich and royal, but in recent days, increased health awareness has enticed people to consume more nuts. A production share of 32 per cent among all other tree nuts at global level has undoubtedly shown the importance and usage of cashew nuts. A comparison of nutrient contents of important nuts has shown that nutrient realization per Dollar is more in cashew nuts than in other nuts such as almond, brazil nut, hazelnut, macadamia nut, pistachio and walnut.

The global area under cashew was 3.38 million hectares with production of 2.13 million tons in 2006-07. The higher area under cashew cultivation has been witnessed in West Africa followed by India, Brazil and Vietnam. Cashew has witnessed a production growth of 8.9% per annum between 1996-97 and till date. In terms of output, India ranks first followed by West Africa and Vietnam. Though India and Vietnam are large producers of cashew nut, they import significant quantity of raw nut to meet their increased processing capacity. African countries process only 12-14% of their output and export the rest in raw form to India and Vietnam. On the Cashew nut shell liquid front, India has potential to produce 0.2 million tons of CNSL, but it produces only 0.05 million tons currently. Given the current scenario, opportunity to Indian cashew sector is plenty.

The cashew kernels exports from India and Vietnam have shown a growth of 3.6 and 28 per cent respectively per annum from 1999-2000 to till date. The major destinations for Indian cashew kernels are USA, the Netherlands, UAE, UK and Japan. For Vietnam kernels, USA, China, European countries, Russia and Japan are the major markets. On the consumption front, USA is the leading consumer of cashew kernels in the world.

Cashew kernels prices are climbing up and ruling at USD 3.55/lb (FOB price of Indian W-320) currently. This is higher than the past record level of USD 3.16/lb in 1999. Factors such as the lower production from the major cashew growing countries including Vietnam, Brazil and Indonesia and increased demand for cashew kernel have triggered the Bull Run. The comparison of W-320 cashew prices at Indian domestic and export market has shown that the prices are higher at the domestic market. This could be mainly attributed to preference for higher-grade kernels in the export market besides rising demand for the same within India. The firming up kernels price gives the indication of tight supply, which in turn has been reflected in the higher price levels of raw nut. The result of price forecast has indicated that the prices would move up or would be in the range bound at the higher level till the end of current year.
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<tr>
<td>°C</td>
<td>Degree Celsius</td>
</tr>
<tr>
<td>$</td>
<td>US Dollar</td>
</tr>
<tr>
<td>%</td>
<td>Per cent</td>
</tr>
<tr>
<td>ACA</td>
<td>African Cashew Alliance</td>
</tr>
<tr>
<td>AFI</td>
<td>Association of Food Industries</td>
</tr>
<tr>
<td>AP</td>
<td>Andhra Pradesh</td>
</tr>
<tr>
<td>ARIMA</td>
<td>Auto Regressive Integrated Moving Average</td>
</tr>
<tr>
<td>CAGR</td>
<td>Compound Annual Growth Rate</td>
</tr>
<tr>
<td>CBN</td>
<td>Central Bank of Nigeria</td>
</tr>
<tr>
<td>CEPCI</td>
<td>Cashew Export Promotion Council of India</td>
</tr>
<tr>
<td>CNSL</td>
<td>Cashew Nut Shell Liquid</td>
</tr>
<tr>
<td>DA</td>
<td>Dearness Allowance</td>
</tr>
<tr>
<td>DCCD</td>
<td>Directorate of Cashew and Cocoa Development</td>
</tr>
<tr>
<td>DEPB</td>
<td>Duty entitlement passbook</td>
</tr>
<tr>
<td>DGCI &amp; S</td>
<td>Director General of Commercial Intelligence and Statistics</td>
</tr>
<tr>
<td>DGFT</td>
<td>Director General of Foreign Trade</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FAO STAT</td>
<td>Food &amp; Agricultural Organization Statistics</td>
</tr>
<tr>
<td>Ha</td>
<td>Hectare</td>
</tr>
<tr>
<td>HYV</td>
<td>High Yielding varieties</td>
</tr>
<tr>
<td>i.e.,</td>
<td>That is</td>
</tr>
<tr>
<td>Kg</td>
<td>Kilo gram</td>
</tr>
<tr>
<td>KSCDC</td>
<td>Kerala State Cashew Development Corporation</td>
</tr>
<tr>
<td>lb</td>
<td>Pound</td>
</tr>
<tr>
<td>LWP</td>
<td>Large White Pieces</td>
</tr>
<tr>
<td>m²</td>
<td>Metre squared</td>
</tr>
<tr>
<td>MAI</td>
<td>Market Access Initiative</td>
</tr>
<tr>
<td>MARD</td>
<td>Ministry of Agriculture and Rural Development</td>
</tr>
<tr>
<td>MDA</td>
<td>Market Development Assistance</td>
</tr>
<tr>
<td>NEPC</td>
<td>Nigerian Export Promotion Council</td>
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<tr>
<td>NRCC</td>
<td>National Research Centre for Cashew</td>
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<tr>
<td>RCN</td>
<td>Raw Cashew Nut</td>
</tr>
<tr>
<td>Rs</td>
<td>Rupees</td>
</tr>
<tr>
<td>S</td>
<td>Splits</td>
</tr>
<tr>
<td>SB</td>
<td>Scorched Butts</td>
</tr>
<tr>
<td>SWOT</td>
<td>Strengths Weakness Opportunity &amp; Threat</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>SWP</td>
<td>Small White Pieces</td>
</tr>
<tr>
<td>UAE</td>
<td>United Arab Emirates</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
</tr>
<tr>
<td>USD</td>
<td>US Dollar</td>
</tr>
<tr>
<td>VINACAS</td>
<td>Vietnam Cashew Association</td>
</tr>
<tr>
<td>Vs</td>
<td>Versus</td>
</tr>
<tr>
<td>W-320</td>
<td>White Wholes</td>
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</table>
Introduction
Introduction to Global Cashew Industry

Cashew, botanically termed as *Anacardium occidentale*, belongs to the family Anacardiaceae. It is generally called as cashew in English but it has several other names around the world. In France it is called as ‘cajou’ and ‘acajou’ and in Spain as ‘maranon’, in India and Sri Lanka as ‘cadju’, in Portugal as ‘caju’, in Italy as ‘anacardio’, in Germany as ‘Acajuban’, in East Africa as ‘mkanju’ and in Indonesia as ‘jambu mente’ (Andrighetti et al, 1989).

The evergreen cashew tree tolerates a wide range of moisture levels and soil types but commercial production is advisable only in well-drained, sandy loam or red soils. The cashew tree is most frequently found in coastal areas, which is also evident from the Figure- 1.5 (global distribution of cashew). Although cashew can withstand high temperatures, a monthly mean temperature of 25°C is found to be optimal and yearly rainfall of 1000 mm is sufficient for production. The cashew tree is vigorous, fast growing under favourable conditions and it may reach a height of 40 to 50 feet. Though cashew tree is yielding many more useful products, cashew kernels are considered as the most important produce, which is consumed mostly as snack and as food ingredients. Besides edible nut, cashew tree also yield cashew fruit, which is used to manufacture jams, candy and alcoholic drink, popularly called as “fenny” in Goa (India) and cashew nut shell liquid (CNSL), which is an important industrial raw material for resin manufacture and the shells that can be burned to provide heat for the decorticating operation.

The average life span of a cashew tree is 25 years. But a tree which was planted during 1888 is seen on the beach at Pirangi do Norte, 24 kilometers from Natal; Brazil also has the world's largest cashew tree with a circumference of 500 meters, occupying an area of 7,300 m². The tree can yield about 80,000 nuts per year during cropping season.

Cashew tree
Cashew trees flourish in extreme heat in the tropics. The seedling trees flower in the third year after planting where blossoming takes place between November and January. Nuts germinate within four days when
lying on wet soil. The Figure- 1.1 depicts the stages of growth of cashew nut from flower to nut maturity.

**Figure- 1.1. Cashew nut development from flower to maturity**

The duration from pollination to nut maturity in cashew varies between 55 and 65 days, depending on the soil and climatic conditions, location and variety used. Grafts are the best planting materials and 156 to 200 grafts are required to plant a hectare of land under normal systems of planting. Under good management, from a hectare of well-managed adult cashew plantation, planted with high yielding varieties of cashew, three to four tons of raw nuts (750 to 1000 kg of kernels) can be obtained per annum.

**Origin**
Cashew nut, originated in Brazil and brought to the world by the Portuguese, is one of the most nutritious nuts with a compelling taste. It was introduced into India during 16th century. No doubt, it is grown in over 32 countries of the world and consumed by one and all around the globe. The world produces around 2.1 million tons per annum of cashew with an average yield of 700 pounds of raw cashew nut per acre (780 kg/hectare) of land.

**Cashew seasonality**
The availability of cashew nut has been witnessed all round the year as the cashew nut is harvested during different months at different origins.
It can be seen from the Figure- 1.2 that cashew availability is more during November to June and the availability is less during July to October. According to cashew price seasonality, the prices are at peak during July to October on account of less availability and the coincidence of major festivals in those months. The cashew nut arrivals of India, Vietnam, Ivory Coast, Nigeria and Ghana coincide with one another whereas the arrivals of Brazil, Indonesia and other African countries like Tanzania, Benin, Mozambique, Kenya coincide. Senegal and Guinea Bissau supply cashew nuts to the World during July and August.

**Figure- 1.2. Cashew arrival seasons from different countries**

It can also be seen from the Figure- 1.2 that the quantum of arrivals of nuts is more from India i.e., nearly 29% of cashew has been from India only. Cashew nut from Vietnam contributes 16% to the total raw cashew nut production followed by Brazil (14%) and so on.

<table>
<thead>
<tr>
<th>Country</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>% contribution to total RCN production</th>
</tr>
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<tbody>
<tr>
<td>India</td>
<td></td>
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<td>29.07</td>
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<td>Brazil</td>
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<td>14.06</td>
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<tr>
<td>Vietnam</td>
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<td>16.41</td>
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<td>Ivory Coast</td>
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<td>4.69</td>
</tr>
<tr>
<td>Guinea Bissau</td>
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<td>5.39</td>
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<td>Benin</td>
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<td>Nigeria</td>
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<td>3.52</td>
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<td>Mozambique</td>
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<td>3.05</td>
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<td>Senegal</td>
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<td></td>
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<td></td>
<td></td>
<td>0.70</td>
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<tr>
<td>Kenya</td>
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<td>0.23</td>
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<tr>
<td>Ghana</td>
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<td></td>
<td>0.70</td>
</tr>
</tbody>
</table>

**Production size of all tree nuts**

The consumption of tree nuts has assumed a greater role in today’s lifestyle since it reflects an individual’s standard of living and status in the society. The consumption pattern of tree nuts has grown enormously over the years. Among the important tree nuts, cashew nut occupies an important place in consumer’s platter. If we analyze the market size of
In total tree nut production, we can realize the importance and place of cashew nut in the dry nut consumption.

![Figure- 1.3. Production size of Tree nuts by quantity in tons (2006-07)](image)

Production size of all tree nuts in raw form (Cashew nut, almond, walnut, pistachio, hazel nut, macadamia nut, Brazil nut, pecans, and pine nuts) at global level accounts nearly 6.74 million tons currently as seen in the Figure- 1.3. Among all nuts, Cashew accounts for about 32% followed by almond (26.2 per cent), hazelnut (14.26 per cent), walnut (13.5 per cent), pistachio (8.55 per cent) and pecans (3.7 per cent). The other nuts like Brazil nut, macadamia nut and pine nut contribute meager share to the total tree nut production.

### Table-1.1. Growth in production of all tree nuts from 1995-96 to 2006-07

<table>
<thead>
<tr>
<th>Tree nuts</th>
<th>Production</th>
<th>CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cashew*</td>
<td>2133000</td>
<td>8.90</td>
</tr>
<tr>
<td>Almond</td>
<td>1766127</td>
<td>3.79</td>
</tr>
<tr>
<td>Hazelnut</td>
<td>960907</td>
<td>1.57</td>
</tr>
<tr>
<td>Walnut</td>
<td>910000</td>
<td>4.34</td>
</tr>
<tr>
<td>Pistachio</td>
<td>576000</td>
<td>2.76</td>
</tr>
<tr>
<td>Brazil nut</td>
<td>73960</td>
<td>4.04</td>
</tr>
<tr>
<td>Macadamia nut</td>
<td>19900</td>
<td>2.64</td>
</tr>
<tr>
<td>Pecans</td>
<td>250000</td>
<td>-</td>
</tr>
<tr>
<td>Pine nuts</td>
<td>50000</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: FAO STAT, Foreign Agricultural Service, USDA and other news sources

*Indicates production data taken from various news sources

The Compound Annual Growth Rate (CAGR) of all important tree nuts in the Table- 1.1 has shown that the Cashew nut production has grown at the rate of 8.9% annually from 1995-96 to 2006-07. The CAGR of
other tree nuts such as almond, walnut, hazelnut, pistachio, Brazil nut and macadamia nut witnessed the growth of 3.79 per cent, 4.34 per cent, 1.57 per cent, 2.76 per cent, 4.04% and 2.64% respectively. Overall, it can be concluded that the Cashew nut dominates in market size of tree nuts and also has huge growth potential compared with other tree nuts.

**Global Cashew production**

The global Cashew production during 2006-07 was nearly 2.1 million tons from an area of 3.37 million hectares. It can be seen from the Figure- 1.4 that India ranks first in output with 620,000 tons, which has contributed nearly 30% to world output followed by West Africa (18.33 per cent) and East Africa (11.49 per cent). Meanwhile, Vietnam and Brazil have contributed nearly 16.5% and 14% respectively. Indonesia had the share of about 5 per cent, while other countries have contributed the rest in the total output.

The Cashew nut has been introduced to India in 16th century in order to prevent soil erosion only. Later the kernels from this nut become a major source of income for most of the people in coastal tropical regions of India.

Though the African countries are producing Cashew nuts in large scale, they export more than 80% in raw form to India and other South-East Asian nations. This is due to lack of necessary infrastructure and modern technology in those countries.

![Figure 1.4: Per cent Contribution of major countries in total Cashew production 2006-07](source: FAO STAT & Various news sources)
Global Cashew cultivation distribution
Cashew nut is cultivated in almost all the continents across the globe. The cultivation has been distributed in many regions in India, Vietnam, Thailand, Indonesia, West and East African countries, and Brazil. Cashew nut is also cultivated in some parts of Sri Lanka, Australia, etc.

Figure- 1.5. Global Cashew distribution

Figure- 1.5 indicates the major Cashew producing countries in the world. It has been cultivated in the lower half of the globe i.e., nearer to the equatorial line. It is also to be noted that most of the Cashew producing countries are mainly concentrated in coastal areas.

Among the countries producing cashew, the Asian countries alone contribute about 65% of global production followed by African countries, with a share of 30% in the total production.

Cashew processing
The major Cashew nut processing countries at global level are India, Vietnam and Brazil. Each of these countries have distinct advantage in processing i.e., India able to process more of best quality cashew nuts right from the inception. Vietnam is expanding the processing capacity to meet its rising output (due to higher yield) besides to process the imported raw nut. Brazil is also practicing their mechanical method of processing, which compensate the labour unavailability in the country. Overall, the processing capacities of these major processing countries have been increasing year after year with respect to size and operational efficiency.
Cashew kernels consumption
USA has remained as the biggest consumer of cashew from long ago followed by India and other EU countries. The increasing health awareness among the people, higher per capita income and standard of living has kept the Cashew consumption at zenith. Other than these traditional countries, there are new entrants into Cashew consuming countries list. Overall, the CAGR of Cashew kernels consumption has stood at 11.6% between 1996 and 2005.

The leading consuming country USA had had the share of 40% of total global consumption in 2006. In India, the kernels consumption has increased by 8.75% annually from 1996 to 2006. The consumption is expected to increase with a rate of 7.88% per annum till 2012. The consumption of other major processing countries Vietnam and Brazil has also increased by 5.6 and 6.8% per annum respectively.

The direction of change in Cashew kernels supply from major countries has shown that India and Vietnam are the stable suppliers to USA over the period of 1996 to 2007.

Cashew is perhaps one of the few commodities that travel maximum distance between the time it is harvested and consumed. This has been the way the industry has evolved in the past. In recent times, Vietnam has demonstrated value enhancement through two important aspects to the Cashew industry. The one aspect is productivity improvement at the farm level and the other is corporate form of organization at the processing level with emphasis on consistency in quality and innovation in packaging.

The global commodity boom has shown positive sign on African economy, despite a weak political infrastructure. Perhaps, this is one of the best times to develop Cashew processing in Africa. High crude oil prices and its subsequent effects on logistic costs could be taken advantage of by the African processors to supply processed nuts to consuming markets.

Increasing energy prices have had an impact on the food crops. The world has started looking at sugarcane and corn for fuel. No more sugar industry is a single product industry. No more rice mills are only for extracting rice from paddy. These industries are striving to extract maximum value from by-products. Why should Cashew be different? Is it not the time to look
into energy dimensions hidden in Cashew- such as ethanol from Cashew apple, power from de-oiled shell waste and so on?

The present handbook is designed in such a way to address all the above issues both national and international context.

Reference

Raw Cashew Nut
CHAPTER 2.1.

Cashew Nut Area in the Major Growing Countries

Cashew nut is cultivated in more than 30 countries in about 3.38 million hectares with global production of 2.13 million tons. India is the leading producer (620,000 tons from 855,000 hectares), exporter of Cashew kernels (worth Rs. 25 billion) as well as importer of raw Cashew nuts (worth Rs.21 billion).

The Cashew acreage in the major producing countries is given in the Figure- 2.1.1. It can be inferred from the figure that the area under Cashew cultivation was much higher in African countries particularly in West African countries (28%) followed by India (25%). Brazil had a share of 21% in terms of area under crop but a lower productivity has kept the country in fourth position with respect to production. The Cashew acreage in Vietnam was only 10.7% of the total global area. The higher yield levels have reserved the third position to Vietnam in terms of output.

CAGR of Cashew acreage in the major processing countries
The area under Cashew cultivation in India has witnessed 4% growth (CAGR) during 1960’s and the similar growth was also witnessed during 1970’s as shown in the Table-2.1.1. The growth rate of area was lower i.e.,
1.83% during 1980’s whereas during 1990’s and 2000-2006 the area has registered a growth of 3.5% and 3.75% respectively.

Table- 2.1.1. CAGR of area in the major Cashew processing countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Period</th>
<th>CAGR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>1960’s</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1970’s</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1980’s</td>
<td>1.83</td>
</tr>
<tr>
<td></td>
<td>1990’s</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>2000-2006</td>
<td>3.75</td>
</tr>
<tr>
<td>Vietnam</td>
<td>1960’s</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>1970’s</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>1980’s</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>1990’s</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>2000-2006</td>
<td>12</td>
</tr>
<tr>
<td>Brazil</td>
<td>1990’s</td>
<td>-0.9</td>
</tr>
<tr>
<td></td>
<td>2000-2006</td>
<td>1.56</td>
</tr>
</tbody>
</table>

Cashew area in Vietnam has grown tremendously in 1960’s by 20% and during 1970’s the area has witnessed a growth of 8%. The area has again witnessed a robust annual growth of 39% during 1980’s. About 12% growth has witnessed during the period between 2000 and 2006.

Though Brazilian area has witnessed a negative annual growth of 0.9% during 1990’s, the increasing global demand for Cashew has influenced the acreage later. It has recorded a positive growth of 1.56% during the period between 2000 and 2006.

Area under Cashew cultivation in the major processing countries
The growing demand for Cashew kernels in USA and EU countries and also the emerging domestic demand from India have induced the major growing countries such as India, Vietnam, Brazil and African countries to increase their acreage under Cashew. The higher acreage has resulted in increased employment opportunities and higher earnings for the stakeholders in Cashew sector through foreign exchange. The expansion in Cashew area over the years is as shown in the Figure- 2.1.2.

The Cashew area from 1990 to 2006 in India has been increasing by 3.1% (CAGR). Vietnam has witnessed an annual growth of 6.2% whereas Brazil’s growth was only 0.42% during the above said periods.

**Cashew acreage forecast**

The forecast given in the Figure- 2.1.3 have indicated that the area under Cashew cultivation has an up trend for India, Vietnam and Brazil. According to the vision by Ministry of Agriculture and Rural Development (MARD) of Vietnam, the area under Cashew cultivation is likely to reach 450,000 hectares by 2010. The forecasted figures are also nearest to this vision at 457,266 hectares by 2010.
Important Cashew growing regions in the major processing countries

Table-2.1.2. Major Cashew growing regions

<table>
<thead>
<tr>
<th>Countries</th>
<th>Growing regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>Andhra Pradesh, Maharashtra, Karnataka, Kerala, Orissa, Tamil Nadu, Goa, West Bengal and some parts of North Eastern states.</td>
</tr>
<tr>
<td>Brazil</td>
<td>States of Ceará, Rio Grande do Norte, Piauí, Maranhão, Paraíba and Bahia. Cashew production is mainly concentrated in North East regions of Brazil.</td>
</tr>
<tr>
<td>Vietnam</td>
<td>Binh Phuoc, Bu Dang, Phuoc Long, Dong Phu, Daknong, Dak lak province and Dak Rlap. In Vietnam, Cashew nut planted areas are mostly in the south eastern parts.</td>
</tr>
</tbody>
</table>

Cashew acreage in India

Figure-2.1.4 depicts the area under Cashew cultivation in the major growing states of India. It is evident from the figure that the area was higher in Andhra Pradesh (171,000 ha) and Maharashtra (164,000 ha) followed by Orissa (125,000 ha), Tamil Nadu (123,000 ha), Karnataka (102,000 ha), Kerala (80,000 ha), Goa (55,000 ha) and other states like West Bengal, Gujarat and Assam.

Source: DCCD, Cochin, Kerala

In terms of area under Cashew cultivation, Kerala has shown a negative growth of 4.15% (CAGR) during the period 1990-2006 (Table-2.1.3). The
negative growth in Kerala was due to crop diversification from Cashew nut to rubber (the realization from rubber was found to be higher) and the recent shortage in labourers particularly for shelling activities in processing. Meanwhile, the ‘other countries’ such as Gujarat, Assam, etc., have registered a higher growth of 24% followed by Maharashtra (12.72%). Andhra Pradesh and Orissa has shown an annual growth of 5.96% and 5.33% respectively for the aforesaid period. Overall during 1990-2006, the area under Cashew in India has witnessed a growth of 3.13% annually.

Table- 2.1.3. CAGR of Cashew acreage in India (1990-2006)

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<td>Goa</td>
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</tr>
<tr>
<td>Maharashtra</td>
<td>12.72</td>
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<tr>
<td>Tamil Nadu</td>
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<tr>
<td>Andhra Pradesh</td>
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<tr>
<td>Orissa</td>
<td>5.33</td>
</tr>
<tr>
<td>West Bengal</td>
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</tr>
<tr>
<td>Others</td>
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<tr>
<td>Total</td>
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Annexure- 2.1.1. Forecasted area under Cashew till 2012 (in hectares)

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<th>Vietnam</th>
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</thead>
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Annexure- 2.1.2. Area under Cashew in the major countries (in hectares)

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<td>362500</td>
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</table>

Source: FAO Stat
### Annexure- 2.1.3. State wise Cashew nut acreage in India (in ‘000 ha)

<table>
<thead>
<tr>
<th>Year</th>
<th>Kerala</th>
<th>Karnataka</th>
<th>Goa</th>
<th>Maharashtra</th>
<th>TN</th>
<th>AP</th>
<th>Orissa</th>
<th>WB</th>
<th>Others</th>
<th>Total</th>
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<td>23</td>
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Source: Directorate of Cashew & Cocoa Development, Cochin, India
CHAPTER 2.2.

Trends in Cashew Nut Production

Global Cashew nut production

The Cashew nut production in 2006-07 is given in the Figure-2.2.1. It is obvious from the figure that India was the leading producer of Cashew nut (620,000 tons) followed by West African countries with 391,000 tons. The third largest producer, Vietnam has an output of 350,000 tons followed by Brazil and East African countries. Thus, the total global production was 2100,000 tons.

Figure- 2.2.1. Global cashew production in 2006-07

Cashew nut production in the major processing countries

The production of Cashew nut over the years from 1990 to 2006 has increased across the major producing countries. It is clear from the Figure-2.2.2 that the production of Cashew in India has been increasing from 1990 to 2006. It can also be inferred that till 2003 Brazil was the second
largest producer among the major processors, afterwards Vietnam has overridden the Brazilian production and attained position No.2 with an output of 350,000 tons. Brazilian output was only 236,140 tons for the same period.

**CAGR of Cashew production**

CAGR of Cashew production from 1960 to 2006 is shown in the Table-2.2.1. According to FAO data given in the table that India’s production has been growing with an annual growth rate of around 4% during the three decades started from 1960’s to 1980’s. During 1990-99 and 2000-06 the production has shown a growth of 5.5% and 5.3% respectively. According to DCCD, Cochin data, the Indian production has shown 6.4% growth in 1990-99 and 5.3% in 2000-06.

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*Source: FAO Stat*

According to FAO data, the higher growth in Vietnam output was recorded during the decade of 1960’s. The data from other news sources have showed that the production growth has peaked during 1960’s, 80’s and 2000-06. Brazilian output has taken a dip during 1990’s and then it recovered during 2000-06.

**Cashew Production Forecast**

Figure- 2.2.3. Forecasted cashew production till 2012

![Cashew Production Forecast Graph](image)
The predicted Cashew production of India and Vietnam in Figure-2.2.3 has shown an increasing trend for the next five years up to 2012, whereas Brazil has witnessed a declining trend for the next five years. According to the forecast, Indian output is likely to reach 688,830 tons by 2010 and Vietnam output will touch 566,630 tons by 2010. Meanwhile, by 2010 the Brazilian output is expected to reach 195,842 tons only.

**Indian Cashew production scenario**

The annual processing capacity of Indian Cashew industry is 1.2 million tons. However, the domestic production is only 50% of this processing capacity and it is insufficient to meet the raw nut requirement. India is depending upon African countries at the larger extent for utilizing the full capacity of its processing sector, which in turn provides employment opportunities particularly to rural women. Now, Vietnam has emerged, as one of the largest processor next to India. Hence, competition is rising in sourcing the raw nuts from other major producing countries like Africa. The need of the hour to Indian Cashew industries is to increase the production potential either by increasing productivity or by increasing the area under cultivation. This requires indigenous raw nut production to be enhanced to more than 2.1 million tons by 2020. Then only it can sustain and retain the acme position in the international trade in the long term.

**The growth rate of Cashew production in India**

The CAGR of Cashew nut production in India has shown a growth of 4.4% from 1990 to 2006. Though Indian Cashew nut production has been increasing over the years due to area expansion, their productivity is very less. The main reason behind this low yield was about 300,000 hectares of Cashew under senile plantation in India. The state wise Cashew output has showed that the annual growth of Cashew production from Maharashtra and Tamil Nadu was higher at 12% and 10% respectively. Almost all the states like Karnataka, Goa, Andhra Pradesh, Orissa, West Bengal has witnessed a positive growth from the year '90 - '06. The production growth was negative in Kerala - it has shown a negative growth of 5.14% annually from '90-'06.

**Table- 2.2.3. CAGR of state wise production in India (1990 to 2006)**

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It is evident from the Figure-2.2.4 that the contribution of Maharashtra to India’s Cashew production was higher at 197,000 tons with a share of 32% followed by Andhra Pradesh (99,000 tons) and Orissa (84,000 tons). The share of Kerala, Tamil Nadu and Karnataka was 12%, 10% and 8.4% respectively in 2006-07.

Cashew nut productivity

The global average productivity of Cashew was 780 kg/ha. According to FAO data, the productivity of Cashew in Vietnam has been increasing over the years. The annual productivity growth of Vietnam during 2000-
06 was 13%. The average productivity was about 2500 kg/ha. The Indian productivity (665 kg/ha) has shown a negative growth during the same period i.e., 0.77%, whereas Brazilian productivity was much lower at 330 kg/ha. However the productivity of Brazil has increased by 6.3% during 2000-06.

According to the Directorate of Cashew and Cocoa Development (DCCD) of India, the annual Indian Cashew productivity has increased by 1.17% from 1993-94 to 2006-07. The current productivity of India is well above the world average at 820 kg/ha, but very less when compared to Vietnam.

### Annexure- 2.2.1. Forecasted output of Cashew nut in tons

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Annexure- 2.2.2. Cashew nut production in tons

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Source: FAO & various news sources
Annexure- 2.2.3. Cashew nut production from FAO data

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Source: FAO stat
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<td>677.97</td>
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<td>666.67</td>
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<td>1986</td>
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<td>642.86</td>
<td>1469.88</td>
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<td>2002</td>
<td>247.42</td>
<td>626.67</td>
<td>2144.88</td>
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<td>268.27</td>
<td>649.35</td>
<td>3570.03</td>
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<td>271.81</td>
<td>685.9</td>
<td>2767.15</td>
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<td>218.1</td>
<td>663.42</td>
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<td>2006</td>
<td>338.19</td>
<td>670.18</td>
<td>2597.52</td>
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</table>

Source: FAO stat
CHAPTER 2.3.

**Raw Cashew Nut Supply by Major Exporters**

The major countries, which export Raw Cashew Nut (RCN) to India and Vietnam, were Ivory Coast, Guinea Bissau, Indonesia, Tanzania, Benin, Ghana, Mozambique, Nigeria and Senegal. The RCN exports by major countries are given in the Figure-2.3.1. It is clear from the figure that the exports from these countries have grown at the rate of 17% annually from 1971 to 2005.

![Figure- 2.3.1. Raw Cashew nut supply from major growing countries](source: FAO Stat)

**CAGR of global imports**

Among the major RCN supplying countries to the world market, Guinea-Bissau’s growth was tremendous with about 76% CAGR over the period of 1996 to 2005 (Table- 2.3.1). Ghana has also witnessed a higher growth of nearly 60%. Besides, African countries, Indonesia has shown an annual growth of 14.5% in raw nut supply to the global market.

<table>
<thead>
<tr>
<th>Countries</th>
<th>CAGR (%)</th>
<th>Quantity in tons (2005)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ivory Coast</td>
<td>29</td>
<td>140010</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>76</td>
<td>93490</td>
</tr>
<tr>
<td>Indonesia</td>
<td>14.5</td>
<td>65960</td>
</tr>
<tr>
<td>Benin</td>
<td>14.8</td>
<td>42870</td>
</tr>
<tr>
<td>Mozambique</td>
<td>39.6</td>
<td>33490</td>
</tr>
</tbody>
</table>

**Table- 2.3.1. CAGR of important countries exporting RCN**

- **CAGR (%)**
- **Quantity in tons (2005)**
Though most of the countries have showed a positive growth in RCN supply during the period, Tanzania and Senegal have recorded a declining trend over the years.

**RCN imports into India**

The quantity of RCN imports into India has been increasing from 1996-07 to 2007-08 as illustrated in Figure-2.3.2. The quantity of RCN imports into India during 1996-97 was 212,866 tons and it has increased to 605,970 tons in 2007-08. The import of RCN in value term has also recorded significant growth during the period from 1996-97 to 2005-06. Due to Rupee appreciation against US dollar, the value of RCN imports has declined during 2006-07 and 2007-08.

**Table-2.3.2. RCN imports into India (quantity, value and unit value)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity (in tons)</th>
<th>Value (in million Rs)</th>
<th>PUV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996-97</td>
<td>212866</td>
<td>6876</td>
<td>32.30</td>
</tr>
<tr>
<td>1997-98</td>
<td>247182</td>
<td>7696</td>
<td>31.13</td>
</tr>
<tr>
<td>1998-99</td>
<td>241561</td>
<td>9580</td>
<td>39.66</td>
</tr>
<tr>
<td>1999-00</td>
<td>253577</td>
<td>11862</td>
<td>46.78</td>
</tr>
</tbody>
</table>
The CAGR of RCN import quantity as shown in Table-2.3.2 has indicated that the import has grown 11.54% annually, whereas the growth in terms of value was 10.33%. Per unit value of RCN has been fluctuating over the years from 1996-97 to 2007-08. The price of RCN in 2007-08 was much lower against its previous levels due to the strengthening of Indian Rupee against US dollar.

**RCN imports into India from major countries**

The top four major African countries, which export RCN into India are Ivory Coast, Guinea Bissau, Tanzania and Benin. Imports of RCN by India on the basis of country of origin are given in the Figure-2.3.3. According to the figure, imports from the above said countries have fluctuated much. Ivory Coast, Guinea Bissau, Tanzania and Benin accounted for 78 to 82% of total RCN imports by India. Among these countries, most of the countries are West African countries except Tanzania.
The Figure- 2.3.4 indicates the RCN imports into India during 1996-97 to 2007-08 from the other African countries. The countries such as Ghana, Mozambique, Senegal, Nigeria and Kenya have contributed to the extent of 18 to 22% to imports.

**Projected RCN imports from African countries**

The projected figures of RCN exports from important African countries have shown in the figure- 2.3.5. This has given a signal that the exports from the major exporter Ivory Coast would continue to increase till 2010. Meanwhile, the exports from other countries would witness growth.

**African countries share in India’s RCN import**

The share of African countries in Indian import over the years is given in the Figure- 2.3.6. It can be inferred from the figure that during 1996-97 to 1999-2000 the share of East African countries (Tanzania, Nigeria,
Mozambique and Kenya) in Indian import have increased constantly. But the share of West African countries such as Ivory Coast, Guinea Bissau, Benin, Senegal, Burkina, Togo, Ghana and Mali has increased by two to three-fold during this period. The CAGR of East African countries export from 1996-97 to 2007-08 was only 2%, whereas the West African countries have shown a remarkable growth of 24%.

**Change in direction of RCN import into India**

It can be seen from the Table- 2.3.3 that the countries like Ivory Coast, Guinea-Bissau, Benin and Indonesia were stable suppliers of RCN to India during the period of 1996-97 to 2007-08. Though Mozambique, Kenya was also the major suppliers of RCN to India, they were unstable suppliers because of their less probability retention.

**Table- 2.3.3. Transition probability matrix for RCN imports into India**

<table>
<thead>
<tr>
<th>Countries</th>
<th>Ivory Coast</th>
<th>Guinea - Bissau</th>
<th>Indonesia</th>
<th>Benin</th>
<th>Mozambique</th>
<th>Nigeria</th>
<th>Kenya</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ivory Coast</td>
<td>0.26</td>
<td>0.27</td>
<td>0.10</td>
<td>0.00</td>
<td>0.25</td>
<td>0.12</td>
<td>0.00</td>
</tr>
<tr>
<td>Guinea - Bissau</td>
<td>0.45</td>
<td>0.15</td>
<td>0.29</td>
<td>0.00</td>
<td>0.03</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.81</td>
<td>0.00</td>
<td>0.17</td>
<td>0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Benin</td>
<td>0.00</td>
<td>0.00</td>
<td>0.32</td>
<td>0.68</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Mozambique</td>
<td>0.00</td>
<td>0.80</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.11</td>
<td>0.09</td>
</tr>
<tr>
<td>Nigeria</td>
<td>0.00</td>
<td>0.20</td>
<td>0.16</td>
<td>0.63</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Kenya</td>
<td>0.24</td>
<td>0.75</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
<td>0.00</td>
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</tr>
<tr>
<td>Vietnam</td>
<td>0.80</td>
<td>0.00</td>
<td>0.00</td>
<td>0.20</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

It is evident from the table that Benin has higher retention probability of 0.68 which indicates that it can retain 68% of its India’s import share by
gaining 63% of Nigeria share and 20% of Vietnam share. At the same time, it has lost the remaining 32% of its share to Indonesia.

The next stable exporter of RCN to India was Ivory Coast, which can retain 26% of its own share in India’s RCN import and lost 27%, 25%, 12% and 10% of its share to Guinea-Bissau, Mozambique, Nigeria and Indonesia respectively. However, it has gained 81%, 80%, 45% and 24% of Indonesia’s, Vietnam, Guinea-Bissau and Kenya’s share over the period of 1996-97 to 2006-07. Overall, the net gain for Ivory Coast from Indonesia and Guinea –Bissau was 71% and 18% respectively. The other stable markets for India’s RCN import were Indonesia (with retention capacity of 17%) and Guinea-Bissau (with the retention capacity of 15%). Guinea-Bissau has gained 80%, 75% and 27% share from Mozambique, Kenya and Ivory Coast, while lost 45% to Ivory Coast and 29% to Indonesia. Hence, overall it lost 18% to Ivory Coast.

**RCN import by India during 2007-08**
The RCN imports by India during 2007-08 have given in the Figure- 2.3.7.

![Pie chart showing RCN import into India in 2007-08](image)

It is evident from the figure that the RCN imports from Ivory Coast (205,405 tons with 34% contribution to India’s total import) was higher in 2007-08 followed by Guinea-Bissau (16%) with the import quantity of 98,056 tons. The other major countries from where India has been importing RCN were Tanzania (79,109 tons with 13% share), Benin (57,982 tons with 10% share) and Indonesia with 7% share (40,659 tons).

**India’s RCN Import forecast**
RCN import by India has been forecasted till 2012. This has given an indication that imports will touch around 785,756 tons by 2012.
Cashew Handbook 2008 - A Global Perspective

Table- 2.3.4. Forecasted RCN imports by India

Year
1996
1997
1998
1999
2000
2001
2002
2003
2004

RCN import
212866
247182
241561
253577
248728
348625
386547
452898
578884

Year
2005
2006
2007
2008
2009
2010
2011
2012

RCN import
565400
586044
605970
642617
678335
714148
749952
785756

If the RCN supplies at the global level increase, the major processing countries
India and Vietnam will be able to meet their increased processing capacity.
Annexure- 2.3.1. RCN supply by major Cashew growing countries (in tons)
Year Benin
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005

780
0
860
770
0
1250
0
0
0
0
0
0
0
0
20
0
750
0
0
270
1170
3080
3530
8480
9480
8730
11200
19180
14160
29220
36370
33460
43120
39330
36560
42870

Ivory
Coast
0
0
0
0
0
0
0
40
110
120
30
540
720
1540
1450
3100
5450
4290
1850
8490
4330
8090
8790
3090
11610
24670
7020
36930
26460
74550
63380
87570
104770
84810
114650
140010

Ghana
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
570
310
0
880
1350
3960
3630
170
4960
31990
30700
31260

GuineaIndonesia Mozambique
Bissau
1190
0
66250
660
0
53380
950
0
67530
0
0
33200
1270
0
72900
0
0
65590
970
0
13820
1150
20
0
0
60
0
400
90
0
930
370
0
2350
780
0
1500
1630
0
2000
1810
0
8000
2210
0
6620
3800
0
5930
7590
0
10470
7000
0
10500
8390
0
9410
1210
0
8400
3220
20
16920
14600
0
5500
19290
13970
30
18160
60
28420
38620
7370
30990
28100
20110
0
27210
1820
650
15360
2630
1370
28600
4600
30730
31640
24030
56930
25620
21080
16890
39550
5450
63110
50390
38450
71690
57090
32660
80850
56490
39730
93490
65960
33490

Nigeria Senegal Tanzania Others
1000
0
1000
0
1000
0
1000
0
1000
0
1000
0
1000
0
1000
0
1000
0
1000
0
1000
0
1000
0
1000
0
1000
0
1000
0
230
0
2290
0
4350
0
9750
600
9480 1090
13980
0
5700 2290
13630 1060
2420 2120
16110 1150
22010 1310
2510
0
860 2110
650 6980
15970 14910
13810
10
4930 3160
19060 4500
22010
290
18790
910
17280 1360

Source: FAO Stat

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87020 25110
115860 11880
127430 16460
113630 10670
134190 21810
117000 15530
67540 13950
74760 1850
44200 4280
39590 5040
9060 18540
25150 14830
15220 19430
10510 11630
33500 18030
26180 15120
60860 23170
30680 26860
26710 33100
4260 35710
10760 104950
21050 114340
27730 91230
20 33420
46190 63190
75280 32980
33590 12410
81550 17070
99890 17730
161540 13230
98610 22290
96490 27510
75340 30100
71450 37150
82300 29240
32390 28410

Total
181350
182780
214230
159270
231170
200370
97280
78820
49650
46240
29930
44650
39500
28490
64210
55050
106040
83650
90900
69920
146830
186070
184730
67800
222710
244490
95760
177220
201790
399780
341730
315180
433800
448470
490220
486520

47 of 260
~~~


Annexure- 2.3.2. Forecasted supply of RCN from major producing countries

<table>
<thead>
<tr>
<th>Year</th>
<th>Benin</th>
<th>Ivory Coast</th>
<th>Ghana</th>
<th>Indonesia</th>
<th>Mozambique</th>
<th>Nigeria</th>
<th>Senegal</th>
<th>Tanzania</th>
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### Annexure- 2.3.3. Import of RCN into India (Quantity in tons)

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Source: DGFT & Various custom houses

### Annexure- 2.3.4. Import of RCN into India (Value in Million Rs.)

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Source: DGFT & Various custom houses
Cashew Scenario in India

India is the leading producer of both raw Cashew nut and kernels at global level. Besides these, it is also a major importer of raw Cashew nut for processing and second largest consumers of Cashew kernels after USA. It contributes nearly 30% of the global Cashew production of 2100,000 tons. The Cashew season in India starts from March to June. The total area under Cashew cultivation in 2006-07 was 850,000 hectares with the production of 620,000 tons and average productivity of 820 kg/ha. The CAGR of area and production in India was 3.1% and 4.4% for the past 14 years period from 1993-94 to 2006-07.

Cashew nut acreage is highly concentrated in East coast regions (Tamil Nadu, Andhra Pradesh, Orissa, and West Bengal) i.e., about 50% of area under Cashew than West coast regions (Kerala, Karnataka, Goa, and Maharashtra) contribute 47% of acreage. With respect to output, the West coast regions contributes nearly 56% of the total production compared with merely 41% from the East coast region. The reasons for this gap between area and production were more acreage under senile plantations in East Coast regions and availability of high yielding varieties in Goa and Maharashtra.

Apart from the traditional Cashew-growing states, Cashew is also being grown to a certain extent in states like Gujarat and Assam. Among all these states, Andhra Pradesh and Maharashtra have major share of the total area under Cashew cultivation.

India exports around 100 to 125 thousand tons of Cashew kernels per annum. The major buyers of Indian kernels are United States, Netherlands, UAE, UK and Japan. The Cashew trade in India is mostly concentrated in places like Kollam (Kerala), Mangalore (Karnataka), Jeypore (Orissa), Vetapalam and Phalasa (Andhra Pradesh) and Mumbai (Maharashtra).

Though India is the leading producer of Cashew kernels, the opportunity in utilizing the by-products is not been fully exploited. There is lot of scope for Cashew Nut Shell Liquid (CNSL), Cashew husk and Cashew apple.
India’s share in Cashew production and imports

Figure- 2.4.1 indicates that the RCN imports into India have been increasing over the years from 1990-91 to till date along with the domestic production. It is interesting to note that the domestic production and imports have witnessed higher growth after 2000. The growth in imports and its contribution the total supply in the country are significant currently. More or less, imports have equal share with domestic production since 2004-05. The higher processing capacity and more demand from domestic and other consuming countries have prompted to source more RCN and kept the total availability at higher levels.

When we look at the share of domestic production to total availability since 1990-91 to till date, it was mostly in the range of 65-77% during 1990’s. After 2000, it has declined and reached the level of 48%. On the other hand, import’s share in the total availability has been increased from 22% in 1990-91 to about 50% currently.

Although close to half of the world Cashew nuts has been processed in India, increasing imports and declining domestic production of RCN in total availability is becoming a threat to Indian Cashew industry. The best ways to get rid of these problems are rejuvenation and re-plantation of Cashew trees to increase the productivity.

In the current budget (2008), Indian government has allotted Rs.11 billion package for the revival of crops like Cashew, coconut, and pepper. It is expected that this would help Cashew growers in a much better way to replant their crops with new high yielding varieties.
Domestic Cashew consumption vs. production in India

In India, the Cashew nut production has shown a growth rate of 4.8% annually from 1990-91 to 2006-07. Likewise, the consumption of Cashew has also showed an annual growth rate of 4.7%.

Figure-2.4.2 shows that the Cashew production in 1990-91 was fully consumed by domestic consumers. But the production has outstripped consumption in the year 1991-92. After 2000-01 the share of domestic consumption to total production has declined. The reason might be increased area under cultivation during these periods. Moreover, the demand for Indian Cashew in the global market pushed up the exports.

Though India is the leader in Cashew production and exports, in the year 2006-07 the country has lost its first position in exports to Vietnam. The later has increased its processing capacity and turned itself as competitor to India. At the same time, rising domestic consumption has also restricted the expansion of overseas markets. The increase in Cashew consumption in domestic as well as in international markets provides good opportunity for stakeholders in Cashew sectors.

RCN imports taking large share in kernels exports

The kernel to RCN conversion ratio is 4 i.e., the average out-turn of
kernels from raw Cashew nuts is 25%. If we convert the kernel exports equivalent to raw Cashew nut, then the trend has showed that over the years (from 1990 to till date) the kernel exports have been increasing along with raw Cashew nut imports.

Annexure- 2.4.1. Total production of Cashew nut in India during 2006-07

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Source: DCCD, Cochin, India

Annexure- 2.4.2. RCN imports in to India vs domestic production

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<th>% Import to total</th>
<th>% Domestic production to total</th>
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Source: DCCD, Cochin, India
### Annexure- 2.4.3. Domestic consumption share in domestic production

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### Annexure- 2.4.4. Import of RCN into India - kernel to RCN conversion ratio 4

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<th>% share of import to total exports</th>
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### Annexure- 2.4.5. State wise Cashew nut production in India (in ‘000 tons)
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<th>Tamil Nadu</th>
<th>Andhra Pradesh</th>
<th>Orissa</th>
<th>West Bengal</th>
<th>Others</th>
<th>Total</th>
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Source: DCCD, Cochin, India

Annexure- 2.4.6. State wise Cashew nut Productivity in India (in kg/ha)

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<th>Tamil Nadu</th>
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<td>720</td>
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<td>850</td>
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<td>1300</td>
<td>640</td>
<td>880</td>
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<td>2006-07</td>
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<td>690</td>
<td>1500</td>
<td>670</td>
<td>890</td>
<td>860</td>
<td>1000</td>
<td>700</td>
<td>820</td>
</tr>
</tbody>
</table>

Source: DCCD, Cochin, India
African Cashew Industry

African countries contribute nearly 30% to the global Cashew production. The production of raw Cashew nuts in Africa during 2006-07 was 636,000 tons and about 85% of the raw nuts produced has been exported. The major Cashew producing countries in the African continent are Ivory Coast, Guinea-Bissau and Tanzania. They are ranked 4th, 5th and 6th respectively in the group of major Cashew producers in the global market after India, Vietnam and Brazil.

In Africa, Cashew has been produced in two seasons. In East Africa, Cashew has been harvested during September to January and coincides with the harvesting season of Brazil. Meanwhile in West Africa, Cashew has been harvested during January to June and coincides with the harvesting period of India and Vietnam. The important East African countries, which are producing Cashew nuts are Tanzania, Nigeria, Mozambique and Kenya. Likewise the important West African countries, which are producing Cashew nuts, are Ivory Coast, Guinea Bissau, Benin, Senegal, Burkina, Togo, Ghana, Mali and Guinea-C. In African countries, more than 2.6 million people have involved in Cashew production with an average holding of 1 to 3 hectare. Here, yield of Cashew per tree is only 2-4 kg.

Table- 2.5.1. Cashew production in different African countries during 2006-07

<table>
<thead>
<tr>
<th>Countries</th>
<th>Production in tons</th>
<th>% to total Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ivory Coast</td>
<td>200,000</td>
<td>31.45</td>
</tr>
<tr>
<td>Guinea Bissau</td>
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<td>15.72</td>
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</tr>
<tr>
<td>Nigeria</td>
<td>75,000</td>
<td>11.79</td>
</tr>
<tr>
<td>Mozambique</td>
<td>65,000</td>
<td>10.22</td>
</tr>
<tr>
<td>Benin</td>
<td>45,000</td>
<td>7.08</td>
</tr>
<tr>
<td>Senegal</td>
<td>15,000</td>
<td>2.36</td>
</tr>
<tr>
<td>Ghana</td>
<td>15,000</td>
<td>2.36</td>
</tr>
<tr>
<td>Togo</td>
<td>5,000</td>
<td>0.79</td>
</tr>
<tr>
<td>Kenya</td>
<td>5,000</td>
<td>0.79</td>
</tr>
<tr>
<td>Burkina</td>
<td>5,000</td>
<td>0.79</td>
</tr>
<tr>
<td>Mali</td>
<td>3,000</td>
<td>0.47</td>
</tr>
<tr>
<td>Guinea-C</td>
<td>3,000</td>
<td>0.47</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>636,000</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>
It is clear from the Table-2.5.1 that among the Cashew producing countries in Africa, Ivory Coast is the major producer (200,000 tons), which is contributing 31% to total African production followed by Guinea Bissau and Tanzania (15.72% each), Nigeria (11.79%), Mozambique (10.22%), Benin (7.08%), Senegal and Ghana (2.36% each). The other countries contribution is very meager to the total output.

African Cashew scenario

The area under Cashew in African countries was shown in Figure- 2.5.1. The Cashew nut area in Mozambique, Tanzania have remained almost steady from 1990 to till date, whereas the area under Cashew in the other countries like Nigeria, Guinea Bissau, Benin, and Ivory Coast has been increased over the years. If we look into the production pattern in Figure-2.5.2, the output has been increasing in Guinea Bissau and Ivory Coast, while in other countries it has shown a mixed pattern from 1990 to till date.

Cashew nut processing in African countries
Nigeria is the largest processor in East African countries followed by Mozambique. Nigeria process nearly 33% of their Cashew production domestically and the remaining has been sent to India and Vietnam for processing. Meanwhile, Mozambique process 35 to 40% of their produce and the remaining has been sent for processing to other countries. Tanzania
also process about 10-15% of raw Cashews domestically and Kenya process higher share of raw Cashews among the East African countries.

It is interesting to note that though West African countries are producing nearly 400,000 tons of raw Cashews against 250,000 tons in East African countries, the processing activities were much limited in West African countries compared to East African countries.

It is evident from the Table- 2.5.2 that the West African countries process only 4-5% of their produce except Burkina Faso, which process about 20% of its production.

Table- 2.5.2 Countries processing capacity with respect to total production (In tons)

<table>
<thead>
<tr>
<th>Countries</th>
<th>Production</th>
<th>Domestic processing</th>
</tr>
</thead>
<tbody>
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<td>Ivory Coast</td>
<td>200000</td>
<td>10000</td>
</tr>
<tr>
<td>Guinea Bissau</td>
<td>100000</td>
<td>5000</td>
</tr>
<tr>
<td>Tanzania</td>
<td>100000</td>
<td>10000 – 15000</td>
</tr>
<tr>
<td>Nigeria</td>
<td>75000</td>
<td>24400</td>
</tr>
<tr>
<td>Mozambique</td>
<td>65000</td>
<td>22750 – 26000</td>
</tr>
<tr>
<td>Benin</td>
<td>45000</td>
<td>1800</td>
</tr>
<tr>
<td>Senegal</td>
<td>15000</td>
<td>0</td>
</tr>
<tr>
<td>Togo</td>
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<td>0</td>
</tr>
<tr>
<td>Ghana</td>
<td>15000</td>
<td>750</td>
</tr>
<tr>
<td>Kenya</td>
<td>5000</td>
<td>3000</td>
</tr>
<tr>
<td>Burkina</td>
<td>5000</td>
<td>1000</td>
</tr>
<tr>
<td>Mali</td>
<td>3000</td>
<td>0</td>
</tr>
<tr>
<td>Guinea-C</td>
<td>3000</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>636,000</td>
<td>78700 – 86950</td>
</tr>
</tbody>
</table>

Overall, the African countries are processing 12-14% of their domestic production and exporting much of their Cashew in raw form to the major processing countries like India, Vietnam and Brazil.

Among the raw nuts producers in West Africa, Guinea Bissau Cashews are considered as superior ones followed by Beninese produce. Since Mozambique process 35 – 40% of its produce domestically, it exports Cashew kernels to The Netherlands, South Africa and Italy. In East African countries, Kenyans are earning more income due to their higher processing capacity of 60%.
The Major Cashew producing regions in Africa

<table>
<thead>
<tr>
<th>Country</th>
<th>Growing Regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cote D’Ivoire</td>
<td>Abidjan, Napicoledougou, Natio-Kobadara</td>
</tr>
<tr>
<td>Guinea Bissau</td>
<td>Bissau</td>
</tr>
<tr>
<td>Tanzania</td>
<td>Mtwara, Lindi, Coast, Ruvuma, Tanga</td>
</tr>
<tr>
<td>Nigerian</td>
<td>East - Enugu, Abia, Imo, Anambra, Ebonyi and cross-river states</td>
</tr>
<tr>
<td></td>
<td>West – Oyo, Osun, Ondo, Ekiti, and Ogun states</td>
</tr>
<tr>
<td></td>
<td>Middle belt – Kwara, Kogi, Nassarawa, Benue, Taraba, Niger and FCT</td>
</tr>
<tr>
<td>Mozambique</td>
<td>Nampula, Zambesia, Sofala and Cabo Delgado</td>
</tr>
<tr>
<td>Benin</td>
<td>Zou – Nord, Borgou, Donga, Atacara, Collines, Couffo and Plateau</td>
</tr>
<tr>
<td>Senegal</td>
<td>Casamance region, Dakar</td>
</tr>
<tr>
<td>Ghana</td>
<td>Brong Ahafo, Jaman, Wenchi, Atebubu, Kintampo</td>
</tr>
<tr>
<td>Kenya</td>
<td>Kwale, Kilifi, Malindi and Lamu districts</td>
</tr>
</tbody>
</table>

**SWOT analysis**

**Strengths**
- Africans countries are the major producers and main suppliers of raw Cashew nut to the World markets.
- There is huge potential for more Cashew cultivation because of land and labour availability.
- African Cashew Alliance is a major supportive factor for African Cashew industry. It is a private-public partnership that aims at promoting the African Cashew sector from production to consumption.

**Weakness**

The major weaknesses in African Cashew cultivation are:
- Lack of well performing planting materials
- Cashew plants attacked by parasites and poor management
- Lower margin earned by the Cashew growers in African countries because they are selling the produce mostly in raw form.

The major weaknesses to most of the African countries with respect to processing are:
- Cashew processing equipments are not manufactures locally so they have to depend on other countries, which incurs much cost for transport.
• Lack of finance for purchasing Cashew processing machineries
• Lack of market access for kernels
• There is no national export brand and no credible quality certification, which makes the country's kernels lack recognition in the international market.

Opportunity
• Techno Serve has assessed there is possibility of new processing plants emergence in many African countries in future.
• African Cashew Alliance (ACA) and West African Trade Hub (WATH) acts as a facilitator for African Cashew trade. The ACA enables Cashew stakeholders to exploit the sector’s potential for economic growth and employment. Its members include representatives along the complete value chain.
• According to TechnoServe, the Cashew processing in Africa could generate annual revenues as high as $500 million by 2015, of which 40% would go to wages for manual labour and the remaining $300 million would be with them as net profit.
• Recently Nigerian Export Promotion Council (NEPC) and Central Bank of Nigeria (CBN) have formed strategic partnership with six other bodies to actualize a Cashew export promotion scheme. The group is expected to evolve strategies for addressing production, processing and marketing problems in the Cashew business.

Threat
• Declining output in proportion to total global output. i.e., besides the increase in world Cashew production, Africa’s share has decreased over the years.
• Bush fires in Cashew plantations leads to cut down in Cashew production.
• The lack of processing in African countries leads them to depend more on other countries and thereby these countries forgoing the benefits of Cashew kernels production and exports.
### Annexure- 2.5.1. Cashew area in important African countries (in ha)

<table>
<thead>
<tr>
<th>Year</th>
<th>Mozambique</th>
<th>Benin</th>
<th>Cote d’Ivoire</th>
<th>Guinea Bissau</th>
<th>Nigeria</th>
<th>Tanzania</th>
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<tbody>
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<td>1990-91</td>
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<td>20000</td>
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<td>75000</td>
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<tr>
<td>1992-93</td>
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<td>40000</td>
<td>45000</td>
<td>80000</td>
<td>90000</td>
<td>55000</td>
</tr>
<tr>
<td>1993-94</td>
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<td>55000</td>
<td>70000</td>
<td>75000</td>
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</tbody>
</table>

Source: FAO Stat

### Annexure- 2.5.2. Cashew production in important African countries (in tons)

<table>
<thead>
<tr>
<th>Year</th>
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<th>Benin</th>
<th>Cote d’Ivoire</th>
<th>Guinea Bissau</th>
<th>Nigeria</th>
<th>Tanzania</th>
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</tbody>
</table>

Source: FAO Stat & Various News source
CHAPTER 2.6

Cashew Supply and Demand Scenario in the Major Countries

India

The increased processing capacity in India is favouring higher production and RCN imports from other countries, as it is evident from the Table- 2.6.1. According to DCCD, Cochin the total processing capacity of India was 1.3 million tons and the total availability of RCN for processing was 1.24 million tons in 2007.

Table- 2.6.1. Supply and demand scenario for India

<table>
<thead>
<tr>
<th>Year</th>
<th>RCN Prod.</th>
<th>Import</th>
<th>Total Supply</th>
<th>Total kernel production</th>
<th>Kernel export</th>
<th>Domestic kernel consumption</th>
<th>Total demand (RCN equivalent of kernels)</th>
</tr>
</thead>
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<td>212866</td>
<td>630696</td>
<td>157674</td>
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<td>89011</td>
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<td>2006</td>
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<td>301511</td>
<td>118540</td>
<td>182971</td>
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<td>2007</td>
<td>637746</td>
<td>605970</td>
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<td>310929</td>
<td>114340*</td>
<td>196589</td>
<td>1243716</td>
</tr>
<tr>
<td>2008</td>
<td>655117</td>
<td>642617</td>
<td>1297734</td>
<td>324434</td>
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<td>207361</td>
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<td>2009</td>
<td>672137</td>
<td>678335</td>
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<td>337618</td>
<td>118671</td>
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<td>1350472</td>
</tr>
<tr>
<td>2010</td>
<td>688833</td>
<td>714148</td>
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<td>350745</td>
<td>120288</td>
<td>230457</td>
<td>1402981</td>
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<tr>
<td>2011</td>
<td>705227</td>
<td>749952</td>
<td>1455179</td>
<td>363795</td>
<td>121004</td>
<td>241891</td>
<td>1455179</td>
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<tr>
<td>2012</td>
<td>721340</td>
<td>785756</td>
<td>1507096</td>
<td>376774</td>
<td>123521</td>
<td>253253</td>
<td>1507096</td>
</tr>
</tbody>
</table>

Note:
1. Total kernel production and domestic kernel consumption figures are estimated based on 25% kernel recovery.
2. The figures in red colour indicates the estimated by ARIMA model.
3. The total demand in last column was derived by converting the total kernel production to RCN equivalent.
4. * Indicates the actual kernels export from India during 2007-08 (April-March)
The forecasted figures of RCN production and RCN imports show that both are likely to meet Indian vision on processing capacity to increase by 1.5 million tons by the year 2012. On demand side, the domestic kernel consumption has witnessed an annual growth rate of 8.88% from 1996 to 2006. The CAGR for the projected figures till 2012 has shown that the domestic consumption may grow by 7.35% annually. However, the kernels export has showed a growth of 5% annually. On supply side, the production and raw nuts import from other countries have witnessed 4% and 11.5% growth annually. During 2007, Indian kernels export was lower against 2006 due to the strengthening of Rupee against Dollar and competition from Vietnam.

Overall, the supply-demand projection for Indian Cashew industry shows a bright future to the stakeholders who involved both in supply chain and value chain of Cashew. Higher growth can be attained through higher expansion in production as well as import of raw nuts. Thus, it is expected to fulfill the increased processing capacity of Cashew sector.

II. Vietnam

<table>
<thead>
<tr>
<th>Year</th>
<th>RCN Production</th>
<th>Import</th>
<th>Total Supply</th>
<th>Total Kernel Production</th>
<th>Kernel Export</th>
<th>Domestic Kernel Consumption</th>
<th>Total Demand (RCN equivalent of kernels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>59100</td>
<td>51310</td>
<td>110410</td>
<td>27602</td>
<td>6080</td>
<td>21523</td>
<td>110410</td>
</tr>
<tr>
<td>1997</td>
<td>66900</td>
<td>116110</td>
<td>183010</td>
<td>45753</td>
<td>22750</td>
<td>23003</td>
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<td>1998</td>
<td>54000</td>
<td>128130</td>
<td>182130</td>
<td>45533</td>
<td>21050</td>
<td>24483</td>
<td>182130</td>
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<tr>
<td>1999</td>
<td>41200</td>
<td>124130</td>
<td>165330</td>
<td>41333</td>
<td>15800</td>
<td>25533</td>
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</tr>
<tr>
<td>2000</td>
<td>67600</td>
<td>184010</td>
<td>251610</td>
<td>62903</td>
<td>35000</td>
<td>27903</td>
<td>251610</td>
</tr>
<tr>
<td>2001</td>
<td>73100</td>
<td>210560</td>
<td>283660</td>
<td>70915</td>
<td>41000</td>
<td>29915</td>
<td>283660</td>
</tr>
<tr>
<td>2002</td>
<td>128800</td>
<td>250130</td>
<td>378930</td>
<td>94733</td>
<td>63000</td>
<td>31733</td>
<td>378930</td>
</tr>
<tr>
<td>2003</td>
<td>164400</td>
<td>291660</td>
<td>456060</td>
<td>114015</td>
<td>80000</td>
<td>34015</td>
<td>456060</td>
</tr>
<tr>
<td>2004</td>
<td>204700</td>
<td>339360</td>
<td>544060</td>
<td>136015</td>
<td>100000</td>
<td>36015</td>
<td>544060</td>
</tr>
<tr>
<td>2005</td>
<td>232000</td>
<td>326790</td>
<td>558790</td>
<td>139698</td>
<td>103000</td>
<td>36698</td>
<td>558790</td>
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<td>2006</td>
<td>350000</td>
<td>306992</td>
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<td>37064</td>
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<tr>
<td>2007</td>
<td>432374</td>
<td>278853</td>
<td>709740</td>
<td>177435</td>
<td>140000*</td>
<td>37435</td>
<td>709740</td>
</tr>
</tbody>
</table>

Note:
1. Data for production and export till 2005 from various news sources
2. The consumption figures till 2005 from FAO STAT (converted RCN to kernel equivalent based on 25% recovery). For 2006 and 2007 it was
projected minimum by 1% growth.
3. Import figures were arrived by subtracting production from total demand (export and domestic demand)
4. The total demand in last column was derived by converting the total kernel production to RCN equivalent.
5. *Indicates estimated exports from Vietnam but it couldn't meet this target due to actual lower production leads to export default by some of the new entrants in Cashew kernels trade.

The Vietnam supply and demand equation has showed that the supply during 2007 was 709,740 tons including the domestic production as well as raw nuts imports from African countries. On supply side, both production and raw nut imports have witnessed an annual growth of 22.6% and 18.2% respectively. Meanwhile on demand side, the kernel exports from Vietnam and domestic kernel consumption has shown a growth of 29% and 5.6% annually.

Vietnam has surpassed India in Cashew kernels export during 2006. Thereafter, India has regained its position of leading exporter of Cashew kernels as Vietnam’s export is expected to be lower this year against its estimated level of 140,000 tons.
### III. Brazil

#### Table- 2.6.3. Supply and demand scenario for Brazil

<table>
<thead>
<tr>
<th>Year</th>
<th>RCN Production</th>
<th>Import</th>
<th>Total Supply</th>
<th>Total kernel production</th>
<th>Kernel export</th>
<th>Domestic kernel consumption</th>
<th>Total demand (RCN equivalent of kernels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
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<td>0</td>
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<td>1998</td>
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<td>2002</td>
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<td>194020</td>
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<td>194020</td>
</tr>
<tr>
<td>2004</td>
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<td>222210</td>
<td>55553</td>
<td>47440</td>
<td>8113</td>
<td>222210</td>
</tr>
<tr>
<td>2005</td>
<td>152751</td>
<td>53149</td>
<td>205900</td>
<td>51475</td>
<td>41860</td>
<td>9615</td>
<td>205900</td>
</tr>
<tr>
<td>2006</td>
<td>236140</td>
<td>12046</td>
<td>248186</td>
<td>62047</td>
<td>51951</td>
<td>10096</td>
<td>248186</td>
</tr>
<tr>
<td>2007</td>
<td>190354</td>
<td>19560</td>
<td>209914</td>
<td>52478</td>
<td>41878</td>
<td>10601</td>
<td>209914</td>
</tr>
</tbody>
</table>

**Note:**

1. Production figures till 2007 and consumption figures till 2005 from FAO STAT
2. Consumption figures till 2005 from FAO STAT and 2006 and 2007 was estimated if it increases 5% annually.
3. Kernel exports also from FAO STAT till 2005 and 2006 and 2007 was estimated based on the past movement.
4. The RCN import was calculated by subtracting total production from total demand.
5. The total demand in last column was derived by converting the total kernel production to RCN equivalent.

The supply and demand equilibrium of Cashew kernels in Brazil has witnessed that the production in Brazil has been increasing over the years from 1996 to 2007 with an annual growth of 3%. Meanwhile, the estimated imports have showed a growth of 1.1% annually. On demand side, both kernels export and domestic consumption have showed an annual growth of 6.8% and 4.3% respectively.

Though India and Vietnam have witnessed a significant growth in production and exports, Brazil did not show any significant change over the years.
R C N Processing
Cashew Nut Production vs Processing

Cashew nut production is largely a function of land availability with suitable agro-climatic condition combined with prudent farm operations. Thus, one observes Cashew nut being produced across geographies albeit at varying degrees of scale and productivity.

On the other hand, processing of Cashew nut for kernels is driven by different set of competencies. Availability of skilled yet affordable manpower, investment capital for setting up manufacturing facilities and financing trade and lastly, access to profitable market for the output are the key drivers that decide processing location. Countries or regions that have been able to mobilize these have emerged successful. Africa as a region has not been able to leverage its raw nut production advantage. On the other hand, India and Vietnam have consistently excelled in processing. Since inception, India has held its dominant position in the Cashew nut processing. The availability of better processing technology and skilled manpower is considered to favour the Cashew nut processing industries in India.

Source: DCCD, India, FAOSTAT & various news sources
In general, India, Vietnam, Brazil and African countries are the major Cashew nut processors in the world. Figure- 3.1.1 indicates that India and Vietnam has installed processing capacity in excess of their own raw nut production. Indian processing capacity is 1200,000 tons, while its raw nut availability is nearly half of that only. Likewise, Vietnam has an installed processing capacity of 650,000 tons, while its own production of raw nuts is 400,000 tons. African countries act as feeder to India and Vietnam. Brazil follows an advanced processing technology that is less manpower intensive. However, value realization is believed to be lower in Brazil against the realization achieved in Vietnam and India.

Traditionally, most of the raw nut from East Africa was shipped into India for processing and subsequently, re-exported as kernels. Manual processing, such as that practiced in India, tends to give higher yield of whole kernels than the mechanized methods in use in Brazil (Errington and Coulter, 1989).

The processing methods currently followed in India are drum roasting and steam boiling. About 60% of the processors are following steam-boiling method, while remaining 40% follows drum-roasting method. The quantity of kernel recovered in drum roasting is slightly lower, compared with steam boiling, as spoiled nut burns completely, while it is being roasted.

**Vietnam Cashew nut Processing**

Encouraged by high economic value, Vietnam has placed a strong emphasis on developing Cashew cultivation and processing. Vietnam has about 60 Cashew processing factories during 2000 with the total annual capacity of 220,000 tons of raw Cashew nuts. Now, it has been increased to some 200 processing factories with the total capacity of 600,000 tons a year. Vietnam can export 115,000 tons of Cashew nut a year thereby it can earn $500 million per year. The method of processing used in Vietnam is more or less similar to Indian processing methods. Hence, the recovery and quality are also approximately same in both the countries.

**Brazil Cashew nut processing**

Unlike India and Vietnam, Brazil follows a mechanized method of processing. Hence, the recovery of wholes grade is lesser in the country.
The mechanization in processing can’t be followed in India because Cashew industry is highly a labour-intensive one and able to provide employment to nearly 500,000 people around the country.

**Table-3.1.1. Cashew processing industry in Vietnam and India**

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Indian processing industry</th>
<th>Vietnam processing industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed capacity</td>
<td>1200,000 tons of RCN per year as on 2007</td>
<td>600,000 tons of RCN per year as on 2007</td>
</tr>
<tr>
<td>Number of units/factories</td>
<td>Over 2000</td>
<td>200</td>
</tr>
<tr>
<td>Per cent share of large units (5000 – 10000 tons per year)</td>
<td>60</td>
<td>50 – 60</td>
</tr>
<tr>
<td>Per cent share of own RCN</td>
<td>40 -50%</td>
<td>60 – 70%</td>
</tr>
<tr>
<td>Factories HACCP certified</td>
<td>60%</td>
<td>40 – 50%</td>
</tr>
<tr>
<td>Labour cost inflation per annum</td>
<td>About 8 – 10%</td>
<td>&gt;10%</td>
</tr>
<tr>
<td>Domestic demand for kernels</td>
<td>55-62%</td>
<td>25-28%</td>
</tr>
<tr>
<td>Key challenges</td>
<td>Raw nuts at affordable rates</td>
<td>Labour migration to urban areas</td>
</tr>
<tr>
<td></td>
<td>Wage rates</td>
<td>Bank finance availability</td>
</tr>
<tr>
<td></td>
<td>Transportation costs</td>
<td>Raw material sourcing</td>
</tr>
<tr>
<td></td>
<td>Exchange rate fluctuation</td>
<td>Increasing profitability of other plantation crops such as rubber, coffee</td>
</tr>
<tr>
<td>Key strengths</td>
<td>Quality</td>
<td>• Packaging innovation</td>
</tr>
<tr>
<td></td>
<td>Product range</td>
<td>• Cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td>competitiveness</td>
</tr>
</tbody>
</table>
Flow chart of Cashew nut processing

Raw Cashew Nut Procurement

Sun Drying

Steam Boiling

Drum Roasting

Shelling

Using Hammer

Mechanical Sheller

Drying by Borma dryers

Peeling

Re-humidification (if Steam boiling method followed)

Grading

Packing

In Polythene pouch

Tin packing
CHAPTER 3.2.

Cashew Nut Processing in India

The cashew-processing unit in India was started at Mori of Rajahmundry in the 18th century. Afterwards in the beginning of the 19th century, it has been extended to Palasa and Vetapalem. There was a rapid growth in Palasa region due to the easy availability of raw nuts from adjoining districts and the neighbouring state.

The processing methods followed in India during 2002 were drum roasting, oil bath roasting and steam boiling. In the country, about 66% of the processors including the states such as Kerala, Tamil Nadu, Andhra Pradesh, Orissa and West Bengal followed the drum roasting method. Nearly 27% of the processors followed steam-boiling method including states such as Karnataka, Goa and Maharashtra. Only few industries (7 per cent) followed an outdated method of processing called oil bath roasting in 2002.

Now, the processing scenario in India has changed and the processing practice of 2002 has been reversed i.e., about 60% of the processors follow steam boiling and the remaining 40% of the processors opt for drum-roasting methods currently. Processing cost of steam boiling is slightly higher than drum roasting. However, steam boiling has an added advantage of CNSL extraction as an extra benefit. According to the processors, the nut recovery is good in steam boiling when compared to drum roasting, while the taste and shelf life of Cashew kernels are good in drum roasting.

Table-3.2.1. Cashew growing states and processing regions in India

<table>
<thead>
<tr>
<th>States</th>
<th>Processing regions and districts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andhra Pradesh</td>
<td>Tuni in East Godavari district, Palasa in Srikakulam district, Vetapalam in Prakasham district, and Rajmundry in West Godavari district.</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>Vengrula</td>
</tr>
<tr>
<td>Orissa</td>
<td>Chatrapur, Puri, Ganjam, Koraput, and Navarangpur</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>Panruti (Cuddalore district) and Kanyakumari</td>
</tr>
<tr>
<td>Karnataka</td>
<td>Mangalore</td>
</tr>
<tr>
<td>Kerala</td>
<td>Kollam</td>
</tr>
<tr>
<td>Goa</td>
<td>Goa</td>
</tr>
<tr>
<td>Gujarat</td>
<td>Valsad, Dang districts</td>
</tr>
</tbody>
</table>
Currently, the drum roasting method is followed in states like Tamil Nadu (Panruti), Andhra Pradesh (Palasa) and Kerala (Cochin). The steam boiling method is followed in states such as Karnataka (Mangalore), Orissa, Goa and Maharashtra.

In Karnataka and Maharashtra, 100% of the processors follow steam-boiling method. In Andhra Pradesh, the processors in Tuni district are following steam boiling (50 per cent) and the processors in Palasa districts adapting drum-roasting method (50 per cent). In Goa, 90% steam boiling and 10% drum roasting is being followed.

In Orissa, 50% of drum roasting and 50% of steam boiling methods is being followed, while in Kollam 90% of the processors use drum roasting technique and only 10% follows the steam boiling method.

The Cashew processing units in the important Cashew processing states in India was given in the Table-3.2.2. It can be inferred that the processing capacity of states has been expanded much in the recent days but the capacity utilization is much lower.

### Table-3.2.2. Cashew processing industry in India during 2005-06

<table>
<thead>
<tr>
<th>States</th>
<th>Processing units (Nos.)</th>
<th>Capacity (tons)</th>
<th>Utilization (tons)</th>
<th>Source: DCCD, Kochi, India</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Indigenous</td>
<td>Import</td>
<td>Total</td>
</tr>
<tr>
<td>Kerala</td>
<td>432</td>
<td>700,000</td>
<td>67,000</td>
<td>320,000 387,000</td>
</tr>
<tr>
<td>Karnataka</td>
<td>266</td>
<td>65,000</td>
<td>45,000</td>
<td>20,000 65,000</td>
</tr>
<tr>
<td>Goa</td>
<td>45</td>
<td>21,000</td>
<td>21,000</td>
<td>- 21,000</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>350</td>
<td>20,000</td>
<td>20,000</td>
<td>- 20,000</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>417</td>
<td>565,000</td>
<td>294,000</td>
<td>225,000 519,000</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>175</td>
<td>95,000</td>
<td>92,000</td>
<td>- 92,000</td>
</tr>
<tr>
<td>Orissa</td>
<td>60</td>
<td>11,000</td>
<td>11,000</td>
<td>- 11,000</td>
</tr>
<tr>
<td>West Bengal</td>
<td>30</td>
<td>8,000</td>
<td>8,000</td>
<td>- 8,000</td>
</tr>
<tr>
<td>Chattisgarh</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>- 0,000</td>
</tr>
<tr>
<td>NE States</td>
<td>22</td>
<td>15,000</td>
<td>15,000</td>
<td>- 15,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1800</strong></td>
<td><strong>1500,000</strong></td>
<td><strong>573,000</strong></td>
<td><strong>565,000 1138,000</strong></td>
</tr>
</tbody>
</table>

The number of processing industries in India during 2005-06 were 1800 units with processing capacity of up to 1500,000 tons. But the actual quantities of raw Cashew nut processed through these units were about 1140,000 tons. The raw
Cashew nut availability for these processing units from domestic production was 573,000 tons and through import was 565,000 tons. Thus availability totaled at 1140,000 tons in 2005-06. The current availability of raw nut from domestic as well as from imports is estimated at 1240,000 tons.

**Procedures followed for processing**

**Raw nut procurement:** Raw nuts are generally bought through commission agents from interstates and from foreign countries to meet the Indian processing capacity of 1200,000 tons.

**Storage, drying of raw nuts:** Raw nuts are kept stored in gunny bags with 80 kg capacity in warehouse. Processors feel that hilly area nuts can be stored up to two years, without spoilage in warehouse, whereas nuts from the coastal areas can be stored just about 4-5 months. Through sun drying, the moisture content is reduced to 8% (dry basis) in storage.

The raw nuts can be processed through drum roasting or steam boiling methods.

- **Drum Roasting:** Drum roasting machine consists of feed hopper, rotary drum, gears and water tanks with sprinklers and a surface. A feeding tank/hopper can contain 800-kg raw nuts. As the moisture content and size of the nut has an impact on the qualitative efficiency of kernels in drum roasting, roasted nuts are tested for their quality to optimize feed rate and drum revolutions.

- **Steam Boiling:** Under the steam boiling process, a cylindrical drum with a hopper on the top for feeding raw Cashew nuts is used. A boiler is used for generating steam and is sent to the drum through a pipe at the bottom. The pipe is connected to a perforated central stem and laterals inside the drum. A steam gauge is fitted with a valve for controlling pressure to the steam pipe connecting the steam generator and drum. Cashew shell cake is used as fuel and it requires about 50 kg of cake to steam boil a batch of 320 kg of raw nuts. The crucial parameters, i.e., steam pressure and duration, vary from industry to industry, due to various factors such as variation of the origin of raw nuts, capacity and efficiency of boiler, skill of a labourer, etc.

- **Shelling:** Skilled women labourers are involved in the shelling section. Roasted nuts are tapped gently in the shelling section,
two-three times manually, with the use of wooden mallets and this impact force helps the nut to crack and the kernel is separated. The raw nuts processed through steam boiling method are shelled by means of mechanical decorticator or a hand cum foot-operated cutter is used for shelling. The nuts are placed one by one between two blades and cut to the depth of the shell. A hand lever is used for breaking open the shell. Another labourer separates the opened nuts and shells. Due to the tiring nature of shelling, the labourers exchange positions. The output of two workers ranges from 50-100 kg raw nuts per day. The average production is in the range of 11-25 kg per day per pair. Partial mechanisation of shelling and steam boiling results in release of shell oil that can affect workers' hands. One must be careful during cutting, as to avoid injury to labourers during the process. The shelling percentage is normally around 25. The average recovery of wholes is about 92 per cent. Roasted nuts are mixed with ash, so that skin damage against CNSL can be avoided. The output of wholes is taken into consideration for wage calculation.

• **Kernel Drying:** After separation from the shells, the kernel is dried to bring down the moisture and loosen the adhering testa by means of Borma dryers. The nuts are placed in trays with wire mesh bottoms and loaded into chambers that are built with either brick or metal. The trays are arranged in a trolley and in turn, put inside the chamber. The drying chamber gets hot air from the generator where spent shells, after extracting CNSL, are burnt as a source of heat. The kernels inside the chamber are put through varying temperatures and require highly skilled labourers for avoiding scorching of kernels. Positions of trays are changed at regular intervals of time for maintaining uniform heating. The drying percentage in borma dryer has been worked out at 4-5 per cent.

• **Peeling:** Peeling of dried kernels is done manually by sharp edged small knife. The operational capacity ranges from 7-8 kg/head/day. As like shelling the output of wholes is taken into consideration for wage calculation. On an average, 70% of wholes are recovered by this method. Preliminary grading of 7-10 grades is completed in this section. Those to be rejected are separated in the peeling section and graded as black baby
bits, completely spoiled, white reject and difficult to peel.

- **Re-humidification:** The kernels processed through steam boilers have to undergo this process to prevent excessive breakage by handling and transport after final grading. Kernels are kept in a high humid room for a few hours till they come back to a moisture content of 5% (maximum limit).

- **Grading and packing:** Grading is done according to specifications laid down by the Cashew Export Promotion Council of India. More than 25-30 grades are sorted out for domestic market and export. Grading is done manually. Cleanliness is maintained in this section to a great extent. Different grading lists are available for export and indigenous supply of kernels. Grading of whole kernel is based on counts, i.e., the number of whole kernels per pound. The main groups are white wholes, that are sub-divided into counts 200/210, 220/240, 300/320, 400/450 and 500/520, Butts-wholes with small pieces chipped off, white splits-kernel halves, LWP (Large White Pieces) of size over 60 mm, SWP (Small White Pieces) of sizes < 40 mm, scorched grades showing some discoloration due to over roasting, shrivelled or spotted or dessert kernels.

- The permissible moisture content at the end of grading is in the range of 3-5% (dry basis) and kernel must be free from any impurities and odour. For maintaining hygienic condition, either plastic or aluminium containers are used for shifting from section to section.

- **Packing:** Tin containers of 25-pound or 50-pound capacity are used for packaging kernel and these tins are packed in carton boxes. In a kernel-filling machine, 4-6 tins are placed on a vibrating platform, while filling by a chute. Blowers that are provided across the chute remove dust and kernels with less weight. The tins are vacumised and flushed with CO₂ with the help of VITAPACK machine and sealed afterwards. The use of CO₂ brings down oxidative rancidity and also assists in checking leakage. Any leakage in filled containers can be detected by the hollow sound that comes out while tapping the sides of the tin. Tin tester is also used for checking airtight packing by dipping in water.
Flexible Packaging (Moulded Vacuum Packaging) with nitrogen, as inert gas is a better method for bringing down the heaviness and incurs less cost of packing. MVP system produces consistent rectangular blocks that range in size from 500 gm to 25 kg. This is a big improvement in quality production with the advantages of transport, handling, display, stock count, etc. The vacuum barrier bag and cardboard box are fully recyclable. The rectangular shape of primary packs ensures that the movement is minimum during transportation and handling, providing the maximum protection to the contents. The removal of air and gas flush bring down the incidence of rancidity and bacterial growth.

**Capital investment:** In a Cashew nut processing unit, the highest amount is invested on buildings (64.94 per cent), followed by machinery, equipment, (22.08 per cent) and land at an overall level. The big capital investment is due to provision of workplace for processing units, as it is labour intensive.

W320 is a benchmark grade meant for analysing the qualitative efficiency of Cashew processing. The out turn of kernels depends on the quality of raw nut, efficiency of roasting and kernel drying and the dexterity of labour.

According to the processors, nearly 30-40% of W-320 grade are produced all over the world, which has higher demand from US and EU countries. Meanwhile, W-180 and W-240 grade kernels have higher demand in Middle East countries.

**Current status of Cashew processing in India**
In India, eastern states are regions of promise for Cashew as they have shown rapid development in cultivation and process over the last two decades. There could be continual improvement based on interaction and provision of knowledge and technology. The major Cashew processing centres in the east coast, Tuni in Andhra Pradesh and Jeypore in Orissa are now attracting the attention of Cashew manufacturers from the west coast due to the availability of raw Cashew and cheap labourers in these regions.

According to government sources, Chhattisgarh state will set up three Cashew nut processing units in the iron ore rich Bastar region. The three units will be set
up at Kumharvand, Karmari and Turenaar. These are remote areas having tribal
stronghold. The units would be equipped for processing nuts including shelling,
peeling, grading into different sizes and colours in accordance with standard
grading, drying or humidifying and packing.

The total area under Cashew production in Chhattisgarh is about 10,000 hectare,
of which 2,000 hectare is in Bastar region. The present productivity of Cashew is
480 kg/ha in the state, while the national average is about 700-800 kg/ha. Three
private firms are already operating processing units in Bastar region to tap the
rich potential of Cashew nut production in the Bastar region.

In the states like Karnataka, Goa and Maharashtra, the Cashew processors are
mostly following steam-boiling methods. Hence, more scope for Cashew nut shell
liquid production at the large extent from these states to satisfy the increasing
global demand for this liquid is expected.

Reference:
Natural Resources Institute, Chatham, Kent, UK.

Bangalore – 560 008.
CHAPTER 3.3.

Cashew Processing - Analysis of Cost Structure in India

India has been better placed in Cashew nut processing among the countries in the world due to the availability of better processing technology. Moreover, India has tradition and enjoys high reputation in quality Cashew kernel production.

Table 3.3.1. Comparison of RCN processing cost (Rs/kg of raw nut) during 2002 and 2008

<table>
<thead>
<tr>
<th>Processing stages</th>
<th>2002</th>
<th>2008</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tin packing</td>
<td>Plastic pouch packing</td>
<td></td>
</tr>
<tr>
<td>Dryig raw nuts</td>
<td>0.15</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Steam boiling &amp; sun drying</td>
<td>0.18</td>
<td>1.33</td>
<td>1.33</td>
</tr>
<tr>
<td>Shelling of nuts</td>
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<td>7.25</td>
</tr>
<tr>
<td>Kernel drying</td>
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<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Cooling</td>
<td>-</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Peeling</td>
<td>1.26</td>
<td>1.96</td>
<td>2.10</td>
</tr>
<tr>
<td>Grading</td>
<td>0.57</td>
<td>1.57</td>
<td>1.57</td>
</tr>
<tr>
<td>Packaging</td>
<td>1.53</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(1) If tin packaging</td>
<td>-</td>
<td>1.38</td>
<td>-</td>
</tr>
<tr>
<td>(2) If plastic pouch packing</td>
<td>-</td>
<td>-</td>
<td>0.56</td>
</tr>
<tr>
<td>Total</td>
<td>5.16</td>
<td>14.29</td>
<td>13.61</td>
</tr>
</tbody>
</table>

Note: The processing cost in Tamil Nadu obtained through primary survey is taken for calculation for 2008. For 2002, the cost has been taken from Indian Cashew Handbook 2002.

The comparison of processing cost of Cashew nut during 2002 and 2008 is given in the Table-3.3.1. It indicates that in 2002 the cost of processing was Rs.5.16/kg of raw nut, while it is Rs.14.29/kg for packing through tin and Rs.13.61/kg for plastic pouch packing in 2008. The labour cost constitutes most of the share in the total cost, except packaging; all other costs purely indicate labor cost.
Table-3.3.2 indicates that the wages vary with stages of processing. For example, shelling operation, a woman can shell maximum of 8 kg per day and per kg shelling cost is Rs.5.40 + Rs.14.80 DA (Dearness Allowance has been given in addition to the wage if the shelled quantity exceeds 6 kg a day). In case of peeling operation, a female labour can peel at maximum of 7-8 kg per day and per kg peeling cost is Rs.6 + Rs.14.80 DA (the dearness allowance is provided if she peels more than 5 kg/day). The next activity carried out by women labour - grading involves a cost of Rs.4.80/kg. The wages for grading operation are given based on the whole grade recovery. On an average, a women labour is able to grade a maximum of 10 kg per day. Here also the DA will be given if they grade more than 7 kg.

Packaging of kernels can be done in tin or in plastic pouch. The traders prefer to pack in plastic pouch if the consignment is for exports, and tin packing if it is within the country. Usually the packing capacity of a tin is 11.34 kg, which is kept inside a carton (having 2 tins with capacity of 22.68 kg). The cost of a tin is Rs.52 with carrying capacity of 11.68 kg, whereas the plastic pouch cost is Rs.30 with capacity to carry 22.68 kg.

Tin package cost is escalating because its prices is linked with the price
of steel. However tin has recyclability i.e., nearly 40% of the tin could be reused so that we can recover Rs.40 (if a carton is used for packaging) when the tin containers are sold.

The main advantage of processing raw Cashew nut through steam boiling method is the realization of CNSL with superior quality and the shell cake can be reutilized for fuel purposes.

**Wage inflation in Cashew processing**

It can be noticed from the Table-3.3.1 that the processing cost in 2008 has increased more than twice against its 2002 levels.

The male labour involved in steam boiling and drying in 2002 was earning Rs.45/day, whereas wage has increased to Rs.85/male labour currently. Shelling cost (excluding DA) during 2002 was Rs.2.70/kg for woman labour but the current wage is Rs.5.40/kg (excluding DA). Likewise peeling cost was Rs.3.22/kg in 2002 but the current wage is Rs.6/kg.
CHAPTER 3.4.

SWOT Analysis of Cashew Industries in Major Processing Countries

Indian Cashew industry

Strengths
1. India is the leader in both Cashew nut production and kernels exports in the world.
2. The increase in domestic Cashew consumption in India would pave the way for Cashew industry growth.
3. The area under Cashew has been expanding in India. The Directorate of Cashew and Cocoa Development is taking steps to increase the area under Cashew to one million hectares by 2012.
4. In the processing front, India has better technology and inexpensive and semi-skilled labor.
5. Higher processing capacity i.e., 1.2 million tons per annum has kept India at the leading position in the processing front.
6. Manual processing provides good quality kernels and the realization of wholes is also higher compared to the competing countries. Hence Indian Cashew kernels fetch good demand and commend high price in the international markets.
7. India’s Cashew industry was the first to use quality control for improvement of performance. The ISO 6477 standard was introduced in 1988 in India.
8. India also has a long tradition and good reputation as a high quality processor of Cashew.
9. Chattisgarh state in India is going to set up three Cashew nut processing units particularly in the remote areas having tribal stronghold.
10. There is no import duty for raw Cashew nut imports into India.

Weaknesses
1. Lower productivity due to senile plants and lack of good agricultural practices. According to studies, nearly 34% of the total Cashew crops in India are senile plants.
2. Cashew growers are not adopting high yielding varieties for planting.
3. Though India has higher processing capacity, the raw nut availability is very low (only 50% of total processing capacity) and
the processors have to depend on other African countries for their processing requirement.


5. The cost of processing has been increasing and pose a threat to processors on account of higher input costs like freight, labour, etc.,

6. There is not much research on CNSL and apple usage in India. Mostly the Cashew apple was wasted in the plant itself even though it has lot of scope to be converted into so many products like jam, juice, jelly and alcoholic drink like “fenny”. Likewise India is the leading producer of Cashew kernels hence the by-products Cashew shell are abundant. Though India’s CNSL and its products have good export enquiries from other countries, the actual production (45,000 tons) is far below the potential production of 200,000 tons.

Opportunities

1. The production in the competing countries like Brazil and Vietnam are expected to decline this year, which paves good opportunity to Indian Cashew processors to increase their exports.

2. Indian Cashew growers can adopt high density planting as is the practice followed in Vietnam to increase the production.

3. To carry research and development activities, India has research stations working on Cashew such as Directorate of Cashew and Cocoa Development (DCCD), National Research Centre for Cashew (NRCC) concentrating on varietal development and improvement in forward linkage along with backward linkage like Cashew Export Promotion Council of India (CEPCI).

4. In some of the major Cashew producing and processing states, separate Cashew manufacturers associations and Cashew development corporations exist to deal with the issues related to Cashew for their state specific and to promote trade in their state.

5. In traditional Cashew growing areas, DCCD has planned to undertake re-plantation of senile plants to increase the productivity.

6. Under the eleventh plan (2007–12), the Government of India has decided to take up Cashew cultivation in a big way in Chattisgarh, Jharkhand and the Northeastern region.

7. In the 2008 budget, Indian government has allotted Rs.11 billion
package for the revival of Cashew along with coconut and pepper. This would help Cashew growers in a much better way to replant their crops with new higher yielding varieties. This would provide a renaissance to Indian Cashew sector, as it will reduce the dependency on imports of RCN from other countries to a large extent.

8. The emerging concept of organic/bio-dynamic Cashew is likely to get good place in international arena.

9. The research and development of value added Cashew products turn the attention of international consumers towards Indian Cashew. The initiative of Kerala State Cashew Development Corporation (KSCDC) on Cashew products like Cashew vita, Cashew powder, Cashew soup powder and Cashew bitz under CDC Cashews is a one such example.

**Threats**

1. The Government of India has decreased the Duty Entitlement Passbook (DEPB) rate to 1.5% from the existing rate of 3 per cent, which is expected to hurt the exporters to a large extent.

2. Decline in area under cultivation in the major Cashew growing state of Kerala.

3. Lower production with respect to total processing capacity increases the dependency on other countries for raw materials.

4. The emerging competition from Vietnam in Cashew exports.

5. Increasing crude oil prices and Rupee movement against US dollar

**Vietnam Cashew industry**

**Strengths**

1. Higher productivity due to good agricultural practice as well as high density planting.

2. Vietnamese planned to increase Cashew nut productivity to 4000 kg/ha from the current level of 2000 kg/ha.

3. At present, Vietnamese Cashew processors are exporting their kernels to about 40 countries like US, China, Holland, Australia, UK and Germany.

4. During 2006-07, Vietnam surpassed the leading kernels exporter India and gained the title of leading exporter with the export turnover of $650 million.
Weakness

1. Though Vietnam expanded their processing it is facing shortage in labour availability i.e., the sector now has approximately 300,000 workers, meeting only 60% of the demand of processing plants.

2. Vietnamese Cashew firms have to pay an import tariff of 5 to 7.5% on raw Cashews, which restricts their competitiveness in the global market. They also exempt import duties, but only on imported raw Cashews that can be processed for export within 275 days. However, most domestic Cashew processors and exporters have failed to meet these requirements and cannot benefit from the incentives.

3. The current default by the exporters for shipment due to unexpected escalation of processing cost shake the reliability of Vietnam exporters.

Opportunity

1. Research and development on modern equipments for production and processing and research on High Yielding Varieties aimed at improving quantity and quality.

2. Vietnam Cashew Association (VINACAS) has set a target of increasing their export turnover to $700 million by 2010 and $820 million by 2020.

Threats

1. The Vietnamese Dong has been depreciating against the US dollar continuously for the past 5-6 years. This poses threat to RCN import by Vietnam.

2. Competition from India

Brazilian Cashew industry

Strengths

1. The area under Cashew cultivation is more in Brazil when compared to the second largest Cashew growing country, Vietnam.

Weakness

1. Though Brazil has higher area under Cashew, the productivity of Cashew is much lower i.e., the yield of Cashew in Brazil is around 350 kg/ha, which is much below the world average of 780 kg/ha.

2. As Brazilians follow mechanical processing methods, the realization of good quality (whole grades) is poorer while splits and pieces are more.
3. The mechanical processing methods give more broken nuts, which fetch half of a value of whole nut and the quality of nut also deficient in taste, colour and flavour which contributed to lower price realization to Brazilian exporters.

Opportunities
1. Brazil is very near to most of the major Cashew consuming countries like US and EU countries hence it can take advantage of logistic costs on Cashew trade against India and Vietnam.

2. Productivity can be improved once Brazil follows good agricultural practices, planting of HYV through proper research and development.

Threats
1. Competition from India and Vietnam
CHAPTER 3.5.

Prospects of Cashew Nut Shell Liquid in India

Cashew shell is a hard woody outer coverage of cashew nut. It occupies nearly 70% of cashew nut weight and the kernel occupies the remaining part. Though the kernel is the major valuable produce from cashew nut, the shell also has an economic value. Besides kernel, the shell yields Cashew Nut Shell Liquid (CNSL), which is dark reddish brown viscous liquid. The shell oil represents one-fourth of the mass of an unshelled nut and is approximately equal to that of the kernel. The cashew nut shell liquid contains 80% Anacardic acid, 10-15% Cardol and small amounts of other materials notably the methyl derivatives of Cardol.

Uses of CNSL

1. About 75% of CNSL produced is used in manufacture of friction particle, which is used for the automotive industry.
2. The CNSL and the resins containing cardanol have found significant applications in brake lining for cars and clutch disks.
3. Surface coatings containing CNSL have an excellent glossy appearance with optimum levels of hardness.
4. The resin of CNSL is added to paint and synthetic varnishes in order to control their properties and to reduce their cost. Its ability to destroy the termites combined with its anti-microbial action is known since a long time and is used in protection of the hulls of boats.
5. Paints and varnishes made from CNSL have superior properties than those of conventional oils or synthetic resins. Incorporating sulphur in CNSL has made varnishes resistant to water and gasoline.
6. The resins of CNSL give excellent lacquers, which are more resistant than vegetable and mineral oils. Lacquers developed from CNSL could be used for insulation, protective coatings for furniture, buildings, automobiles, etc.
7. The resins of CNSL alone or in combination have significant qualities of impermeability and can be used in the coating of roofs.
8. The resin of CNSL modified with phosphorus is added to cement. This material adheres well to porous bricks, steel and the concrete.
9. In laminating industry it is used for reducing brittleness and improving the flexibility of the laminates.
10. Using CNSL, a novel and cheaper liquid crystalline polyester has been synthesized that can substitute for polymer fibres and films in speciality applications.
11. CNSL is also used in nano-technology for targeted drug delivery.
12. In tropical medicine, CNSL has been used in treating leprosy, elephantiasis, psoriasis, ringworm infections and warts.
13. The cashew nut shell cake from CNSL extraction can be used as a good source of fuel for cashew nut processing.
14. The by-product of CNSL, Cardanol especially chlorinated products of cardanol and hydrogenated cardanol are found to have pesticidal action.
15. The various components of cardanol can be suitably modified to obtain emulsifiers and surface active agents, dyestuffs, antioxidants, plasticizers, stabilizers, accelerators, curatives, reclaiming agents and ion-exchange resins.

Global CNSL production
The global cashew nut shell liquid production is 125,000 tons (http://www.adarshsanoor.com/cnsl.asp), in which India’s share is 36% (i.e., 45,000 tons). Brazil CNSL production during 2004 was 37,000 tons.

Prospects for CNSL production in India
The total processing capacity of cashew industry in India is 1200,000 tons. The availability of cashew shell after processing these 1200,000 tons of raw nuts is 840,000 tons. The cashew nut shell liquid recovery varies from 20-24% i.e., India’s has capacity to produce 1700,000 to 200,000 tons of CNSL, but as of now it is producing about 45,000 tons of CNSL only. The gap between potential and actual production is too wide i.e., India realizes only 22-25% of its total potential. The production of CNSL is now limited to Karnataka, Goa, South Arcot district in Tamil Nadu and partially in Kollam and in Puducherry (UT).

The major importing countries of cashew nut shell liquid from India are USA, Korea republic, Japan and Zimbabwe. The enquiries for CNSL from these countries are increasing, which gives huge potential for its production and exports. Once the cashew processors realize the benefits from CNSL and its products, they could go for improved processing techniques to realize more CNSL production.

Economics of CNSL production
The shell recovery from cashew nut = 70 per cent
From 100 kg of cashew shell,
CNSL realization is 21.75 kg and Shell cake is 74 kg.
The current practice in India is to buy the shell, extract oil from it and sell
back the de-oiled cake. The net cost of cashew shell is about 65% of the value of CNSL. Processing cost is about 10-12% of the value of CNSL.

**Projection of export realization from CNSL in India**

India is exporting only 17% of its total CNSL production (45,000 tons) to countries like Japan, Korea republic, USA, Zimbabwe, China and Egypt.

If we apply the above calculations at national level, India can earn nearly Rs.83.25 crores at current level of production of 45,000 tons at current costs. If India is producing CNSL with full potential of 170,000 to 200,000 tons, then it can realize Rs.314 to 370 crores, which is nearly 15% of export income earned through kernel exports. Mostly the cashew processing firms are themselves involved in CNSL preparation as a co-generation activity.

Hence, the value of CNSL and its cake puts forth enormous employment and income generating avenues to the cashew industry as a whole.

**CNSL exports from India**

The cashew nut shell liquid exports from India have been increasing over the years from 1989-90 to 2007-08. The CAGR of CNSL exports (quantity wise) for the above years were 4 per cent, whereas the value of exports has increased by 7% annually.

![Figure-3.5.1. Quantity of CNSL exports from India](image)

It is clear from the Figure-3.5.1 that the quantity of CNSL export has been increasing over the years because of its higher acceptance in the international markets. The export of CNSL in the year 2007-08 was 7,813 tons against its previous level of 6,139 tons. The major importing countries of CNSL from India are USA, Korea republic, Japan and Zimbabwe.
The value of CNSL exports has also increased over the years as shown in the Figure-3.5.2. The unit value of CNSL has declined to Rs.15.30/kg in 2007-08 against Rs.16.76 in 2006-07.

Major importers of CNSL
USA is the major importer of Indian CNSL followed by the Korean Republic, Japan, United Kingdom, China and other countries like Indonesia, Zimbabwe, Mexico, Spain, Belgium, Russia, Romania, South Africa, Malaysia, Germany, Egypt, etc. Among these countries, China and Egypt are new entrants into the CNSL trade.

Though various countries are importing CNSL from India over the years, the United States of America and Korea are highly stable buyers for Indian CNSL.

Figure-3.5.3 indicates that the quantity of CNSL exports from India to USA has increased over the years. The CAGR for CNSL exports to USA has shown significant growth of 36% from 1996-97 to 2007-08, while Korea has shown a growth of 0.04% during the same period. Meanwhile, Japan has witnessed a negative growth of 15.6% annually. The exports to other countries are varying over the years. The overall CNSL exports for the same period have shown 14% growth.
It can be inferred from Figure-3.5.3 that the value CNSL exports is also increasing over the years for USA and high fluctuations from other countries has shown that the currency movement has an impact on the value of the trade.

The USA has showed a growth of 34% in value of CNSL imports from India, whereas Korean Republic has witnessed a 3% growth and Japan stands with a negative growth of about 12% annually. The overall growth of value of CNSL exports from India stood at 9% between 1996-97 and 2007-08.

Change in direction of CNSL trade
In order to find out the change in CNSL exports direction from India, a transitional probability matrix has been formed by using Markov chain analysis.

<table>
<thead>
<tr>
<th></th>
<th>U.S.A</th>
<th>Korea</th>
<th>Japan</th>
<th>U.K</th>
<th>China</th>
<th>Others</th>
</tr>
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<tbody>
<tr>
<td>U.S.A</td>
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<td>0.0317</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

The results presented in the Table-3.5.1 indicate that USA has been a stable market for Indian CNSL as reflected with higher probability retention of 0.9380 i.e., the probability that USA can retain its share of imports from one period to another period was about 94 per cent. Likewise, Korean Republic also had a higher retention of 0.6087 i.e, about 61% and Japan had the retention capacity of 40 per cent. Meanwhile, the United Kingdom, China and ‘other countries’ have shown a probability of zero retention indicating that they were the unstable markets for Indian CNSL exports.
USA has taken away 35% of Korea’s and 33% of Japan’s market share in the world trade. At the same time, USA has lost 2.7% each of their own market shares to Korea and Other countries and 0.7% to Japan. Therefore, USA has retained 94% of its original share and lost about 6% to Korea, Japan and to ‘other countries’. Over all the net gain of USA from Korea was 32.3% and from Japan was 32.3 per cent.

The next major gainer among the importers of CNSL from India was Korean Republic, which had a transitional probability of 1 from China, 0.5153 from United Kingdom, 0.0283 from USA and 0.0391 from ‘other countries’. It means, the probability that the Korean Republic would gain in the export share of Indian CNSL from one period to another from China, UK, USA and ‘other countries’ was 100 per cent, 52 per cent, 2.8% and 3.9% respectively. Meanwhile it has lost 35% to USA and 4% to ‘other countries’. Overall, Korea has retained 61% of its market share and lost 39% to USA and ‘other countries’ in the period between 1996-97 and 2007-08.

If we consider Japan, though it has gained 19% of UK’s share, 3% of ‘other countries’ share and 0.7% of USA share, it lost nearly 33% of its own share to USA, 30% to UK from one period to another period. Hence, it has retained 40% of its CNSL import from India. The net loss for Japan from USA was 32.3% and from UK’s was 11 per cent.

United Kingdom could not retain its original share and lost nearly 51.5% to Korea and 29% to ‘other countries’ and 19.5% to Japan. Meanwhile, it has gained 30% of Japan’s share. UK had a net gain of 11% from Japan.

Since China is a new entrant in to the CNSL trade, it has imported nearly 32 tons in 2006-07 and 638 tons in 2007-08. During the period from 1996 till date, China has lost 100% of its share to Korea.

‘Other countries’ could not retain their original share and they lost nearly 93% to USA, 4% to Korea and 3% to Japan. Meanwhile, they have gained 29% of UK market share, 4% of Korea and 3% of USA. Overall ‘other countries’ net loss from USA was 93% and there was no loss and no gain from Korean Republic.

In brief, we can conclude from the Markov chain analysis that USA, Korea
and Japan were the stable markets and other countries were unstable markets for Indian CNSL. For Korea, USA was the major competitor, and for Japan, it was USA and UK. For UK, Korea was the main competitor and for China, Korea was the sole competitor, while for ‘other countries’, USA was the major competitor.

Reference:
The Seventh Asia-Pacific International Symposium on Combustion and Energy Utilization, December 15-17, 2004, Hong Kong SAR
### Annexure-3.5.1. Cashew nut shell liquid exports from India

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity in tons</th>
<th>Value in Rs. Crores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989-90</td>
<td>3014</td>
<td>3.00</td>
</tr>
<tr>
<td>1990-91</td>
<td>5658</td>
<td>5.56</td>
</tr>
<tr>
<td>1991-92</td>
<td>4542</td>
<td>4.02</td>
</tr>
<tr>
<td>1992-93</td>
<td>4258</td>
<td>3.81</td>
</tr>
<tr>
<td>1993-94</td>
<td>3625</td>
<td>2.90</td>
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<tr>
<td>1994-95</td>
<td>3807</td>
<td>2.44</td>
</tr>
<tr>
<td>1995-96</td>
<td>760</td>
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<td>1734</td>
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<td>1997-98</td>
<td>4446</td>
<td>7.17</td>
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<td>1999-00</td>
<td>1930</td>
<td>3.74</td>
</tr>
<tr>
<td>2000-01</td>
<td>2246</td>
<td>3.89</td>
</tr>
<tr>
<td>2001-02</td>
<td>1814</td>
<td>5.93</td>
</tr>
<tr>
<td>2002-03</td>
<td>7215</td>
<td>8.36</td>
</tr>
<tr>
<td>2003-04</td>
<td>6926</td>
<td>7.03</td>
</tr>
<tr>
<td>2004-05</td>
<td>7474</td>
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<td>6993</td>
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</tr>
<tr>
<td>2007-08</td>
<td>7813</td>
<td>11.98</td>
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</table>

Source: Director General of Foreign Trade, India

### Annexure-3.5.2. Country-wise export of CNSL from India (Quantity in tons)

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<tr>
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</thead>
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<td>2095</td>
<td>100</td>
<td>620</td>
<td>653</td>
<td>3075</td>
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<tr>
<td>Korea</td>
<td>263</td>
<td>616</td>
<td>185</td>
<td>715</td>
<td>697</td>
<td>931</td>
</tr>
<tr>
<td>Japan</td>
<td>848</td>
<td>1072</td>
<td>233</td>
<td>291</td>
<td>66</td>
<td>123</td>
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<tr>
<td>U.K</td>
<td>357</td>
<td>586</td>
<td>923</td>
<td>23</td>
<td>53</td>
<td>32</td>
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<tr>
<td>China</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Others</td>
<td>267</td>
<td>77</td>
<td>471</td>
<td>281</td>
<td>777</td>
<td>17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1735</strong></td>
<td><strong>4446</strong></td>
<td><strong>1912</strong></td>
<td><strong>1930</strong></td>
<td><strong>2246</strong></td>
<td><strong>4178</strong></td>
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<td>5834</td>
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<td>Korea</td>
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<td>125</td>
<td>524</td>
<td>447</td>
<td>1010</td>
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<tr>
<td>Japan</td>
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<td>135</td>
<td>154</td>
<td>31</td>
<td>59</td>
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<td>China</td>
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<td>32</td>
<td>0</td>
<td>81</td>
<td>638</td>
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<td>Others</td>
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<td>0</td>
<td>613</td>
<td>16</td>
<td>193</td>
<td>131</td>
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<td><strong>6023</strong></td>
<td><strong>6926</strong></td>
<td><strong>7474</strong></td>
<td><strong>6405</strong></td>
<td><strong>6993</strong></td>
<td><strong>7813</strong></td>
</tr>
</tbody>
</table>

Source: Director General of Foreign Trade, India
## Annexure-3.5.3. Country wise export of CNSL from India (Value in Rs. crores)

<table>
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<tr>
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<tr>
<td>U.S.A</td>
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<td>0.79</td>
<td>0.76</td>
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<tr>
<td>Korea Rep.</td>
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<td>0.46</td>
<td>1.71</td>
<td>1.35</td>
<td>1.48</td>
</tr>
<tr>
<td>Japan</td>
<td>0.92</td>
<td>1.45</td>
<td>0.41</td>
<td>0.63</td>
<td>0.18</td>
<td>0.25</td>
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<tr>
<td>Others</td>
<td>0.32</td>
<td>0.18</td>
<td>0.73</td>
<td>0.52</td>
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<tr>
<td><strong>Total</strong></td>
<td>2.77</td>
<td>7.17</td>
<td>4.21</td>
<td>3.74</td>
<td>3.89</td>
<td>5.89</td>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.A</td>
<td>5.24</td>
<td>6.45</td>
<td>6.45</td>
<td>5.97</td>
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<td>7.58</td>
</tr>
<tr>
<td>Korea Rep.</td>
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<td>1</td>
<td>2.37</td>
<td>1.96</td>
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<tr>
<td>Japan</td>
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<td>0.19</td>
<td>0.24</td>
<td>0.09</td>
<td>0.3</td>
<td>0.36</td>
</tr>
<tr>
<td>U.K</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.62</td>
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<td>China</td>
<td>0</td>
<td>0</td>
<td>0.04</td>
<td>0</td>
<td>0.06</td>
<td>1.15</td>
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<tr>
<td>Others</td>
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<td>0</td>
<td>0.86</td>
<td>0.03</td>
<td>0.2</td>
<td>0.3</td>
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<tr>
<td><strong>Total</strong></td>
<td>8.37</td>
<td>7.04</td>
<td>7.9</td>
<td>7.09</td>
<td>10.28</td>
<td>11.97</td>
</tr>
</tbody>
</table>

Source: Director General of Foreign Trade, India
Cashew Kernels
CHAPTER 4.1.

Global Cashew Kernels Export from Major Supplying Countries

The global cashew kernels export has been increasing consistently over the years. An annual growth rate of 6.6% has been witnessed from 1996 to till date. Higher demand for kernels from USA, The Netherlands, United Arab Emirates and Saudi Arabia has led to a flourishing kernel exports from India, Vietnam and Brazil.

Growth of global cashew kernel export
The global cashew kernels exports have witnessed significant growth from 1986 to 2005. The Indian kernels export has been increasing at an annual growth rate of 6.50% from 1986 to 2005 (FAO Stat). During the period, Brazil and Vietnam kernels export has shown a positive growth, while Sri Lanka and other African countries (like Mozambique, Kenya and Nigeria) have witnessed a negative growth. Brazilian exports have registered a growth of 3.36% and Vietnam has recorded a higher growth of 21.46% from 1986 to 2005.

The share of cashew kernels export from major countries

![Figure 4.1.1. Cashew kernels export from major countries](image)

It is evident from the Figure- 4.1.1 that the cashew kernels export from India had been fluctuating during the period from 1996 to 2005. The country has recorded higher share in 1999 and thereafter the share has been taken away by some other origins. The kernels export from Brazil had also been fluctuating over the year from 1996 to 2005.
Direction of global cashew kernels exports
The direction of global cashew kernels exports has been analysed to identify the reliable suppliers of cashew kernels to the world markets. Though cashew nuts have been produced in more than 30 countries around the world, the exports of kernels were mainly from India and Vietnam. This could be attributed to their expanded processing capacity and tremendous growth in domestic cultivation as well. The data for this analysis has been taken from FAO Stat from 1996 to 2005. During this period, it has been identified that India and Vietnam were reliable suppliers of cashew kernels.

In order to identify the strength of countries reliability in kernels exports, a transitional probability matrix was framed by Markov chain analysis. It is clear from the Table-4.1.1 that India and Vietnam were the stable countries for cashew kernels exports and the remaining countries are unstable. India has shown the probability retention of 0.64 i.e., it can retain about 64% of its share in global cashew kernels export. It is also evident from the table that India has lost 5%, 29% and 2% share to Vietnam Brazil and Indonesia respectively from 1996 to 2005. At the same time, it has gained 24%, 59%, 43% and 83% of Vietnam, Brazil, Indonesia and Kenya market share respectively during the same period. Hence, India had net gain of 19% from Vietnam, 30% from Brazil, 41% of Indonesia and 83% from Kenya over the years 1996-2005.

Table-4.1.1. Results of Markov chain analysis for cashew kernels exports

<table>
<thead>
<tr>
<th>Countries</th>
<th>India</th>
<th>Vietnam</th>
<th>Brazil</th>
<th>Indonesia</th>
<th>Sri Lanka</th>
<th>Mozambique</th>
<th>Nigeria</th>
<th>Kenya</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>0.64</td>
<td>0.05</td>
<td>0.29</td>
<td>0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Vietnam</td>
<td>0.24</td>
<td>0.71</td>
<td>0.05</td>
<td>0.01</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.59</td>
<td>0.34</td>
<td>0.06</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.43</td>
<td>0.00</td>
<td>0.47</td>
<td>0.00</td>
<td>0.00</td>
<td>0.07</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>0.00</td>
<td>0.00</td>
<td>0.15</td>
<td>0.00</td>
<td>0.00</td>
<td>0.85</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Mozambique</td>
<td>0.00</td>
<td>0.00</td>
<td>0.42</td>
<td>0.01</td>
<td>0.02</td>
<td>0.17</td>
<td>0.38</td>
<td>0.00</td>
</tr>
<tr>
<td>Nigeria</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Kenya</td>
<td>0.83</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.06</td>
<td>0.11</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

The kernels export probability retention was reported to be high for Vietnam with 0.71. Thus it has retained 71% of its market share and lost remaining 24% to India and 5% to Brazil during the period 1996-2005. In the mean time, the country has gained 34% of Brazilian and 5% of Indians’ share. Though Vietnam has gained 5% of India’s share, its net trade effect was loss of 19% to India and net gain of 29% from Brazil.
Brazil was not a stable supplier of kernels to the world market, since it has lost 59% of its share to India and 34% to Vietnam though it has gained 47% of Indonesian share and 42% of Mozambican share, 29% of Indian share and 5% of Vietnam share. Overall, Brazil has net loss of 30% to India and 29% to Vietnam over the periods of 1996-2005.

Indonesia and Sri Lanka were considered as unstable supplier of cashew kernels. They gained very little from other countries, but lost more to other origins. Indonesia has lost 43% of its share to India, 47% to Brazil and only 7% to Mozambique. Meanwhile, Sri Lanka has lost more than 3/4th of its share to Mozambique and the remaining share to Brazil.

Some African countries had their presence in global cashew kernels export in the past, have lost their position with the emergence of new and stable suppliers. One of the major African cashews processing country, Mozambique has retained 17% of its share in global kernels exports by gaining 85% of Sri Lankan and 11% of Kenyan share. The Nigeria has lost its entire share to Mozambique, and Kenya has lost about 83% of its share to India and 11% to Mozambique, though it has gained only 3% of Indonesian share.

Overall, the major processing countries such as India, Vietnam and Brazil have strengthened their level of competition. With this, they are posing competition not only to the other countries like Indonesia, Mozambique and Kenya but also among themselves.

**Indian export scenario**

The cashew kernels export from India has witnessed an annual growth of 5% from the year 1996-97 to 2007-08. Though the kernels exports have been increasing steadily over the period, it has peaked in 2004-05 when the exports have reached 126,669 tons. The major importers of Indian cashew kernels are USA, The Netherlands, United Arab Emirates and ‘other countries’ (Saudi Arabia, Singapore, Spain, Israel, Italy, Germany, Australia, Norway, Hong Kong, Lebanon, Russia, Greece, New Zealand, Kuwait, Bahrain, Korea, Malaysia, etc.).

The kernels exports to important cashew consuming countries have been given in the Table-4.1.2. It can be observed that the exports to USA have grown at a rate of 4.78% for the above said period. Kernel exports to The
Netherlands, UK, Japan have shown a negative growth rate of 0.49%, 0.56% and 0.78% respectively. The kernels exports to other countries have increased significantly during the period. Exports to UAE, France, Canada and Saudi Arabia have recorded growth of 16.96%, 5.4%, 6.97% and 15.27% respectively.

<table>
<thead>
<tr>
<th>Countries</th>
<th>CAGR from 1996-97 to 2007-08</th>
<th>CAGR from 2003-04 to 2007-08</th>
<th>2007-08 exports in tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>4.78</td>
<td>-5.27</td>
<td>42690</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>-0.49</td>
<td>4.34</td>
<td>13627</td>
</tr>
<tr>
<td>UK</td>
<td>-0.56</td>
<td>-10.71</td>
<td>3758</td>
</tr>
<tr>
<td>Japan</td>
<td>-0.78</td>
<td>-3.14</td>
<td>5114</td>
</tr>
<tr>
<td>UAE</td>
<td>16.96</td>
<td>19.40</td>
<td>12690</td>
</tr>
<tr>
<td>France</td>
<td>5.41</td>
<td>11.27</td>
<td>4033</td>
</tr>
<tr>
<td>Canada</td>
<td>6.97</td>
<td>-14.82</td>
<td>659</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>15.27</td>
<td>12.48</td>
<td>3422</td>
</tr>
</tbody>
</table>

Source: Various customs sources, India

If we look into the five-year's CAGR from 2003-04 to 2007-08, it has witnessed that the export growth was negative in the case of USA, UK, Japan and Canada. Meanwhile, it has increased in case of UAE with an annual growth of 19.4%, Saudi Arabia with 12.5%, France with 11.3% and The Netherlands with 4.34%.

The top five destinations for Indian kernels from 2003-04 to 2007-08 with their respective share in India’s total kernels exports are given in the below Figure-4.1.2. Among the major destinations, USA takes a major share in India’s exports followed by United Arab Emirates and United Kingdom. Though USA has major share in India’s kernel exports, its share has been declining from 48% in 2003-04 to 37% in 2007-08. On the other hand, the Netherlands share has been increasing from 2003-04 to 2006-07 except for 2007-08. United Arab Emirates, Japan, France and Saudi Arabia have also witnessed higher share over the years.
Direction of India’s cashew kernels exports

It is evident from the Table-4.1.3 that USA, the Netherlands and United Arab Emirates were stable markets for Indian kernels, whereas United Kingdom, Japan, France and Canada were unstable markets. The higher probability retention of USA has shown that USA has retained 76% of its share and lost 6% of its share to UK, 3% to Canada, 1% each to UAE and France. Meanwhile, the whole share of UK has been taken away by USA and it also grappled 93% of Japan share and 7% of other minor destinations share. Hence, the net gain for USA from UK was 94%.

Table-4.1.3. Quantity of Cashew kernel exports from India (in tons)

<table>
<thead>
<tr>
<th></th>
<th>U.S.A</th>
<th>Netherlands</th>
<th>U.K</th>
<th>Japan</th>
<th>U.A.E</th>
<th>France</th>
<th>Canada</th>
<th>Others</th>
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</thead>
<tbody>
<tr>
<td>USA</td>
<td>0.76</td>
<td>0.00</td>
<td>0.06</td>
<td>0.00</td>
<td>0.01</td>
<td>0.01</td>
<td>0.03</td>
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</tr>
<tr>
<td>Netherlands</td>
<td>0.02</td>
<td>0.58</td>
<td>0.17</td>
<td>0.22</td>
<td>0.00</td>
<td>0.01</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>U.K</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<td>0.00</td>
</tr>
<tr>
<td>Japan</td>
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<td>0.00</td>
<td>0.28</td>
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<tr>
<td>Canada</td>
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<td>0.00</td>
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<td>0.98</td>
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<td>0.02</td>
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</tbody>
</table>

The Netherlands had probability retention of 0.58 i.e., it has kept 58% of its market share and lost 22% its share to Japan, 17% to UK and only 2% to USA. At the same time, the country has gained 100% of France share and 7% of ‘other countries’ share. United Arab Emirates probability retention was 0.28 i.e., it has retained 28% of its market share and lost remaining share to ‘other countries’, but gained 98% of Canada’s share. The unstable markets such as UK and France have lost 100% of their share to USA and the Netherlands respectively. The other unstable market Japan has lost 93% of its share to USA and 7% to UK though it has gained 22% of Netherlands’s share.
Vietnam Export Scenario
At present, Vietnam is one of the major processors and exporters of cashew nut. The country has witnessed a growth of 31% annually in its exports from 1999 to 2006.

Table-4.1.4. Quantity of cashew kernels exports from Vietnam

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity of kernels export</th>
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</thead>
<tbody>
<tr>
<td>1999</td>
<td>15800</td>
</tr>
<tr>
<td>2000</td>
<td>35000</td>
</tr>
<tr>
<td>2001</td>
<td>41000</td>
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<td>2002</td>
<td>63000</td>
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<tr>
<td>2003</td>
<td>80000</td>
</tr>
<tr>
<td>2004</td>
<td>100000</td>
</tr>
<tr>
<td>2005</td>
<td>103000</td>
</tr>
<tr>
<td>2006</td>
<td>127000</td>
</tr>
</tbody>
</table>

Source: VINACAS & Various news sources

Vietnam Cashew kernel export
Vietnam had exported mostly unprocessed cashew nuts and it was the situation throughout the 1990s. However, industry-wide efforts in upgrading processing facilities paid off when the nation surpassed Brazil to become the world’s No.2 cashew nut processor and exporter in 2002. According to the Vietnam Association of Cashew Processors, Vietnam now imports raw cashews for export processing. Vietnamese cashew has been sold to 40 countries. Nearly 40% of the produce has been sent to the US, 20% to China, 20% to the Europe and the remaining to Russia, Japan and the Middle East countries.

It is seen from the Figure- 4.1.3 that the cashew kernels exports from Vietnam has been in up trend and recorded a growth of nearly 28% from 1999 to 2007. The export volume during 1999 was only 15,800 tons but it has been increasing significantly and has reached 140,000 tons in 2006. With this, Vietnam has become the leading exporter of cashew kernels in
the world. It is a commendable break through in the cashew sector. The main reason behind this achievement is the higher productivity of cashew in Vietnam against the leading producer, India.

Comparison of cashew kernels exports from major processing countries

![Figure- 4.1.4. Comparison of cashew kernels exports](image)

It is evident from the Figure-4.1.4 that the Vietnamese kernels exports have been increasing over the year from 1999-2000 to till date with a tremendous annual growth of 28%. During this period, Indian exports have been increasing at the rate of 3.6% annually. Meanwhile, Vietnam has over taken India’s position of the leading exporter of cashew kernels in 2006-07. However, their production and processing capacity is still lower than the World cashew leader, India.

Brazilian cashew exports

<table>
<thead>
<tr>
<th>Countries</th>
<th>Exports in tons</th>
<th>% to total</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>29484</td>
<td>70.93</td>
</tr>
<tr>
<td>Canada</td>
<td>3132</td>
<td>7.53</td>
</tr>
<tr>
<td>Italy</td>
<td>1630</td>
<td>3.92</td>
</tr>
<tr>
<td>Lebanon</td>
<td>1207</td>
<td>2.90</td>
</tr>
<tr>
<td>Netherlands</td>
<td>832</td>
<td>2.00</td>
</tr>
<tr>
<td>Germany</td>
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<td>1.74</td>
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<tr>
<td>France</td>
<td>573</td>
<td>1.38</td>
</tr>
<tr>
<td>Others</td>
<td>3984</td>
<td>9.58</td>
</tr>
<tr>
<td>Total</td>
<td>41567</td>
<td>100.00</td>
</tr>
</tbody>
</table>
The cashew kernels export from Brazil in 2003 has been given in Table-4.1.5. This has indicated the higher exports to USA i.e., about 71% of their exports share to USA only and 7.5% of their exports to Canada. Canada has imported nearly 4% of the Brazilian total exports.

The cashew nut production has shown an annual growth rate of 2.4% in Brazil from 1990 to 2005. Meanwhile, the cashew kernels exports from Brazil have shown an increase of 2.5% annually as shown in Figure-4.1.5.

In Brazil, maximum of 25% raw cashew nut equivalent of total production was retained for domestic consumption. The remaining has been exported along with the imported raw nuts from other African countries.

![Figure-4.1.5. Brazilian Cashew Kernels Exports](image)

Source: FAO Stat

**Indian Vision 2020**

- CEPCI visualizes export of 275,000 tons of cashew kernels by 2020 against the current 115,000 tons. This requires Indian raw nut production to be increased to 1.9 million tons, while maintaining imports at 0.50 million tons.
- The Vision 2020 goal is to produce 1.95 million tons of cashews. Of this, the East will have to produce half of the Vision 2020 goal, which will be close to 950,000 tons. At least 200,000 tons will have to come from Tamil Nadu, 400,000 tons from Andhra Pradesh and 350,000 tons from Orissa, West Bengal, and Northeast.
- CEPCI has also visualized that this level of production leads to employment generation of 850 million man-days for 1.25 million workers and sustainable horticulture opportunities for one million farmers.
- The number of countries to which cashews are exported shall be increased from 60 to 125.
- CEPCI will target a compounded annual growth rate in exports to
20% ‘focus’ countries in the new markets being explored.

- It will strive to ensure that at least 20% of the exports will be value-added and marketed under the ‘Made In India’ brand.
- CEPCI will also strive to enhance productivity and competitiveness in cultivation and post-harvest technology of raw cashew nuts by motivating all departments under the Ministry of Agriculture at central and state levels.
- Efforts will be made to raise awareness about the nutrition value of cashew to target groups and other benefits to a larger audience. Studies will be launched to substantiate, validate and confirm the benefits to the consumer.
- Multilateral initiatives will be launched to foster co-operative and collective efforts in the promotion of cashew consumption for all-round development of the cashew economy.

Vietnam vision

- Vietnam’s Ministry of Agriculture and Rural Development (MARD) has announced a strategy to develop the country’s cashew sector by 2010 and 2020

- This strategy is focusing on development of high-quality cashew growing areas, setting up large processing establishments and product diversification.

- The country has planned to increase its cashew output to 666,000 tons in 2020, from expected 500,000 tons in 2010.

- It has planned to increase the acreage under cashew to 450,000 ha during 2010 and improving the productivity to 3-4 tons per hectare.

- Vietnam has also targeted cashew export revenues of 820-850 million U.S. dollars in 2020, up from estimated 560 million dollars in 2007.
### Annexure- 4.1.1. Cashew kernels exports from major supplying countries (in '000 tons)

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Vietnam</th>
<th>Brazil</th>
<th>Indonesia</th>
<th>Sri Lanka</th>
<th>Mozambique</th>
<th>Nigeria</th>
<th>Kenya</th>
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Source: FAO Stat
Annexure- 4.1.2. Quantity of Cashew kernels exports from India to various countries (in tons)

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</table>

Source: Director General of Foreign Trade & various customs sources, India
Annexure- 4.1.3. Value of Cashew kernels exports from India to various countries (in Million Rs.)

<table>
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<td>22888.97</td>
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Source: Director General of Foreign Trade & various customs sources, India
Global Cashew Kernel Imports by Major Consuming Countries

The global cashew kernels import in the year 2005 was reported to be 286,440 tons. The Compound Annual Growth Rate (CAGR) of kernels import by countries around the world was 11.6% during the period 1999-2005. The major cashew kernels importers were USA, The Netherlands, United Kingdom, Australia, Germany and Canada. The other major countries, which import kernels, were United Arab Emirates, Russia, Japan, France and China.

USA is the major importer of cashew kernels and it can be inferred from the Figure- 4.2.1 that about 40% (i.e., 114,200 tons) of global cashew imports in 2005 was contributed by US alone. The Netherlands has contributed nearly 13% (36,180 tons) to the total imports. Meanwhile, Australia and Germany have equally contributed about 4.4% to the total imports.

Table- 4.2.1. CAGR of cashew kernels import by major countries

<table>
<thead>
<tr>
<th>Countries</th>
<th>CAGR from 1999-2005 (%)</th>
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</thead>
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<td>17.57</td>
</tr>
<tr>
<td>Canada</td>
<td>22.32</td>
</tr>
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<td>France</td>
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<td>Germany</td>
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<td>Japan</td>
<td>3.21</td>
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<td>Netherlands</td>
<td>9.33</td>
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<tr>
<td>UK</td>
<td>16.85</td>
</tr>
<tr>
<td>USA</td>
<td>9.51</td>
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<tr>
<td>UAE</td>
<td>18.27</td>
</tr>
<tr>
<td>China</td>
<td>8.55</td>
</tr>
<tr>
<td>Russia</td>
<td>46.17</td>
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<tr>
<td>Others</td>
<td>13.78</td>
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</tbody>
</table>
The CAGR of cashew kernels import by major countries (as it is given in Table- 4.2.1) has witnessed that the growth was prominent in Russia from 1999 to 2005 with CAGR of 46% followed by Canada with 22%. United Arab Emirates, Australia, United Kingdom and Germany have shown a growth of 18.27%, 17.6%, 16.9% and 14% respectively.

Global major suppliers of cashew kernels
In 2005, India and Vietnam had majority of the share to the tune of nearly 78% in exports (Indian export was 114,141 tons and Vietnam was 108,800 tons). Between these two countries, India’s share was 40% and Vietnam has contributed 38%.

India’s kernel supply to world major importers
Table- 4.2.2 has shown that India has been loosing the share in total global imports from 2002-03 onwards except in 2004-05. The share in USA imports has been declining from 2002-03 to 2005-06. The imports from India by The Netherlands, United Kingdom, France and Russia have declined much in 2005-06 against its 2004-05 levels.

<table>
<thead>
<tr>
<th>Countries</th>
<th>From India</th>
<th>Total imports</th>
<th>% to total</th>
<th>From India</th>
<th>Total imports</th>
<th>% to total</th>
<th>From India</th>
<th>Total imports</th>
<th>% to total</th>
<th>From India</th>
<th>Total imports</th>
<th>% to total</th>
</tr>
</thead>
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<td>48304</td>
<td>101770</td>
<td>48</td>
<td>61546</td>
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<td>47</td>
<td>43145</td>
<td>114200</td>
<td>38</td>
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<tr>
<td>Netherlands</td>
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<td>20600</td>
<td>59</td>
<td>12237</td>
<td>25410</td>
<td>48</td>
<td>15693</td>
<td>24100</td>
<td>65</td>
<td>18736</td>
<td>36180</td>
<td>52</td>
</tr>
<tr>
<td>UK</td>
<td>4840</td>
<td>10360</td>
<td>47</td>
<td>5392</td>
<td>10890</td>
<td>50</td>
<td>7108</td>
<td>14990</td>
<td>47</td>
<td>6238</td>
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<td>France</td>
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<td>5000</td>
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<td>2444</td>
<td>3650</td>
<td>67</td>
<td>3329</td>
<td>4410</td>
<td>75</td>
<td>3470</td>
<td>5350</td>
<td>63</td>
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<td>12030</td>
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<td>1558</td>
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<td>14</td>
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<tr>
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<td>15</td>
<td>275</td>
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<td>3</td>
<td>873</td>
<td>11910</td>
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<td>1114</td>
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<td>9</td>
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<tr>
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<td>1700</td>
<td>31</td>
<td>1413</td>
<td>4180</td>
<td>34</td>
<td>2331</td>
<td>5410</td>
<td>43</td>
<td>1990</td>
<td>6360</td>
<td>31</td>
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<td>100828</td>
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<td>286440</td>
<td>46</td>
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</table>

The Indian share in markets of The Netherlands, United Kingdom, France and Russia may be taken away by Vietnam and Brazil.

Role of USA in global kernels import
The global cashew kernel import market is highly dominated by USA. Hence, it is worthwhile to look into the USA imports over the years. The quantity of kernels imported by USA is given in the Figure- 4.2.2. It is clear from the figure that the imports of kernels have been increasing and shown a growth of 7.85% during 1996 to 2007.
Value of cashew kernels import by USA
The cashew kernels import of USA in value terms has also shown an increasing trend over the years with an annual growth of 6.37%.

Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics
USA kernels imports from major processing countries

Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics

The kernel imports by USA have witnessed a clear upward trend from 1996 to 2007, which is evident from the Figure- 4.2.4. USA imports from India have been increasing from 1996-2007 with an annual growth of 4.53% in quantity terms and 3.19% by value terms. Kernels imports from Brazil also increasing with an annual growth of 3.11% by volume and 1.95% by value terms.

Meanwhile, USA imports from Vietnam have shown an inverted pyramid structure in growth with a remarkable growth of 35.36% in volume terms and 33.23% in value terms as witnessed from Table- 4.2.3.

Table- 4.2.3. CAGR of cashew kernels import by USA from major countries (1996-2007)

<table>
<thead>
<tr>
<th>Countries</th>
<th>CAGR of quantity imports</th>
<th>CAGR of value imports</th>
</tr>
</thead>
<tbody>
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<td>3.19</td>
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<td>Vietnam</td>
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<td>33.23</td>
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<tr>
<td>Brazil</td>
<td>3.11</td>
<td>1.95</td>
</tr>
<tr>
<td>Mozambique</td>
<td>-30.32</td>
<td>-30.54</td>
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<tr>
<td>Indonesia</td>
<td>7.7</td>
<td>7.08</td>
</tr>
<tr>
<td>Kenya</td>
<td>10.17</td>
<td>10.12</td>
</tr>
<tr>
<td>Others</td>
<td>1.71</td>
<td>0.52</td>
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</table>
Share of cashew processing countries in USA imports (Quantity)

The kernels import figures for 2007 clearly indicates that the import from Vietnam was highest followed by India and Brazil.

In terms of quantity of cashew kernel imported by USA in 2007, Vietnam taken the prime position with a share of 36%, followed by India with 33.6% and Brazil with 25.5%. Tanzania (1.7%), Indonesia (1.6%), Mozambique (0.3%) and Kenya (0.2%).

Share of important cashew processing countries in USA imports (Value)

Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics
The kernels import by value terms was highest from India with a share of 35.2% followed by Vietnam with 35% and Brazil with 25.3% share.

### Table- 4.2.4. Share of major cashew kernel suppliers to USA (In%)

<table>
<thead>
<tr>
<th>Year</th>
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<th>Vietnam</th>
<th>Brazil</th>
<th>Total</th>
</tr>
</thead>
<tbody>
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<td>1996</td>
<td>46.98</td>
<td>2.74</td>
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<td>1997</td>
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<td>1998</td>
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<tr>
<td>1999</td>
<td>67.21</td>
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<tr>
<td>2000</td>
<td>52.48</td>
<td>12.43</td>
<td>29.38</td>
<td>94.28</td>
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<tr>
<td>2001</td>
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<td>2003</td>
<td>45.53</td>
<td>27.46</td>
<td>25.21</td>
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<td>2004</td>
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<td>98.39</td>
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<td>2005</td>
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<td>2006</td>
<td>39.20</td>
<td>33.16</td>
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<td>96.08</td>
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<tr>
<td>2007</td>
<td>33.64</td>
<td>36.14</td>
<td>25.54</td>
<td>95.32</td>
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From the above Table-4.2.4, the following inference can be drawn.
- Top three suppliers of cashew kernel have been able to maintain their share above 94% most of the times.
- However, the share among the top three suppliers has seen dramatic change with the emergence of Vietnam as a large supplier.

### Table- 4.2.5. Share of African and other suppliers to US (In%)

<table>
<thead>
<tr>
<th>Mozambique</th>
<th>Tanzania</th>
<th>Kenya</th>
<th>African total</th>
<th>Others</th>
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<tr>
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</tr>
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<td>0.72</td>
<td>0.28</td>
<td>1.09</td>
<td>1.96</td>
<td>3.05</td>
</tr>
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<td>1.55</td>
<td>0.35</td>
<td>2.06</td>
<td>1.85</td>
<td>3.92</td>
</tr>
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<td>0.28</td>
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<td>0.15</td>
<td>2.13</td>
<td>2.56</td>
<td>4.68</td>
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</table>

The share of African countries supplies in USA kernels import has been fluctuating over the years (as given in Table-4.2.5). The reasons could be financial constraint, technology constraint, and availability of skilled manpower, poor marketing infrastructure support.
The other countries, which were exporting cashew kernels to USA were Indonesia, Sri Lanka, China, Kenya, Ivory Coast, South Africa, Thailand and Singapore.

**Drivers of cashew kernel exports by major processing countries**

It is well known that endogenous factors such as raw cashew availability and skilled manpower are the major drivers that drive competitiveness of suppliers. However, in the recent times, exogenous factors such as exchange rate (value of domestic currency against US Dollar), crude oil price are influencing competitiveness of suppliers. Exchange rates and its impact on trade are elaborated below:

1. It is very apparent from the Table-4.2.6 that the Vietnam currency (Dong) has depreciated steadily against the US Dollar over the years from 1996 to 2007. However, the value of Indian Rupee and Brazilian Real has been fluctuating over the years.

2. For Vietnam and India, quantity exported to USA is highly positively correlated with the currency value to an extent of over 80%. However, the influence of currency value on exports from Brazil is found to be relatively insignificant. Probably, factors such as proximity, favourable trade treaties and so on could drive trade between US and Brazil.

3. Since 2002, the value of Indian Rupee has appreciated gradually, while the value of Dong has mildly depreciated. All other conditions remaining same, this could have positively influenced exports from Vietnam to USA as evidenced by the data.

### Table- 4.2.6. Cashew kernel supply by India, Vietnam and Brazil with exchange rate

<table>
<thead>
<tr>
<th>Year</th>
<th>India Quantity</th>
<th>India Value</th>
<th>Vietnam Quantity</th>
<th>Vietnam Value</th>
<th>Vietnam Exchange rate</th>
<th>Brazil Quantity</th>
<th>Brazil Value</th>
<th>Brazil Exchange rate</th>
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<td>3618.6</td>
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<td>5170.9</td>
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<td>19635.2</td>
<td>90255</td>
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<td>284030</td>
<td>3838.8</td>
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<td>239058</td>
<td>10132.0</td>
<td>50403</td>
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<td>47545</td>
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<td>79030</td>
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<td>70058</td>
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<td>27948.1</td>
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<td>34228.3</td>
<td>152207</td>
<td>15968</td>
<td>24707.8</td>
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<td>16421</td>
<td>32030.1</td>
<td>141605</td>
<td>1.952</td>
</tr>
</tbody>
</table>

Note: Exchange rate for India is in Rupees, for Vietnam it is Dong and for Brazil it is Real. All exchange rate quotation is per one US dollar.
The regression result of India’s export quantity against the Indian exchange (Against US dollar) has indicated that one% increase in Rupee against USD will increase the kernels export by 1944 tons. Likewise for Vietnam, a% increase in Vietnam Dong against USD will increase the kernels export from Vietnam by 7.5 tons.

**USA's direction of cashew kernels import**

<table>
<thead>
<tr>
<th>Countries</th>
<th>India</th>
<th>Vietnam</th>
<th>Brazil</th>
<th>Mozambique</th>
<th>Indonesia</th>
<th>Tanzania</th>
<th>Kenya</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.11729</td>
<td>0.40921</td>
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<td>0.01261</td>
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</tr>
<tr>
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<td>0.05470</td>
<td>0.00000</td>
<td>0.01524</td>
<td>0.00000</td>
<td>0.00825</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.92336</td>
<td>0.00000</td>
<td>0.07164</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
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</tr>
<tr>
<td>Mozambique</td>
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<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
</tr>
<tr>
<td>Indonesia</td>
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<td>0.33846</td>
<td>0.27575</td>
<td>0.00000</td>
<td>0.00000</td>
</tr>
<tr>
<td>Tanzania</td>
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<td>0.29022</td>
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<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
</tr>
<tr>
<td>Kenya</td>
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<td>0.00000</td>
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<td>0.00000</td>
<td>0.00000</td>
<td>1.00000</td>
<td>0.00000</td>
</tr>
<tr>
<td>Others</td>
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<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
<td>0.00000</td>
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</tbody>
</table>

The result of transitional probability matrix formed by Markov chain analysis to analyze the change in direction of cashew kernels imports by USA is given in the Table- 4.2.7. The higher probability retention of 0.92 for Vietnam has indicated that it was a stable and a dominant supplier of kernels to USA and able to retain 92% of its share. In the meantime, it has lost very meagre quantity to countries like Brazil, Tanzania and Kenya and gained 29% of Tanzania’s share and nearly 12% of India’s share.

The probability retention of India was 0.45, so it can be inferred that India can retained 45% of its share in kernels import by USA and lost 40% of its share to Brazil, 12% to Vietnam and minimum quantity to Indonesia and Kenya over the years from 1996-2007. At the same time, India has gained the entire share of Mozambique and “other countries” and 92% of Brazil share and 29% of Indonesian share. Though Brazil has gained 71% of Tanzania’s share and 41% of India’s share over the period of 1996-2007, it can retains only 7% of its own share in kernels supply to USA.

The African countries were supplying only little quantity to USA; hence whatever they gained from their neighbouring countries has not reflected much in USA imports. For example, though Tanzania has gained 100% of Kenya’s share, it doesn’t reflect much on USA kernels imports. In brief, it can be inferred that India and Vietnam were the stable suppliers for cashew kernels to USA. Brazil was a less stable supplier; whereas exports from countries like Mozambique, Tanzania and Kenya were unstable during 1996-2007.
### Annexure- 4.2.1. Global cashew kernels import (in tons)

<table>
<thead>
<tr>
<th>Countries</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
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<tr>
<td>Australia</td>
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<td>11910</td>
<td>12610</td>
</tr>
<tr>
<td>Canada</td>
<td>3740</td>
<td>4830</td>
<td>5610</td>
<td>8100</td>
<td>10020</td>
<td>12030</td>
<td>11000</td>
</tr>
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<td>9360</td>
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</tr>
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<td>Netherlands</td>
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<td>20490</td>
<td>19000</td>
<td>20600</td>
<td>25410</td>
<td>24100</td>
<td>36180</td>
</tr>
<tr>
<td>UK</td>
<td>7910</td>
<td>8040</td>
<td>9500</td>
<td>10360</td>
<td>10890</td>
<td>14990</td>
<td>21350</td>
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<tr>
<td>USA</td>
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<tr>
<td>UAE</td>
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<td>China</td>
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<td>2040</td>
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<td>7410</td>
<td>3210</td>
<td>4590</td>
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<td>970</td>
<td>1470</td>
<td>1700</td>
<td>4180</td>
<td>5410</td>
<td>6360</td>
</tr>
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<td>Others</td>
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<td>19650</td>
<td>21270</td>
<td>28130</td>
<td>38970</td>
<td>40140</td>
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<tr>
<td>Total</td>
<td>156850</td>
<td>163010</td>
<td>180040</td>
<td>209430</td>
<td>233140</td>
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<td>286440</td>
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Source: FAO Stat

### Annexure- 4.2.2. Quantity of cashew kernels imports by USA (in tons)

<table>
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<tr>
<th>Year</th>
<th>India</th>
<th>Vietnam</th>
<th>Brazil</th>
<th>Mozambique</th>
<th>Indonesia</th>
<th>Tanzania</th>
<th>Kenya</th>
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Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics
### Annexure- 4.2.3. Value of cashew kernels imports by USA (in '000 USD)

<table>
<thead>
<tr>
<th>Year</th>
<th>India</th>
<th>Vietnam</th>
<th>Brazil</th>
<th>Mozambique</th>
<th>Indonesia</th>
<th>Tanzania</th>
<th>Kenya</th>
<th>Others</th>
<th>Total</th>
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</table>

Source: Department of Commerce, U.S. Census Bureau, Foreign Trade Statistics
CHAPTER 4.3.

Nutritional Aspects of Cashew Nuts

The tree nuts such as cashew, almond, pistachio, walnut, hazelnut, Brazil nut and macadamia nut are rich in nutrition. Understanding the nutritional aspects and promoting their benefits to the consumers facilitates consumption growth of these nuts. Here an attempt has been made to focus the nutrients relished from cashew nut against the other major tree nuts.

Calorific requirement (in Kilo calories)
The calorific requirements of different work groups in different categories as given by the National Institute of Nutrition in India are given in the Table-4.3.1.

Table- 4.3.1. Calorific requirement of different categories of work groups (in kcal)

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<th>Activity level</th>
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<th>Adult Woman</th>
</tr>
</thead>
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<td>Sedentary</td>
<td>2425</td>
<td>1875</td>
</tr>
<tr>
<td>Moderate</td>
<td>2875</td>
<td>2225</td>
</tr>
<tr>
<td>Heavy</td>
<td>3800</td>
<td>2925</td>
</tr>
</tbody>
</table>

Source: National Institute of Nutrition

In general the calorific requirement varies with the age, gender, and physical activity. The calorific requirements of different age groups were discussed in the following Table-4.3.2.

Table- 4.3.2. Calorific requirement of different age groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Kilocalories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnant women</td>
<td>300*</td>
</tr>
<tr>
<td>Lactating women (0-06 months)</td>
<td>550*</td>
</tr>
<tr>
<td>(6-12 months)</td>
<td>400*</td>
</tr>
<tr>
<td>Infants 0-6 months</td>
<td>118 /kg body weight</td>
</tr>
<tr>
<td>6-12 months</td>
<td>98 /kg body weight</td>
</tr>
<tr>
<td>Children 1-3 years</td>
<td>1240</td>
</tr>
<tr>
<td>Children 4-6 years</td>
<td>1690</td>
</tr>
<tr>
<td>Children 7-9 years</td>
<td>1950</td>
</tr>
<tr>
<td>Boys 10-12 years</td>
<td>2190</td>
</tr>
<tr>
<td>13-15 years</td>
<td>2450</td>
</tr>
<tr>
<td>16-18 years</td>
<td>2640</td>
</tr>
<tr>
<td>Girls 10-12 years</td>
<td>1970</td>
</tr>
<tr>
<td>13-15 years</td>
<td>2060</td>
</tr>
<tr>
<td>16-18 years</td>
<td>2060</td>
</tr>
</tbody>
</table>

Note: * indicates in addition to the normal requirements

Source: National Institute of Nutrition
Since energy and nutrients are derived from carbohydrates, proteins, fats, vitamins and minerals, the requirement for the same by each should be known well before to have balanced food.

**Carbohydrates:** 60 to 70% of the total calorie requirement should be obtained from carbohydrates; within this greater importance should be given to complex carbohydrates than simple carbohydrates. They break down quickly during digestion and provide an immediate source of energy to the bloodstream.

**Proteins:** 0.8 - 1 gm protein per kg of ideal body weight should be taken. For e.g. a person with 65 kg should intake 52 - 65 grams of protein. The proteins requirement should be made from various sources.

**Fat:** This should not exceed 20 to 30% of total calorie requirement. The fat requirement should be met largely from vegetable sources and less from animal sources (butter, ghee).

**The supporting points for intake of cashew nut**
According to a study conducted by Kerala State Cashew Development Corporation (KSCDC), the cashew kernels, being a plant food, are cholesterol-free. Cashew kernels contain fat but the general misunderstanding is that fat is cholesterol. Cashew fat in does not possess a nutritional risk and is safe, healthy and trouble free. KSCDC also came out with a result of a study saying that consuming 28 grams of cashew kernels five days a week resulted in a 27% lower risk of developing diabetes. This is attributed to the high content of chromium and certain antioxidants present in the nuts, which help in delaying degenerative diseases such as diabetes. The report also revealed that the cashew kernels are nature’s vitamin pills for children. The kernels are a good source of at least six forms of vitamin. Nuts and seeds don’t contain cholesterol and are a good source of dietary fibre. About 85% of the fat content is essential fatty acids, which are needed by every cell in our bodies. Nuts have a high calorie count. The nut eaters live longer and 30 grams per day is generally considered a healthy amount.

**Glycemic Index**
The glycemic index or GI is an index to know the relative glycemic response to dietary carbohydrates. Not all carbohydrate foods are created equal; in fact they behave quite differently in our bodies. It describes this difference by ranking carbohydrates according to their effect on our blood glucose
levels. By definition, the consumption of high-glycemic index foods results in higher and more rapid increases in blood glucose levels than the consumption of low-glycemic index foods. In contrast, the consumption of low-glycemic index foods results in lower but more sustained increases in blood glucose and lower insulin demands on pancreatic beta-cells. Dietary glycemic load is the sum of the glycemic loads for all foods consumed in the diet. The concept of glycemic load was developed by scientists to simultaneously describe the quality (glycemic index) and quantity of carbohydrate in a meal or diet.

The benefits of low glycemic index foods are,

- Helps people lose and control weight
- Increase the body’s sensitivity to insulin
- Improve diabetes control
- Reduce the risk of heart disease
- Reduce blood cholesterol levels
- Reduce hunger and keep you fuller for longer
- Prolong physical endurance
- Help re-fuel carbohydrate stores after exercise

Some strategies for lowering dietary glycemic load include:

- Increasing the consumption of whole grains, nuts, legumes, fruits and nonstarchy vegetables
- Decreasing the consumption of starchy high-glycemic index foods like potatoes, white rice and white bread
- Decreasing the consumption of sugary foods like cookies, cakes, candy and soft-drinks.

See the Table-4.3.3 for the glycemic index and glycemic load values of selected foods relative to glucose. Foods with higher glycemic index values are at the top of the table, while foods with lower glycemic index values are at the bottom of the table.
Table- 4.3.3. Glycemic index and glycemic load values of selected foods

<table>
<thead>
<tr>
<th>Food</th>
<th>Glycemic Index</th>
<th>Serving size</th>
<th>Carbohydrate per serving (g)</th>
<th>Glycemic Load per serving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dates, dried</td>
<td>103</td>
<td>2 oz</td>
<td>40</td>
<td>42</td>
</tr>
<tr>
<td>Cornflakes</td>
<td>81</td>
<td>1 cup</td>
<td>26</td>
<td>21</td>
</tr>
<tr>
<td>Jelly beans</td>
<td>78</td>
<td>1 oz</td>
<td>28</td>
<td>22</td>
</tr>
<tr>
<td>Puffed rice cakes</td>
<td>78</td>
<td>3 cakes</td>
<td>21</td>
<td>17</td>
</tr>
<tr>
<td>Doughnut</td>
<td>76</td>
<td>1 medium</td>
<td>23</td>
<td>17</td>
</tr>
<tr>
<td>Dates, dried</td>
<td>103</td>
<td>2 oz</td>
<td>40</td>
<td>42</td>
</tr>
<tr>
<td>Cornflakes</td>
<td>81</td>
<td>1 cup</td>
<td>26</td>
<td>21</td>
</tr>
<tr>
<td>Jelly beans</td>
<td>78</td>
<td>1 oz</td>
<td>28</td>
<td>22</td>
</tr>
<tr>
<td>Puffed rice cakes</td>
<td>78</td>
<td>3 cakes</td>
<td>21</td>
<td>17</td>
</tr>
<tr>
<td>Doughnut</td>
<td>76</td>
<td>1 medium</td>
<td>23</td>
<td>17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food</th>
<th>Glycemic Index</th>
<th>Serving size</th>
<th>Carbohydrate per serving (g)</th>
<th>Glycemic Load per serving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soda crackers</td>
<td>74</td>
<td>4 crackers</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td>White bread</td>
<td>73</td>
<td>1 large slice</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>Table sugar (sucrose)</td>
<td>68</td>
<td>2 tsp</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Pancake</td>
<td>67</td>
<td>6&quot; diameter</td>
<td>58</td>
<td>39</td>
</tr>
<tr>
<td>White rice (boiled)</td>
<td>64</td>
<td>1 cup</td>
<td>36</td>
<td>23</td>
</tr>
<tr>
<td>Brown rice (boiled)</td>
<td>55</td>
<td>1 cup</td>
<td>33</td>
<td>18</td>
</tr>
<tr>
<td>Oranges, raw</td>
<td>42</td>
<td>1 medium</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Pears, raw</td>
<td>38</td>
<td>1 medium</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Apples, raw</td>
<td>38</td>
<td>1 medium</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>All-Bran cereal</td>
<td>38</td>
<td>1 cup</td>
<td>23</td>
<td>9</td>
</tr>
<tr>
<td>Skim milk</td>
<td>32</td>
<td>8 fl oz</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>Lentils, dried; boiled</td>
<td>29</td>
<td>1 cup</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>Kidney beans, dried; boiled</td>
<td>28</td>
<td>1 cup</td>
<td>25</td>
<td>7</td>
</tr>
<tr>
<td>Pearled barley; boiled</td>
<td>25</td>
<td>1 cup</td>
<td>42</td>
<td>11</td>
</tr>
<tr>
<td>Cashew nuts</td>
<td>22</td>
<td>1 oz</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Peanuts</td>
<td>14</td>
<td>1 oz</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: 1 oz= 1 ounce = 31.1 grams  
1 tsp= 1 teaspoon  
Source: Linus Pauling Institute, Oregon State University

It is clearly evident from the table that cashew nuts are having less glycemic index value of 22 compared with the food items prepared by cereals and pulses. Therefore, cashew nuts are good for health and also a rich calorific food. Those countries with higher production of nuts (take the advantage of cashew nuts availability with lower cost) can meet out their nutrient requirement by consuming proportionate quantity of cashew nuts along with other cereals and pulses.
### Table- 4.3.4. Comparison of nutrients in different food items (per 100 gms)

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Cashew</th>
<th>Rice</th>
<th>Ragi</th>
<th>Wheat</th>
<th>Sorghum</th>
<th>Maize</th>
<th>Green gram</th>
<th>Chick pea</th>
<th>Peanut</th>
<th>Red gram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proteins (gm)</td>
<td>18.22</td>
<td>6.79</td>
<td>7.3</td>
<td>13.68</td>
<td>11.3</td>
<td>9.42</td>
<td>23.86</td>
<td>19.3</td>
<td>25.8</td>
<td>21.7</td>
</tr>
<tr>
<td>Fat (gm)</td>
<td>43.85</td>
<td>0.56</td>
<td>1.3</td>
<td>2.47</td>
<td>3.3</td>
<td>4.74</td>
<td>1.15</td>
<td>6.04</td>
<td>49.24</td>
<td>1.49</td>
</tr>
<tr>
<td>Carbohydrate (gm)</td>
<td>30.19</td>
<td>81.72</td>
<td>72</td>
<td>71.13</td>
<td>74.63</td>
<td>74.26</td>
<td>62.62</td>
<td>60.66</td>
<td>16.14</td>
<td>62.78</td>
</tr>
<tr>
<td>Fibre Content (gm)</td>
<td>3.3</td>
<td>1.7</td>
<td>3.6</td>
<td>2.7</td>
<td>6.3</td>
<td>7.3</td>
<td>16.3</td>
<td>17.4</td>
<td>8.5</td>
<td>15</td>
</tr>
<tr>
<td>Calorie value (kcal)</td>
<td>553</td>
<td>371</td>
<td>328</td>
<td>339</td>
<td>339</td>
<td>365</td>
<td>347</td>
<td>364</td>
<td>567</td>
<td>343</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>12</td>
<td>11</td>
<td>2</td>
<td>6</td>
<td>35</td>
<td>15</td>
<td>24</td>
<td>18</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>660</td>
<td>120</td>
<td>408</td>
<td>431</td>
<td>350</td>
<td>287</td>
<td>1246</td>
<td>875</td>
<td>705</td>
<td>1392</td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>37</td>
<td>60</td>
<td>344</td>
<td>34</td>
<td>28</td>
<td>7</td>
<td>132</td>
<td>105</td>
<td>92</td>
<td>130</td>
</tr>
<tr>
<td>Phosphorus (mg)</td>
<td>593</td>
<td>136</td>
<td>283</td>
<td>508</td>
<td>287</td>
<td>210</td>
<td>367</td>
<td>366</td>
<td>376</td>
<td>367</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>292</td>
<td>31</td>
<td>144</td>
<td>127</td>
<td>189</td>
<td>115</td>
<td>168</td>
<td>183</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron (mg)</td>
<td>6.68</td>
<td>1.5</td>
<td>3.9</td>
<td>3.9</td>
<td>4.4</td>
<td>2.71</td>
<td>6.74</td>
<td>6.24</td>
<td>4.58</td>
<td>5.23</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>5.78</td>
<td>0.96</td>
<td>4.16</td>
<td>2.21</td>
<td>2.68</td>
<td>3.43</td>
<td>2.87</td>
<td>3.27</td>
<td>2.76</td>
<td></td>
</tr>
<tr>
<td>Thiamine (mg)</td>
<td>0.42</td>
<td>0.1</td>
<td>0.42</td>
<td>0.42</td>
<td>0.237</td>
<td>0.385</td>
<td>0.621</td>
<td>0.477</td>
<td>0.64</td>
<td>0.645</td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td>0.058</td>
<td>0.07</td>
<td>0.19</td>
<td>0.121</td>
<td>0.142</td>
<td>0.201</td>
<td>0.233</td>
<td>0.212</td>
<td>0.135</td>
<td>0.187</td>
</tr>
<tr>
<td>Niacin (mg)</td>
<td>1.062</td>
<td>3.632</td>
<td>1.1</td>
<td>6.738</td>
<td>2.927</td>
<td>3.627</td>
<td>2.251</td>
<td>1.541</td>
<td>12.066</td>
<td>2.965</td>
</tr>
<tr>
<td>Vitamin B6 (mg)</td>
<td>0.417</td>
<td>0.445</td>
<td>0.044</td>
<td>0.622</td>
<td>0.382</td>
<td>0.535</td>
<td>0.348</td>
<td>0.283</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


It can be seen from the Table-4.3.4 that cashew nut has high calorific value of 553 kilocalories when compared to other cereals and pulses taken here for comparison. Though it contains lower carbohydrates, the protein and fat content are very significant in cashew nut. Apart from proteins and fat, the nuts are also a good source of minerals like potassium, phosphorus, magnesium, sodium, calcium and iron.

Studies by KSCDC have showed that the fatty acid content in cashew is not harmful; besides it is cholesterol free safe, healthy and trouble free. Nearly 80% of the fat content in cashew nut is essential fatty acids ie., rich in mono-unsaturated fat which may help to protect the heart.

In terms of protein content, the cashew nuts contain significant amount of proteins next to major pulses. They are also having considerable amount of minerals like potassium, phosphorus and sodium when compared to other food grains. Apart from these minerals, the cashew nuts are also a source of considerable amount of minerals like calcium and iron.
The cashew nuts are also a good source of vitamins such as thiamin, riboflavin and niacin. According to the study conducted by KSCDC, cashew nuts are a good source of dietary fibres. Almost all-important nutritional contents are there in cashew nuts. Hence, there will be a scope for increasing the consumption habit of cashew nut.

Table- 4.3.5. Current prices of important food items

<table>
<thead>
<tr>
<th>Food Items</th>
<th>Recent prices (in US$/kg)</th>
<th>Source from</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cashew</td>
<td>4.09</td>
<td>June issue, Cashew bulletin, India for LWP grade</td>
</tr>
<tr>
<td>Rice</td>
<td>0.80</td>
<td>Reuters</td>
</tr>
<tr>
<td>Ragi</td>
<td>0.36</td>
<td>Reuters</td>
</tr>
<tr>
<td>Wheat</td>
<td>0.45</td>
<td>Reuters</td>
</tr>
<tr>
<td>Maize</td>
<td>0.30</td>
<td>Reuters</td>
</tr>
<tr>
<td>Green gram</td>
<td>0.60</td>
<td>APEDA, India</td>
</tr>
<tr>
<td>Chick pea</td>
<td>0.75</td>
<td>APEDA, India</td>
</tr>
<tr>
<td>Peanut</td>
<td>0.50</td>
<td>Freshplaza.com</td>
</tr>
<tr>
<td>Red gram</td>
<td>0.72</td>
<td>News sources</td>
</tr>
</tbody>
</table>

The current prices of important food items have given in the Table-4.3.5. Though the price of cashew is higher, the mineral contents are more compared with other food items.

Nutrient realization per Rupee of each food items has been given in Table-4.3.6. It can be seen from the table that the price of cashew kernels are higher by four times when compared to other staple food items. Even though the price was very high in case of cashew kernels, the nutrient contents are in significant level. Among the staple food items, ragi and maize are cheaper in prices and hence the nutrient realization i.e., calorie level, protein, fat, some minerals like potassium and phosphorus are high in case of cereals.
### Table 4.3.6. Nutrient realization per dollar value of major food items

<table>
<thead>
<tr>
<th>Food crops</th>
<th>Calorie (Kcal)</th>
<th>Protein (gm)</th>
<th>Fat (gm)</th>
<th>Potassium (mg)</th>
<th>Phosphorus (mg)</th>
<th>Sodium (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cashew</td>
<td>1351.42</td>
<td>44.53</td>
<td>107.16</td>
<td>1612.90</td>
<td>1449.17</td>
<td>29.33</td>
</tr>
<tr>
<td>Rice</td>
<td>4637.50</td>
<td>84.88</td>
<td>7.00</td>
<td>1500.00</td>
<td>1700.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Ragi</td>
<td>9111.11</td>
<td>202.78</td>
<td>36.11</td>
<td>11333.33</td>
<td>7861.11</td>
<td>305.56</td>
</tr>
<tr>
<td>Wheat</td>
<td>7533.33</td>
<td>304.00</td>
<td>54.89</td>
<td>9577.78</td>
<td>11288.89</td>
<td>44.44</td>
</tr>
<tr>
<td>Maize</td>
<td>12166.67</td>
<td>314.00</td>
<td>158.00</td>
<td>9566.67</td>
<td>7000.00</td>
<td>1166.67</td>
</tr>
<tr>
<td>Green gram</td>
<td>5783.33</td>
<td>397.67</td>
<td>19.17</td>
<td>20766.67</td>
<td>6116.67</td>
<td>250.00</td>
</tr>
<tr>
<td>Chick pea</td>
<td>4853.33</td>
<td>257.33</td>
<td>80.53</td>
<td>11666.67</td>
<td>4880.00</td>
<td>320.00</td>
</tr>
<tr>
<td>Peanut</td>
<td>11340.00</td>
<td>516.00</td>
<td>984.80</td>
<td>14100.00</td>
<td>7520.00</td>
<td>360.00</td>
</tr>
<tr>
<td>Red gram</td>
<td>4763.89</td>
<td>301.39</td>
<td>20.69</td>
<td>19333.33</td>
<td>5097.22</td>
<td>236.11</td>
</tr>
</tbody>
</table>

When considering the nutrient content of cashew nut, the mineral and protein content are in significant level in cashew kernels. The sodium realization per Rupee of cashew is higher than other staple foods. Likewise potassium, sodium and fat content are high in cashew kernels against the major staple food rice. Since the fat in cashew kernel is essential fatty acids, it will be a best substitute in a place where other staple foods availability is scarce.

Since potassium is needed to regulate blood pH, keep the water balance; ensure the acidification of the urine and helps for nerve conduction and muscle contractions. It is worth note that the cashew kernels are good source of potassium. Sodium is also an important nutrient for nerve conduction. The National Academy of Sciences also considers 1,500 mg / day of sodium an adequate intake. So, almost all nutrients are present in cashew kernels. The important fact to notice here is we have to take only adequate quantity of cashew kernels as substitute to combat the excess intake of nutrients by means of other food items and avoid the adverse effect of that excess intake.

**Nutritional comparison between important tree nuts**

The major nuts consumed by people across the world are cashew nuts, almond, pistachio, walnuts, hazel nuts, Brazil nuts and Macadamia nuts.
Table- 4.3.7. Nutrient comparison between major nuts (per 100 gms)

<table>
<thead>
<tr>
<th>Nuts</th>
<th>Protein (g)</th>
<th>Calories (kcal)</th>
<th>Total Fat (g)</th>
<th>Vit E (mg)</th>
<th>Iron (mg)</th>
<th>Fiber (g)</th>
<th>Calcium (mg)</th>
<th>Mg. (mg)</th>
<th>K (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almonds</td>
<td>21.22</td>
<td>575</td>
<td>49.42</td>
<td>26.22</td>
<td>3.72</td>
<td>12.2</td>
<td>264</td>
<td>268</td>
<td>705</td>
</tr>
<tr>
<td>Brazil nuts</td>
<td>14.3</td>
<td>656</td>
<td>66.43</td>
<td>5.73</td>
<td>2.43</td>
<td>7.5</td>
<td>160</td>
<td>376</td>
<td>659</td>
</tr>
<tr>
<td>Cashews</td>
<td>18.22</td>
<td>553</td>
<td>43.85</td>
<td>1.458</td>
<td>6.68</td>
<td>3.3</td>
<td>160</td>
<td>376</td>
<td>659</td>
</tr>
<tr>
<td>Hazelnuts</td>
<td>14.95</td>
<td>628</td>
<td>60.75</td>
<td>15.03</td>
<td>4.7</td>
<td>9.7</td>
<td>114</td>
<td>163</td>
<td>680</td>
</tr>
<tr>
<td>Macadamias</td>
<td>7.91</td>
<td>718</td>
<td>75.77</td>
<td>0.54</td>
<td>3.69</td>
<td>8.6</td>
<td>85</td>
<td>130</td>
<td>368</td>
</tr>
<tr>
<td>Pistachios</td>
<td>20.61</td>
<td>557</td>
<td>44.44</td>
<td>2.3</td>
<td>4.15</td>
<td>10.3</td>
<td>107</td>
<td>121</td>
<td>1025</td>
</tr>
<tr>
<td>Walnuts</td>
<td>14.3</td>
<td>642</td>
<td>53.9</td>
<td>2.5</td>
<td>2.4</td>
<td>4.8</td>
<td>94</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>


Table-4.3.7 indicates that in terms of calorific value of important tree nuts, macadamia nuts having higher calorific value followed by brazil nuts, walnuts, hazel nuts, almonds, pistachio and cashew nuts. Meanwhile, iron content is very high in cashew nuts when compared with other nuts.

Table- 4.3.8. Current prices for important tree nuts

<table>
<thead>
<tr>
<th>Nuts</th>
<th>Recent prices (in US$ / kg)</th>
<th>Variety specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almonds</td>
<td>5.19</td>
<td>US Non-pareil</td>
</tr>
<tr>
<td>Brazil nuts</td>
<td>5.50</td>
<td>Medium nuts</td>
</tr>
<tr>
<td>Cashews</td>
<td>4.09</td>
<td>LWP (Rotterdam)</td>
</tr>
<tr>
<td>Hazelnuts</td>
<td>13.53</td>
<td>Turkish standard 2</td>
</tr>
<tr>
<td>Macadamias</td>
<td>7.70</td>
<td>Australian variety</td>
</tr>
<tr>
<td>Pistachios</td>
<td>13.20</td>
<td>Iranian pistachio</td>
</tr>
<tr>
<td>Walnuts</td>
<td>14.00</td>
<td>Light amber brokens</td>
</tr>
</tbody>
</table>

Note: Prices for cashew, Almond, Brazil nut, Hazelnut and Walnut from June issue of cashew bulletin and pistachio and macadamia prices from news sources.

Even though the other nuts possess high nutrient content when compared to cashew nuts, the prices of those nuts are costly when compared to cashew nuts as stated in the Table-4.3.8. Hence, the nutrient realization per dollar is higher in case of cashew nuts compared with other nuts. It is evident from the Table-4.3.9.
Table 4.3.9. Nutrient realization per dollar value of major tree nuts

<table>
<thead>
<tr>
<th>Nuts</th>
<th>Protein (g)</th>
<th>Calories (kcal)</th>
<th>Total Fat (g)</th>
<th>Vit E (mg)</th>
<th>Iron (mg)</th>
<th>Fiber (g)</th>
<th>Calcium (mg)</th>
<th>Mg. (mg)</th>
<th>K (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almonds</td>
<td>40.87</td>
<td>1107.47</td>
<td>95.18</td>
<td>50.50</td>
<td>7.16</td>
<td>23.50</td>
<td>508.47</td>
<td>516.18</td>
<td>1357.86</td>
</tr>
<tr>
<td>Brazil nuts</td>
<td>26.00</td>
<td>1192.73</td>
<td>120.78</td>
<td>10.42</td>
<td>4.42</td>
<td>13.64</td>
<td>290.91</td>
<td>683.64</td>
<td>1198.18</td>
</tr>
<tr>
<td>Cashews</td>
<td>44.53</td>
<td>1351.42</td>
<td>107.16</td>
<td>3.56</td>
<td>16.32</td>
<td>8.06</td>
<td>90.42</td>
<td>713.59</td>
<td>1612.90</td>
</tr>
<tr>
<td>Hazelnuts</td>
<td>11.05</td>
<td>464.17</td>
<td>44.90</td>
<td>11.11</td>
<td>3.47</td>
<td>7.17</td>
<td>84.26</td>
<td>120.48</td>
<td>502.60</td>
</tr>
<tr>
<td>Macadamias</td>
<td>10.27</td>
<td>932.47</td>
<td>98.40</td>
<td>0.70</td>
<td>4.79</td>
<td>11.17</td>
<td>110.39</td>
<td>168.83</td>
<td>477.92</td>
</tr>
<tr>
<td>Pistachios</td>
<td>15.61</td>
<td>421.97</td>
<td>33.67</td>
<td>1.74</td>
<td>3.14</td>
<td>7.80</td>
<td>81.06</td>
<td>91.67</td>
<td>776.52</td>
</tr>
<tr>
<td>Walnuts</td>
<td>10.21</td>
<td>458.60</td>
<td>38.50</td>
<td>1.79</td>
<td>1.71</td>
<td>3.43</td>
<td>67.15</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: Mg. – Magnesium and K – Potassium

The energy realization per dollar is higher in cashew at 1352 kilocalories against other tree nuts. Likewise per dollar realization of protein, minerals like iron, magnesium and potassium are highest in cashew when compared to other tree nuts.

The higher global production of cashew nut has indirectly indicated that most of the global consumers are fond of these nuts because of their taste. From this nutrient analysis also it is evident that cashew nuts are found to be better option to meet out the nutrient requirements compared with other nuts, if we take prices of nuts into consideration.
CHAPTER 4.4.

**RCN and Kernels Price Movement in India**

**Raw cashew nut price movement in India**

The imported raw nut price movement in India over the years from 1965-66 to 2007-08 is given in the Figure- 4.4.1. It could be inferred from the figure that the raw nut prices have attained its peak in 1999-2000 i.e., the price of RCN during that period was Rs.45/kg. Due to crop shortage in major cashew producing countries like Vietnam, Indonesia and Brazil, RCN prices in 2008-09 are likely to reach higher than this level.

![Figure- 4.4.1. Imported Raw Cashew Nut price movement in India](image)

Source: DGCI & S, Custom House

**Seasonality of imported RCN prices in India**

![Figure- 4.4.2. Seasonal index for imported RCN price in India](image)

The seasonal index of imported raw nut prices in India has shown (Figure- 4.2.2) that the prices peak during September and October. Meanwhile, the prices are heading to trough in January month. When we look into the arrivals pattern from different producing countries, it is obvious that the raw nuts availability
will be more during November to May from countries like Brazil, Tanzania, Indonesia, Benin, Mozambique, Kenya, Nigeria and Ivory Coast. In September and October, arrivals will be limited, which will be small and from Guinea Bissau, Indonesia and Tanzania.

**Domestic RCN price movement**
The raw cashew nut prices shown in the Figure- 4.4.3 have increased much in the current year starting from October 2007 to till date due to lower supply from both domestic and international crop. Usually prices slide during the peak arrivals season from April to May, but this year the unavailability of RCN caused prices to move up. Average price of RCN during 2006 in India was Rs.36.70/kg, while it has increased to Rs.39/kg in 2007. Average prices of RCN from January to May 2008 were higher at of Rs.45.70/kg. Lower crop arrivals from important countries such as Ivory Coast, Guinea Bissau and Indonesia has kept RCN prices at peak levels in the current year.

![Figure- 4.4.3. RCN price movement in India](image)

Source: Domestic Trade sources, India

In India, the raw cashew nut prices will be lower during the second quarter of every year due to the higher supply from domestic as well as international producing centres. However, the prices will peak at first as well as in the fourth quarter of every year due to limited supply.

**Spread between RCN and W-320 prices in Orissa, India**

![Figure- 4.4.4. Spread Between RCN & W-320 prices in Orissa](image)

Source: Domestic trade sources, India
It could be inferred from the Figure- 4.4.4 that the prices of raw cashew nut and W-320 were moving together, i.e., whenever the W-320 cashew kernels prices up the RCN prices move also moving up. Hence, we can get an indication from kernel prices, which decides the RCN prices. The present kernels price also indicates tight supply situation in the market and kept raw nut prices at higher levels.

Comparison of W-320 prices in domestic and export market

In cashew grade, W-320 (Whole white) is considered as a reference grade because of its higher consumption and preference around the world. Here an attempt has been made to compare the prices in domestic as well as in export market for Indian origin cashews.

It is clear from the Figure- 4.4.5 that the domestic price of W-320 was higher when compared to its export price. On an average the domestic W-320 prices have premium of Rs.30/kg over export market. The reason behind this price trend is the domestic buyers are not preferred to have whole grade kernels instead they used to consume pieces, butts and other lower grade kernels only. Moreover, W-320 has more enquiries from international buyers particularly from EU and US. Hence, the domestic availability restricted to some extent and mostly consumed by high-income group consumers thus the tight supplies could be seen in the local market. This keep the prices at higher levels. But in the recent days higher inquiries are thus narrowing down the price difference in the domestic and international markets.
The kernel prices of grades like W-320 and LWP in Jeypore (Orissa, India) have shown a similar price trend from the year 2006 to till date (Figure-4.4.6). The prices of these grades have been in increasing trend from October 2007 to till date.

A positive correlation of 86% has been seen between the prices of W-320 and LWP in Jeypore market of Orissa from the year 2006 to till date. The average price premium of W-320 over LWP grade in Jeypore market of Orissa from 2006 to till date was Rs.59/kg.

Cashew kernel price movement in Mangalore, Karnataka
The cashew kernel price movement in Mangalore (Karnataka, India) has given in the Figure- 4.4.7. The positive correlation between prices of LWP and SWP grade kernels has indicated that they are highly influenced by each other movements.

Likewise, the correlation between SWP and W-320 has shown that they have 48% of correlation in Mangalore market over the years 2004 to till date. Meanwhile, the strength of association between the prices of LWP and W-320 is 57% as evident from Table- 4.4.1.
The average price difference between the higher grade W-320 and SWP in Mangalore was Rs.72/kg over the period of 2004 to till date. Likewise the average price difference between W-320 and LWP was Rs.53/kg for the same period. The difference in prices between LWP and SWP over the same period has been Rs.18/kg.

<table>
<thead>
<tr>
<th>Grades</th>
<th>SWP</th>
<th>LWP</th>
<th>W-320</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWP</td>
<td>1.00</td>
<td>0.91</td>
<td>0.48</td>
</tr>
<tr>
<td>LWP</td>
<td>0.91</td>
<td>1.00</td>
<td>0.57</td>
</tr>
<tr>
<td>W-320</td>
<td>0.48</td>
<td>0.57</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Cashew kernel price movement in Kollam market, Kerala

In Kollam market (of Kerala), prices have been moving in the similar pattern. The prices of a kernel grade will influence the prices of other grades in the same direction as shown in the Figure- 4.4.8.

The average price difference between split grade and butts in Kollam market was Rs.10.90/kg for the period of 2005 to till date and the difference between Splits and LWP is Rs.19/kg. Meanwhile, the difference between Split and scorched butts prices were higher at Rs.38.50/kg for the same period of time.

It can be seen from the Table- 4.4.2 that the prices of butts and scorched butts are highly correlated with 96% of correlation. Likewise, the prices of butts and splits grads also shown a higher correlation of 94%. The prices of splits and scorched butts have witnessed 91% of correlation and so on.
Table- 4.4.2. Correlation matrix between grades in Kollam

<table>
<thead>
<tr>
<th>Grades</th>
<th>Butts</th>
<th>LWP</th>
<th>S (Splits)</th>
<th>SB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butts</td>
<td>1.00</td>
<td>0.87</td>
<td>0.94</td>
<td>0.96</td>
</tr>
<tr>
<td>LWP</td>
<td>0.87</td>
<td>1.00</td>
<td>0.89</td>
<td>0.81</td>
</tr>
<tr>
<td>S (Splits)</td>
<td>0.94</td>
<td>0.89</td>
<td>1.00</td>
<td>0.91</td>
</tr>
<tr>
<td>SB</td>
<td>0.96</td>
<td>0.81</td>
<td>0.91</td>
<td>1.00</td>
</tr>
</tbody>
</table>

The cashew kernel prices will be higher during the fourth quarter of every year as it coincides with festive season in India. Prices start moving up from the third quarter onwards.

Annexure- 4.4.1. Per kg imported RCN prices in India (1965-66 to 2007-08)

<table>
<thead>
<tr>
<th>Year</th>
<th>RCN prices in Rs/ kgYear</th>
<th>RCN prices in Rs/ kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965-66</td>
<td>0.94 1987-88</td>
<td>15.72</td>
</tr>
<tr>
<td>1966-67</td>
<td>1.56 1988-89</td>
<td>13.47</td>
</tr>
<tr>
<td>1967-68</td>
<td>1.48 1989-90</td>
<td>13.36</td>
</tr>
<tr>
<td>1968-69</td>
<td>1.56 1990-91</td>
<td>16.29</td>
</tr>
<tr>
<td>1970-71</td>
<td>1.74 1992-93</td>
<td>26.70</td>
</tr>
<tr>
<td>1971-72</td>
<td>1.63 1993-94</td>
<td>24.41</td>
</tr>
<tr>
<td>1972-73</td>
<td>1.57 1994-95</td>
<td>30.45</td>
</tr>
<tr>
<td>1973-74</td>
<td>1.91 1995-96</td>
<td>34.20</td>
</tr>
<tr>
<td>1974-75</td>
<td>2.29 1996-97</td>
<td>31.59</td>
</tr>
<tr>
<td>1975-76</td>
<td>2.30 1997-98</td>
<td>30.60</td>
</tr>
<tr>
<td>1976-77</td>
<td>2.40 1998-99</td>
<td>38.22</td>
</tr>
<tr>
<td>1977-78</td>
<td>3.08 1999-00</td>
<td>45.80</td>
</tr>
<tr>
<td>1978-79</td>
<td>4.10 2000-01</td>
<td>38.23</td>
</tr>
<tr>
<td>1979-80</td>
<td>4.71 2001-02</td>
<td>26.80</td>
</tr>
<tr>
<td>1980-81</td>
<td>7.41 2002-03</td>
<td>30.58</td>
</tr>
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<td>1981-82</td>
<td>10.78 2003-04</td>
<td>30.93</td>
</tr>
<tr>
<td>1982-83</td>
<td>7.54 2004-05</td>
<td>37.85</td>
</tr>
<tr>
<td>1983-84</td>
<td>8.52 2005-06</td>
<td>38.26</td>
</tr>
<tr>
<td>1984-85</td>
<td>10.15 2006-07</td>
<td>30.91</td>
</tr>
<tr>
<td>1985-86</td>
<td>10.57 2007-08</td>
<td>28.83</td>
</tr>
<tr>
<td>1986-87</td>
<td>13.74</td>
<td></td>
</tr>
</tbody>
</table>

Source: DGCI & S, Custom House
Annexure- 4.4.2. Domestic RCN prices in India from 1996- till date (in Rs/kg)

<table>
<thead>
<tr>
<th>Month (Year)</th>
<th>Vetapalam (AP)</th>
<th>Jeypore (Orissa)</th>
<th>Month (Year)</th>
<th>Vetapalam (AP)</th>
<th>Jeypore (Orissa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-06</td>
<td>40.16</td>
<td>41.13</td>
<td>Apr-07</td>
<td>37.00</td>
<td>35.50</td>
</tr>
<tr>
<td>Feb-06</td>
<td>42.91</td>
<td>42.09</td>
<td>May-07</td>
<td>33.99</td>
<td>38.64</td>
</tr>
<tr>
<td>Mar-06</td>
<td>37.50</td>
<td>35.94</td>
<td>Jun-07</td>
<td>30.00</td>
<td>39.69</td>
</tr>
<tr>
<td>Apr-06</td>
<td>32.50</td>
<td>35.10</td>
<td>Jul-07</td>
<td>35.31</td>
<td>36.75</td>
</tr>
<tr>
<td>May-06</td>
<td>31.73</td>
<td>34.50</td>
<td>Aug-07</td>
<td>36.25</td>
<td>35.00</td>
</tr>
<tr>
<td>Jun-06</td>
<td>33.75</td>
<td>34.00</td>
<td>Sep-07</td>
<td>39.23</td>
<td>35.00</td>
</tr>
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<td>Jul-06</td>
<td>36.00</td>
<td>36.98</td>
<td>Oct-07</td>
<td>39.54</td>
<td>40.73</td>
</tr>
<tr>
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<td>36.50</td>
<td>Nov-07</td>
<td>43.94</td>
<td>42.25</td>
</tr>
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<td>35.38</td>
<td>Dec-07</td>
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</tr>
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<td>38.38</td>
<td>Jan-08</td>
<td>51.25</td>
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</tr>
<tr>
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<td>34.34</td>
<td>Feb-08</td>
<td>51.56</td>
<td>49.88</td>
</tr>
<tr>
<td>Dec-06</td>
<td>42.09</td>
<td>36.88</td>
<td>Mar-08</td>
<td>41.88</td>
<td>45.75</td>
</tr>
<tr>
<td>Jan-07</td>
<td>43.44</td>
<td>41.50</td>
<td>Apr-08</td>
<td>38.13</td>
<td>39.34</td>
</tr>
<tr>
<td>Feb-07</td>
<td>43.75</td>
<td>40.94</td>
<td>May-08</td>
<td>43.00</td>
<td>43.40</td>
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<tr>
<td>Mar-07</td>
<td>38.13</td>
<td>35.65</td>
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</table>

Source: Domestic Trade Sources, India

Annexure- 4.4.3. Cashew kernel prices in Jeypore (Orissa) from 2006 to till date (in Rs/kg)

<table>
<thead>
<tr>
<th>Month (Year)</th>
<th>W320</th>
<th>LWP</th>
<th>Month (Year)</th>
<th>W320</th>
<th>LWP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-06</td>
<td>232.75</td>
<td>183.75</td>
<td>Apr-07</td>
<td>226.00</td>
<td>167.50</td>
</tr>
<tr>
<td>Feb-06</td>
<td>228.75</td>
<td>177.50</td>
<td>May-07</td>
<td>222.50</td>
<td>167.50</td>
</tr>
<tr>
<td>Mar-06</td>
<td>216.50</td>
<td>175.00</td>
<td>Jun-07</td>
<td>214.00</td>
<td>168.75</td>
</tr>
<tr>
<td>Apr-06</td>
<td>229.25</td>
<td>176.25</td>
<td>Jul-07</td>
<td>215.33</td>
<td>173.33</td>
</tr>
<tr>
<td>May-06</td>
<td>227.50</td>
<td>177.50</td>
<td>Aug-07</td>
<td>224.50</td>
<td>172.50</td>
</tr>
<tr>
<td>Jun-06</td>
<td>228.75</td>
<td>173.75</td>
<td>Sep-07</td>
<td>242.50</td>
<td>167.50</td>
</tr>
<tr>
<td>Jul-06</td>
<td>236.20</td>
<td>177.00</td>
<td>Oct-07</td>
<td>245.00</td>
<td>180.00</td>
</tr>
<tr>
<td>Aug-06</td>
<td>233.50</td>
<td>175.00</td>
<td>Nov-07</td>
<td>265.00</td>
<td>188.75</td>
</tr>
<tr>
<td>Sep-06</td>
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<td>175.00</td>
<td>Dec-07</td>
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<td>211.00</td>
</tr>
<tr>
<td>Oct-06</td>
<td>232.75</td>
<td>170.00</td>
<td>Jan-08</td>
<td>275.00</td>
<td>220.00</td>
</tr>
<tr>
<td>Nov-06</td>
<td>227.33</td>
<td>170.00</td>
<td>Feb-08</td>
<td>261.25</td>
<td>216.25</td>
</tr>
<tr>
<td>Dec-06</td>
<td>254.00</td>
<td>169.00</td>
<td>Mar-08</td>
<td>253.00</td>
<td>212.00</td>
</tr>
<tr>
<td>Jan-07</td>
<td>243.33</td>
<td>171.67</td>
<td>Apr-08</td>
<td>275.33</td>
<td>220.00</td>
</tr>
<tr>
<td>Feb-07</td>
<td>237.75</td>
<td>170.50</td>
<td>May-08</td>
<td>294.20</td>
<td>240.00</td>
</tr>
<tr>
<td>Mar-07</td>
<td>223.33</td>
<td>166.67</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Domestic Trade Sources, India
Annexure- 4.4.4. Cashew kernel prices in Kollam market of Kerala from 2005 to till date (in Rs/kg)

<table>
<thead>
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Source: Domestic Trade Sources, India
### Annexure- 4.4.5. Cashew kernel prices in Mangalore, Karnataka from '04 to till date (in Rs/kg)

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Source: Domestic Trade Sources, India
CHAPTER 4.5.

Analysis on Indian W-320 FOB Prices

W-320 cashew grade is the reference grade in the international market, as it is produced in larger quantity. W-320 refers to white wholes and the colour of the kernels is white or pale ivory or light ash with characteristic shape. In general the kernels count per pound (lb) of W-320 is 300-320.

Seasonal index for W-320 FOB prices

Note: FOB prices for W-320 in USD/lb, which was exported through Cochin / Tuticorin. Source: Samsons Trading Co, Mumbai

The seasonality for W-320 FOB prices from India has shown in Figure-4.5.1. It could be inferred from the figure that the prices remain higher during June to August and bottom out during February and March of every year.

Cyclical trend in W-320 prices

If we closely look into the W-320 price movement given in Figure- 4.5.2, it shows that the current prices are peaking at USD 3.33/lb, as like 1999 levels peak of USD 3.16/lb. Likewise, the price in 1995 was USD 2.74/lb, the nearer value of this level has been reached in 2004 at USD 2.55/lb. Moreover, the prices in 1996 peak of USD 2.62/lb has been revisited again in 2005 at USD 2.54/lb. Hence, we could get a clue that the W-320 prices have shown a cyclical trend once in ten years.
The W-320 prices hit the highest level during August 1999 at USD3.16/lb. The prices have increased sharply from 2.56/lb in March 1999 to USD3.04/lb in April and attained a peak of USD3.16/lb in August 1999. These higher price ranges stayed for nearly six months from April to September 1999.

The factors triggered higher price levels in 1999:

1. The area under cashew cultivation in the year 1999 was 0.71 million hectares with 0.52 million tons of production. Both area and production were higher in 1999 against its previous year levels.
2. Despite the increased area and production, good domestic and export demand from India has kept the prices at peak in 1999.
3. The domestic consumption and exports of cashew kernel were at higher levels in 1999 at 0.59 million tons and 92,461 tons respectively.

Overall, the price has been remained largely in between USD1.85 and 2.52/lb since 1992 to 2007.

**W-320 cashew prices forecast**
The current price movement has shown in the Figure- 4.5.3 has indicated that W-320 cashew prices have started replicating its 1999 level. Hence, the prices are expected to move up further and likely to stay above USD3.00/lb for at least 6 months period starting from April this year. The current price is USD3.33/lb (June, 2008) and the forecasted (based on ARIMA analysis) price levels were given in the Figure- 4.5.3. The figures have clearly given an indication that the prices will move up till the end of this year.

When we look into the fundamentals of 2008, the area under cashew cultivation has increased by 4.2% to 850,000 hectares in 2007-08 against the last year. The production of cashew has also registered an increase of 8% to 620,000 tons compared the production a year ago. I.e., the area in the year 2007-08 has increased by 150,000 hectares compared to cultivated cashew area in the year 1999. This increase in area has led to rise in production by 100,000 tons in 2007-08 from 1999 production.

On the processing front, the import of raw cashew nut during this year was reported to be 605,000 tons and the kernel exports stood at 114,000 tons. The domestic consumption has also expected to be higher this year as in 1999 on account of increase in health awareness and disposable income.

The factors, which found to influence the current hike in cashew kernel prices at international markets are,

- Shortage in Indonesian and Brazilian crops
- Lower output from Vietnam
- Increased cashew consumption around the world especially in USA. The cashew kernels import by USA has witnessed an annual growth of 7.9% from 1996 to 2007
- Crop damage in the major cashew producing regions of India like Kerala and Mangalore due to incessant rains
- Higher domestic consumption in India and
- The prices of RCN from African origin (Ivory Coast and Guinea Bissau) have increased much this year.
Annexure - 4.5.1 FOB prices of cashew nut in USD/lb (Cochin/Tuticorin)

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Source: Samson's trading Co., Mumbai
Experts Views
1. Introduction
Cashew nut (*Anacardium occidentale* L.) belongs to family *Anacardiaceae*. From its original home in North-East Brazil, it has spread throughout the tropics. Its cultivation is distributed from 27° North to 27° South latitude. Cashew kernels are used in confectionery and dessert. The shells contain oil known as Cashew Nut Shell Liquid (CNSL) used in industry. Cashew nut is widely consumed in rich countries and gives valuable foreign exchange to the producer countries. Today consumers are ready to pay premium price to organically grown products. Further, organic cultivation is economically and ecologically sustainable. So, organic farming is healthy both for the producer and the consumer.

2. Climate
Cashew can be grown from sea level to an elevation up to 700 m. It has been cultivated at places receiving 600 to 4500 mm rainfall and temperature ranging from 20-36°C (av. minimum of coldest month and av. maximum of hottest month).

3. High yielding varieties of India
Various research centres in India have released about 40 high yielding cashew varieties. These varieties are reported to yield 8-20 kg nut per plant per year. They could be classified as early, mid and late season flowering varieties.

3.1. Varieties recommended for organic farming
Only mid and late season varieties are better suited for organic farming. The reason being that in early season varieties the crops flush early and this early flowering attracts maximum infestation of Tea Mosquito Bug (TMB). It is during this period (Nov-Jan) that the weather is cool and the dew fall during early morning followed by cloudy environment results in mass multiplication of TMB, which causes maximum spoilage of flowers. Mid and late season (Feb-Apr) varieties escape this menace. Due to increased

* Principal Scientist, National Research Centre for Cashew, Puttur.
temperature during flowering and fruiting in mid and late varieties, TMB population comes down thereby the crop damage by the pest is minimum or nil. However, under extreme changed weather conditions favorable to sudden outbreak of TMB, its control even with chemical means is difficult. Some of the most promising mid and late flowering varieties released are given below.

3.2. Mid season flowering varieties
i) Bhaskara  
ii) VTH 174  
iii) Dhana (H1608)  
iv) Dharashree  
v) Amrutha (H1597)  
vi) Priyanka (H1591)  
vii) BPP-8  
viii) V-4  
ix) V-7

3.3. Late season flowering varieties
i) Ullal-1  
ii) Chinthamani-1  
iii) Madakkatara-2

4. Land preparation
Wild growth particularly forest tree growth should be cleared from the site selected for cashew cultivation. The roots of the weeds and bushes should be completely uprooted around 2-meter radius of the planting pit. This ensures competition-free environment for the newly planted cashew grafts. In the absence of inter crops or cover crops the space in between the plants could be cleared in phased manner in the subsequent years. Cashew is a sun loving plant, there should not be shade over the plants.

5. Digging of pits
Pits of 1 m x 1 m x 1 m dimension should be dug. A spacing of 7 m x 7 m or 8 m x 8 m or 10 m x 5 m is ideal depending upon the variety and type of land used. In case of vigorous growing varieties, spacing can be 8 m x 8 m and in case of less vigorous varieties, it can be 7 m x 7 m or 10 m x 5 m. If the soil is more fertile, spacing adopted should be more. If there is a hard pan, the bigger pits should be opened of size 1.2 m x 1.2 m x 1.2 m. Hedge row system of planting with a spacing of 10 m x 5 m will be beneficial for growing intercrops during the initial period. The pits should be dug out 15 to 20 days before planting and exposed to sunlight so as to get rid of soil borne pests. Later two third portions of the pits are to be filled with a mixture of topsoil, 6 kg of compost, 20 g bio fertilizers (N fixers and P solubilizers or Varanashi Composter) and 200 g rock phosphate.
6. Planting

Since cashew is a rain fed crop, planting is usually done during monsoon season. However, in heavy rainfall areas the planting may be done once the heavy rains are over. Plants multiplied by vegetative methods (air layers or grafts) are preferred because these plants give higher yields. The grafts prepared using scion sticks of high yielding mother trees behave like the mother plants. While establishing cashew garden, instead of a single variety it is preferable to go for two to four varieties having middle and late flower bearing habits. To prevent pest problems, it is better to avoid early season flowering varieties as explained earlier. Healthy plants should be planted after carefully removing the polythene bags without disturbing the rhizosphere soil. Soil at the center of the pit should be scooped out for planting. After placing the plant into the pit, the soil around it should be pressed gently. In case of grafts, care should be taken to see that the graft joint is at least 5 cm above the ground level. This clearance will help to locate and remove the sprouts on the rootstock below the graft joint (Fig. 1 and 2). The remaining one-third portion of the pit should be gradually filled up to the ground level within 2 years.

6.1. Staking and mulching

After planting the graft, a stake should be provided to support the plant and loosely tied to plant with a jute thread (Fig. 1). This prevents damage to the graft joint due to wind blow. The soil around the plant should be covered with thick mulch of green or dry leaves for better soil and moisture conservation.

7. After care, training and pruning

Side shoot growth below the graft joint should be removed periodically. Emerging side shoots above graft joint should be removed by secateurs up to 50-75 cm height of the stem. There should be a clear single stem up to 50-75 cm height. This should be attained by removing the lower branches in stages so that the tree gets enough strength to withstand heavy wind. Single stem at base facilitates easy cultural operations, nut collection, and surveillance of Cashew Stem and Root Borer (CSR) infestation. New and longer stakes should be provided after removing old and weaker ones during the second and third year after planting. De-blossoming should be carried out for the first two years after planting. Further, regular pruning of weaker branches in the initial years of growth helps to encourage the establishment of good framework (Fig. 3). Third year onwards flower
panicles need not be removed. After 3-5 years, the main branch, which is growing vertically should be beheaded at a height of 2.5 m to 3.5 m. This would reduce over shading effect of higher branches on the lower branches, which encourages better spread of the canopy as well as uniform distribution of light on all the branches.

The ideal period for pruning would be after nut harvesting and before the onset of new shoots. This could be taken up at the end of May or beginning of June. When large sized shoots are pruned, care should be taken to see that the cut surface is as smooth as possible and hence sharp blades should be used. Cut portion should be swabbed with 10% bordeaux paste.

8. Soil and water conservation methods
Cashew being mostly unirrigated crop, requires proper soil and moisture conservation measures. In slope area, terracing should be taken up around each plant within second year (Fig. 4 and 5). Initially terrace with inward slope should be made and a catch pit of 2 m x 0.3 m x 0.45 m (l x b x h) at a distance of 1.8 m-2 m away from the base of the plant on the upper side of the slope should be dug. The terrace and trench could be also constructed in semicircular pattern. On a level land, square circular or staggered trench of 0.3 m depth should be dug and the soil should be spread around plant basin (Fig. 6 and 7). After the earthwork, the soil around should be mulched with organic matter. This prevents erosion during rainy season and avoids direct exposure to sunlight thereby efficiently conserving soil moisture in summer (Fig. 8).

9. Manuring
In organic farming system, nutrient should be given in organic way. A grown up cashew tree produces about 20 kg of biomass waste per year (cashew leaf litter, prunings, waste cashew apples etc.). This should be returned to the soil. In addition, 33 kg compost or 50 kg FYM or 20 kg poultry manure with 50 g bio-fertilizers should be applied when there is optimum soil moisture. Manure application should be taken up in the beginning of monsoon (June) at low rainfall areas and in mid monsoon (August) in high rainfall areas. Addition of bio-fertilizers namely N-fixers and P-solubilisers also gives benefits. If Varanashi composting method is used, additional dosage of bio-fertilizers is not required. For young plants, the dosage starts from one fifth of recommendation and increases year after year till fifth year. After the application of organic manure around the trees, it should be covered by a thin layer of soil and properly mulched.
Periodic spray of cow’s urine (1:10 dilution) or compost tea (1: 40 dilution) facilitates better growth. They also prevent pest and disease attack.

When there are plants of more than 20 years age in an orchard, pits of 0.5 m length, breadth and depth are dug at the centre of trees and cashew biomass with fruits are incorporated into the pits along with organic manure and bio-fertilizers. Cow dung slurry of 20% should be added into it and covered by a thin layer of soil. May is the ideal month for carrying out this operation. Some of the roots of old trees may get exposed and are prone to CSRB attack hence, these roots are covered by thin layer of soil.

9.1. Alternate manures
In view of rising demand for organically grown cashew, strategies need to be developed for organic farming for different agro-ecological zones because organic manure availability may vary according to different locations. Some of the commonly available organic manures like poultry manure, Farm Yard Manure (FYM), vermicompost, oil cakes, coir pith, organic manure mixtures etc. hold promise in organic farming in cashew as per the results obtained at NRCC. There is high potentiality to utilize cow dung slurry in major cattle rearing areas. In addition to the above manures, poultry litter and oil cakes are also available in huge quantities in most of the states. Green leaf is in abundance in Kerala, coastal Karnataka and Maharashtra, where cashew is mostly grown. The green leaf can serve as good organic manure to cashew. Green manure crops like gliricidia and pongamia can be grown very well under rain fed conditions on the border or inside cashew plantations to produce green manure.

While considering the quantity of nutrients available in soil, the approximate quantity of organic manure required to meet the recommended dose of Nitrogen of 500 g per tree is presented in Table 2. The recommended dose of Nitrogen has been arrived at, based on the trials conducted in various research stations. In organic manure, availability of nutrients normally stretches for a longer period and in addition the loss of nutrients through leaching is least.

If the nutrients are applied through chemical fertilisers hardly 50% of nitrogen and 75% of the applied potash (K2O) will be made available to the plants due to nutrient loss through seepage, runoff and de-nitrification.
Such nutrient loss is negligible in the case of organic manures. Detailed study on this aspect needs to be taken up for suggesting options to farmers like, the exact quantity of different organic manures to be applied per tree depending upon the availability of these manures in the respective locality.

The quantity of organic manures mentioned in Table 2 will meet the full requirement of Phosphorous (P$_{2O_5}$) and Potash (K$_{2O}$) in all cases except in green manure and groundnut cake. When these are used, bone meal and wood ash may be suggested to supplement P$_{2O_5}$ and K$_{2O}$ requirements for producing cashew organically.

### Table 2: Quantity of organic manures required for adult cashew tree

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<td>14.7</td>
</tr>
<tr>
<td>Cashew waste compost</td>
<td>33.0</td>
</tr>
<tr>
<td>Neem cake</td>
<td>9.61</td>
</tr>
</tbody>
</table>

Note: Calculated based on nutrient concentration in each type of manure as worked out at NRCC.

### 10. Cover cropping

Leguminous crops such as *Pueraria javanica*, *Calopogonium mucunoides* and *Centrosema pubescens* enrich the soil nutrients, add organic matter, prevent soil erosion and conserve soil moisture. Seeds of these cover crops can be sown in the beginning of rainy season at the rate of 12 kg per ha in the inter space of cashew orchard. Beds of 30 cm x 30 cm are prepared in sloppy degraded soils by loosening the soil and mixing compost or cow dung. Then the seeds are sown in the beds and covered by a thin layer of soil. Presoaking of the seeds in water for six hours ensures better germination. Fencing is necessary to avoid cattle grazing. *Gliricidia maculata* can be grown in the interspace between two rows of cashew or all along the border (Fig. 9). If it is grown in the interspace it may be spaced at one meter distance. Three rows of *gliricidia* can be grown in the interspace of two rows of cashew. *Gliricidia* may be grown by sowing seeds or planting
stem cuttings of one meter length during rainy season. Nearly 60 kg leaf and tender branches can be collected to apply to each cashew plant from this green manure crop (Fig. 10).

11. Intercropping
Leguminous crops like horse gram, cowpea, and other crops such as ground nut, tapioca, vegetable and fodder crops, elephant-foot yam (Fig. 11 and 12) are grown as intercrops in cashew plantations. Among the various annuals, biennials, fruit crops and tree species, pineapple has been found to be the best when grown as inter or mixed crop (Fig. 13). In cashew garden for the first 7 years, pineapple could be grown in the inter-space between two rows of cashew. Three trenches could be opened in between the rows across the slope. Size of trench should be of one m width, 0.5 m depth and of any convenient length. In each trench two rows of pineapple suckers should be planted at 60 cm between rows and 40 cm between two suckers within the row. For one meter length, half basket of compost should be added and mixed with soil before planting suckers. One hectare cashew orchard can accommodate 15,000 suckers. Pineapple starts yielding from second year and after fourth year, it should be replanted in a new trench dug out by the side of existing trench or the same could be retained till seventh year of cashew plantation.

After seven years, because of heavy shade of cashew tree over the pineapple and due to difficulty in picking raw cashew nuts fallen over pineapple plants, it may not be feasible to grow this intercrop economically. Nearly 40 tons of pineapple fruits can be expected for seven years with a gross return of about US $ 4518.70. Expenditure would be US $ 2259.37 and hence net profit from pineapple alone will be US $ 2259.37 per ha of cashew garden. Apart from giving an additional income, 30% increase in cashew nut production was also observed mainly due to better soil and water conservation in the trenches, where pineapple is planted across the slope between two rows of cashew.

Other crops like turmeric, ginger and elephant foot yams can be grown as intercrops organically for the first 5 years of planting cashew. The profit realized from these crops may range from US$ 451.87 to US$ 1129.68 per ha.

12. Mixed cropping
It is not possible to achieve sustainability by growing only one particular type of crop. Whatever is the size of holding, growing a variety of crops within the
available land contributes to the ecological balance. While selecting mixed crops its compatibility with the main crop, spacing, and availability of light, manure and water requirement should be properly studied. Mango, sapota, kokum, amla, jack fruit etc. could be grown as mixed crops in cashew orchards (Fig. 14). In countries like Malaysia, Indonesia and Cambodia, rambutan, longon, dwarf bamboos are grown with cashew by providing proper spacing for each crop according to canopy coverage. Considering various mixed crops grown in different cashew growing areas and from the experiments conducted at NRCC Puttur, some of the promising combinations of crops are listed below. Nevertheless, farmers are advised to study carefully various aspects of cultivating mixed crops in their locations namely suitability, irrigational requirements, marketing avenues etc. before adopting them in their orchards. Some of the crop combinations along with spacing recommended for each crop in high-density multispecies situations are given below.

1. Between two rows of cashew, the spacing maintained is 30 m. In the middle of two rows planting mango, tamarind, silk cotton, jack, sapota, amla etc. at a uniform distance of 10 m (as shown in Fig. 15) would give additional income. These crops do not require irrigation. But timely pruning of these trees would be highly beneficial after seven years of planting. Catch pits will benefit in conserving soil and water.

2. Between the rows of cashew the spacing maintained is 21 m. In the middle, two rows of planting with guava or longon and rambutan or breadfruit at 7 m distance between rows and 6 m between plants would be economical (Fig. 16). These crops require light irrigation and are not suitable for dry areas.

3. Between two rows of cashew the spacing maintained is 10 m. In the middle, planting acacia or casuarinas along with wild mango to the borders at 12 m distance would give ecological sustainability (Fig. 17). Acacia and casuarinas should be regularly pruned after 2-3 years and leaves may be incorporated into cashew basins. After 5-6 years these trees are cut and sold. For planting in the borders some of the wild mango could be selected and multiplied by softwood grafting and may fetch much more price in the domestic market itself when compared to the popular varieties.

4. The other combination would be cashew, dwarf bamboo and kokum as in Fig. 18. Bamboo is gaining more importance for its suitability for fabrication of cheap and beautiful furniture and handicraft materials. Due to flowering, there is decline in bamboo crop over the years and abrupt shortfall of supply may increase the price in the future. Kokum is a fruit of various medicinal uses. From rind of the kokum fruit, juice and
beverages are prepared. The chemical content hydroxy citric acid is known to have the properties of anti-obese effect. The juice prepared from the rind has natural cooling effect on body and is widely used in Maharashtra and Karnataka. The fat content extracted from the seeds of kokum is having special properties of melting at higher temperature thereby it can be blended with cocoa, milk and sugar and chocolate thus made can be kept stable at room temperature, unlike other cocoa chocolates prepared purely from cocoa butter. At NRCC, kokum is grown as a mixed crop in cashew gardens accommodating 200 trees each in one-hectare area. About 20-30 kg fruit from a single tree (400-600 kg per ha) can be expected. The return from a kokum tree will be about US $ 2.25-3.38 and US $ 451.8 - 677.81 per ha. The cost of cultivation is US $ 0.67 per plant (US $ 135.5 per ha.) and net profit will be US $ 1.58-2.71 per plant or US $ 361.5 - 542.2 per ha.

13. Irrigation and drainage
Cashew is grown under rain fed conditions. However, it is preferable to give supplementary irrigation during summer months, especially during January-March at fortnightly intervals at the rate of 200 liters per plant, which is proved to double the yield. This is evident from the research results obtained at NRCC. Cashew responds well for drip irrigation at the rate of 60-80 liters of water per tree once in four days after the initiation of flower panicles till fruit set and development (January-March). However, cashew cannot withstand water stagnation. In high rainfall, areas plantations located in low-lying areas should have trenches to drain out excess water.

14. Weed management
Generally weeding in cashew can be done twice a year. One weeding is recommended in the month of August before manure application and another just before the start of flushing and flowering (October or November). The weed biomass can be effectively recycled as mulch cum green manure by applying around plant basin.

15. Plant protection
In India about 60 insect pest species are identified to affect cashew. Major pests are Tea Mosquito Bug (TMB), Cashew Stem and Root Borer (CSRB), Leaf Miner, Leaf and Blossom Webber and Flower Thrips as well as Cashew Apple and Nut borer. So far, there is no major disease causing economic loss in cashew.
15.1. Management of Tea Mosquito Bug (TMB) – *Helopeltis antonii* Sign. (Heteroptera; Miridae)

Tea mosquito bug can cause yield reduction to the tune of 30-40% by damaging tender shoots, inflorescences and nuts. Both adults and nymphs (Fig 19 and 20) of TMB suck the sap from tender shoots, panicles and immature nuts and apples resulting in the formation of black lesions. These lesions on shoots and panicles coalesce causing shoot blight or blossom blight (Fig. 21). The plants can escape TMB attack if the new flush is delayed. Planting mid season or late season flowering varieties would be the right strategy to escape TMB. Even early flowering varieties also flower 10-15 days late if the plants are grown organically compared to chemical fertilizer applied ones. The delay in flowering naturally minimizes the incidence by escaping multiplication of TMB population. The pest could be repelled by smoking the garden by burning organic residues three times each during flushing, flowering and fruiting. Care must be taken to see that small heaps of organic wastes in several places on the ground below the canopy of the tree is burnt slowly. This can be achieved by putting a thin layer of soil on the heaps and setting fire. At any chance the burning should not produce too much of heat lest flowers and shoots get affected. Clean cultivation is another method to check multiplication of TMB considerably. All weeds should be removed and heaped as mulch. Encouraging multiplication of weaver ants (*Oecophylla smaragdina*) checks the TMB (Fig. 22). These ants feed on the eggs and nymphs of the TMB. In the initial stages the colonies of weaver ants may be brought from near by forest.

At NRCC Puttur, a plot of 2.5 hectares is maintained for the last four years and though initially the TMB damage was noticed in small pockets, no economic loss on yield was observed. Here the organic insecticides like Servo-agro-spray oil (Petroleum by-product), Phalada III Cl and Phytozeal were sprayed during flushing, flowering and fruiting periods. All of these were found effective. Though little damage was noticed due to TMB initially in certain mid varieties (V-4), later it did not spread indicating that the pest can be brought under check with these organic pesticides.

15.2. Management of Cashew Stem and Root Borer (CSRB) - *Plocaederus ferruginus* L. (Coleoptera; cerambycidae)

Older cashew trees are more prone to infestation by CSRB (Fig. 23). Adult female beetles (Fig. 24) lay eggs in the bark crevices of the stem (near to the collar region) or on the exposed roots. After hatching, the young
grubs (Fig. 25 and 25-a) tunnel immediately into the trunk or root regions. Due to extensive feeding by irregular tunneling in the bark, the translocation of the nutrients is hampered leading to drying of leaves and twigs. In the infested portions the gum and frass (chewed fibres and excreta pellets) start oozing out from the tree, which is the initial symptom of pest attack. Curative measures given below should be taken up immediately.

The infested portion having frass below the bark on either the main stem or root portion after suitably digging the soil should be carefully chiseled to inflict minimum damage to the bark. Tunnels should be tracked (Fig. 26) towards the fresher frass to locate the CSRB grubs, which should then be removed and killed. In case white powdery fibers are seen it indicates that the grubs have entered the heartwood for pupation. In such cases a pliable wire (for example automobile gear wire) should be inserted deep into the pupation hole and pushed in till a slushy sound is heard or milky white fluid flows out indicating damage to the grub or pupa. Later chiseled portion of the bark should be swabbed with 10% bordeaux paste. When a paste of cow dung and ash is applied to the injured portion of the bark, it helps in curing of wounds. Swabbing neem oil is also quite effective.

Trees having more than 50% of the bark circumference damage with yellowing of the canopy hardly ever recover. However, the pest stages in such trees will act as inoculum for the next season. Hence phyto-sanitation should be adopted by uprooting such trees, which are beyond recovery and disposed off immediately, along with removal of pest stages in other infested trees. Such operations prevent build up of pest inoculum. As the pest incidence occurs during the period of nut collection (Feb-May), the infested trees can be marked and curative measures could be adopted immediately, so that the grubs do not inflict more damage. As preventive measure, brushing waste motor oil once or twice a year to the lower trunk region discourages egg laying (Fig. 26).

Minor pests like Cashew Apple and Nut Borer (Fig. 27 and 28), leaf miner, leaf and blossom webber could be mechanically controlled at younger stages of plant growth or with organic sprays suggested for TMB. As the plant grows older, the loss is insignificant.
16. Harvesting
Only the fallen nuts should be collected from the base of the tree to avoid damaging the flowers and unripe nuts (Fig. 29). The fruits should not be harvested from the tree. The nuts, after separating from the fruits, should be washed with water, sun dried for 2-3 days (Fig. 30) and stored in gunny bags at a height of at least 4 inches above the ground by placing them over a wooden plank. Nuts should be sold in the same year and should not be stored for the future.

17. Nut yield
All the varieties recommended have a yield potential of over 8 kg per tree or 1 to 1.5 tons per hectare. Though cashews yield starts from the fourth year, its full potential (about 8 kg per tree) will be realized after 8-10 years depending on the level of management (Fig. 31).

18. Cost and returns
The cost and returns of cashew grown on a hectare of the land in India is shown in the tables 3 – 6. The returns from inter or mixed cropping is not taken into consideration. Cashew as a single crop block has been taken into account. From this table, one can analyze the cost and returns from cashew alone in different phases of growth. In the first year, the cost involved per tree is US $ 2.28, but over the years one can notice a decrease in it. Cashew starts yielding from the fourth year. The yield goes on increasing from one kilo in fourth year to 7 kilos in tenth year. The economical return starts from the fifth year, where it is US $ 51.72 per ha and at the end of the tenth year it will be US $ 656.06 per ha. But, if one takes the cumulative returns for the ten years, it will be US $1346.61 per ha (or US $ 8.63 per tree). By growing the inter crop, returns can be expected in the very first year of planting. The economical sustainability could be achieved by inter and mixed cropping even during the time of fluctuations in prices of the main crop output.
Cost and returns

Cost of cultivation per hectare of cashew Spacing: 8 m x 8m (156 plants)

Table 1: From 1st to 3rd year

<table>
<thead>
<tr>
<th>Particulars</th>
<th>1st year</th>
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<td>4. Digging of pits</td>
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<td>6. Application of organic manure</td>
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<td>9. Organic spray</td>
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<td>157.51</td>
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<td>Per plant (US $)</td>
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<td>C. Total cost of cultivation (A+B)</td>
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<td>Per plant (US $)</td>
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<td>1. Nut yield kilo/tree</td>
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<td>2. Kilo/ha</td>
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<td>3. Price/ kilo (US $)</td>
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<td>-161.72</td>
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Table 2: From 4th to 7th year

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<td>Cost US $</td>
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<td>5. Organic spray</td>
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<td>0.49</td>
<td>0.49</td>
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<td>1. Compost manure 24-30 kg/plant (US $ 0.02/kilo)</td>
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<td>C. Total cost of cultivation (A+B)</td>
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<td>1. Nut yield kilo/tree</td>
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<td>5. Net returns (US $)</td>
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### Table 3: From 8th to 10th year

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<td>Man day</td>
<td>Cost US $</td>
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<td><strong>A. Labour cost (US $ 1.69/day)</strong></td>
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<td>1. Watching (part time)</td>
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<td>25.41</td>
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<td>3. Weeding</td>
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<td>16.94</td>
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<td>5. Soil conservation</td>
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<td><strong>B. Cost of inputs</strong></td>
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<tr>
<td>1. Compost manure 30 kg/plant@ US $ 0.02/kg</td>
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<td>95.14</td>
<td>4680 kg</td>
<td>95.14</td>
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<tr>
<td>2. Biofertilizers (50g/ plant@ US $ 0.13)</td>
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<td>21.14</td>
<td>21.14</td>
<td>63.42</td>
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<td>5.64</td>
<td>5.64</td>
<td>5.64</td>
<td>16.92</td>
</tr>
<tr>
<td><strong>Total B</strong></td>
<td>121.92</td>
<td>121.92</td>
<td>121.92</td>
<td>365.77</td>
</tr>
<tr>
<td><strong>Per plant (US $)</strong></td>
<td>0.78</td>
<td>0.78</td>
<td>0.78</td>
<td>2.34</td>
</tr>
<tr>
<td><strong>C. Total cost of cultivation (A+B)</strong></td>
<td>252.36</td>
<td>206.62</td>
<td>206.62</td>
<td>665.60</td>
</tr>
<tr>
<td><strong>Per plant (US $)</strong></td>
<td>1.61</td>
<td>1.32</td>
<td>1.32</td>
<td>4.25</td>
</tr>
<tr>
<td><strong>D. Economics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Nut yield kilo/tree</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>2. Kilo/ha</td>
<td>780</td>
<td>936</td>
<td>1092</td>
<td>2808</td>
</tr>
<tr>
<td>3. Price/ kilo (US $)</td>
<td>0.79</td>
<td>0.79</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>4. Returns/ ha (US $)</td>
<td>616.20</td>
<td>739.44</td>
<td>862.68</td>
<td>2218.32</td>
</tr>
<tr>
<td>5. Net returns (US $)</td>
<td>363.84</td>
<td>532.82</td>
<td>656.06</td>
<td>1552.72</td>
</tr>
<tr>
<td>6. Net returns per plant (US $)</td>
<td>2.33</td>
<td>3.41</td>
<td>4.20</td>
<td>9.95</td>
</tr>
</tbody>
</table>
Table 4: From 1st to 10th year

<table>
<thead>
<tr>
<th>Particulars</th>
<th>1-3 year</th>
<th>4-7 year</th>
<th>8-10 year</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Man day</td>
<td>Cost US $</td>
<td>Man day</td>
<td>Cost US $</td>
</tr>
<tr>
<td>A. Labour cost (US $ 1.69/day)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Fencing/Watching (part time)</td>
<td>-</td>
<td>79.07</td>
<td>60</td>
<td>101.64</td>
</tr>
<tr>
<td>2. Land preparation</td>
<td>79</td>
<td>133.86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Soil conservation</td>
<td>30</td>
<td>50.83</td>
<td>30</td>
<td>50.83</td>
</tr>
<tr>
<td>4. Digging of pits</td>
<td>30</td>
<td>50.83</td>
<td>50.83</td>
<td></td>
</tr>
<tr>
<td>5. Planting</td>
<td>14</td>
<td>23.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Application of organic manure</td>
<td>17</td>
<td>28.79</td>
<td>32</td>
<td>54.20</td>
</tr>
<tr>
<td>7. Weeding</td>
<td>15</td>
<td>25.41</td>
<td>40</td>
<td>67.76</td>
</tr>
<tr>
<td>8. Training &amp; pruning</td>
<td>4</td>
<td>6.78</td>
<td>8</td>
<td>13.56</td>
</tr>
<tr>
<td>9. Organic spray</td>
<td>11</td>
<td>18.63</td>
<td>20</td>
<td>33.88</td>
</tr>
<tr>
<td>10. Harvesting</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>25.41</td>
</tr>
<tr>
<td>Total A</td>
<td>200</td>
<td>417.92</td>
<td>175</td>
<td>296.45</td>
</tr>
<tr>
<td>Per plant (US $)</td>
<td>2.68</td>
<td>1.90</td>
<td>1.92</td>
<td></td>
</tr>
<tr>
<td>B. Cost of inputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Grafted plants US $ 0.3388/plant</td>
<td>180</td>
<td>60.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Compost manure</td>
<td>114.15</td>
<td>361.54</td>
<td>285.43</td>
<td></td>
</tr>
<tr>
<td>3. Biofertilizers</td>
<td>63.42</td>
<td>84.56</td>
<td>63.42</td>
<td></td>
</tr>
<tr>
<td>4. Organic certification</td>
<td>16.92</td>
<td>22.56</td>
<td>16.92</td>
<td></td>
</tr>
<tr>
<td>Total B</td>
<td>255.48</td>
<td>468.66</td>
<td>365.77</td>
<td></td>
</tr>
<tr>
<td>Per plant (US $)</td>
<td>1.64</td>
<td>3.00</td>
<td>2.34</td>
<td></td>
</tr>
<tr>
<td>C. Total cost of cultivation (A+B)</td>
<td>673.40</td>
<td>765.11</td>
<td>665.60</td>
<td></td>
</tr>
<tr>
<td>Per plant (US $)</td>
<td>4.31</td>
<td>4.90</td>
<td>4.26</td>
<td></td>
</tr>
<tr>
<td>D. Economics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Nut yield kg/ tree</td>
<td>10</td>
<td>18</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>2. Kilo/ ha.</td>
<td>1560</td>
<td>2808</td>
<td>4368</td>
<td></td>
</tr>
<tr>
<td>3. Price/ kg (US $)</td>
<td>0.79</td>
<td>0.79</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>4. Returns/ ha (US $)</td>
<td>1232.40</td>
<td>2218.32</td>
<td>3450.72</td>
<td></td>
</tr>
<tr>
<td>5. Net returns/ha (US $)</td>
<td>-673.40</td>
<td>467.29</td>
<td>1552.72</td>
<td></td>
</tr>
<tr>
<td>6. Net returns per plant (US $)</td>
<td>-4.31</td>
<td>2.99</td>
<td>9.95</td>
<td></td>
</tr>
</tbody>
</table>

Note: Costs worked out in Indian rupee and converted to US Dollars. One US$=44.26 Rupees in 2006.

19. Significance of organic cultivation and its potentiality
Cashew is grown in most of the places as a naturally grown crop with less attention hence the expected returns are not achieved. For organic cultivation, Leaf litter, dried twigs, branches, fruits etc. should be utilized as organic inputs for the cashew tree. There is growing demand for organic food grains, fruits, vegetables and other products, which would fetch premium...
price in the international market. Since dairing and rearing of animals are a part and parcel of most of the farming systems, the availability of organic materials in plenty determines the scope for organic cultivation of most of the crops, apart from converting a large number of smaller cashew holdings into organic.

In organic farming, most important aspect is maintaining the soil fertility status. When organic materials are added to the soil, the soil microbes work on them and convert them into readily available nutrients for the plants apart from improving the soil structure. Earthworms, millipedes, centipedes and many soil macro fauna also play major role in improving the properties of soil.

Annexure – 1
Organic sprays which could be utilized in cashew cultivation:

1. Sprays providing nutrition and imparting protection from insects/diseases.
   a. Cattle urine: For every one liter of cattle urine, 8-10 liter of water should be added and sprayed.

   b. Compost tea: One kg of well-degraded compost powder is mixed in 40 liter of water, filtered and sprayed. Varanashi Bio spray is one such formulation, which is readily available in the market.

   c. Jeevamrutha: 10 kg fresh cow dung, 5-10 liter of cattle urine, 2 kg of black Jaggary (or palm sugar), 1 kg legume seed powder (black gram/ Bengal gram/ green gram), one handful soil from the bunds of the field should be mixed in 200 liters water. All these constituents are mixed in a barrel, kept in shade for 2 days stirring three times a day. The mouth of the barrel should be kept closed with a wet gunny bag. The solution is to be used for spraying within 7 days of its preparation. Filter before use.

   d. Beejamrutha: 5 kg fresh cow dung, 5 liter cattle urine, 50 g CaO (lime), one handful of soil from the bunds of field should be mixed in 20 liter water. All these constituents have to be thoroughly mixed and used for the seed treatment. Treated seeds have to be shade dried and sown. The treatment enhances germination. Cashew nuts can be soaked for a day in this solution before sowing.

2. Organic sprays for control of pests.
   a. Strychnos nux-vomica: Seeds, bark, leaves and roots of this plant are used. Two kg of the plant part is crushed and boiled in 30 liter of water. The solution should be filtered and sprayed in 1 : 2 proportion with water. It proves useful in avoiding TMB to certain extent. Spraying once in 15 days during the flushing period is suggested.
b. **Neem seed concoction**: One kg of pounded neem seeds are soaked in 10 liter of water for 10-12 h then 20 liter of water and 1 ml of liquid soap are added, filtered and sprayed. It is useful against some insect pests.

c. **Tobacco concoction**: 200 g tobacco should be tied in a piece of cloth and boiled in 2 liter of water and allowed to soak for 24 h and filtered. 100 ml of neem oil with 20 ml of liquid soap are added and diluted in 5 liter of water and sprayed.

d. **Neem oil/ Castor oil**: 200 ml of neem / castor oil is mixed with 40 ml of liquid soap and diluted in 10 liter water and sprayed. This is effective against TMB if sprayed frequently.

e. **Lantana**: One kg lantana (*Lantana camera* L.) leaves are finely crushed and diluted in 10 litre of water and sprayed, which is effective against leaf miner.

f. **Fish**: One kg of fresh fish is crushed and mixed with one kg of black jaggary or palm sugar and allowed to ferment for 15 days. This preparation may be used at 15 ml per one liter of water for spraying. This is effective against bacterial diseases.

g. **Annona (Custard apple- *Annona squamosa* L.) + Chilli + Neem seed**: Two kg of Annona leaves should be shredded and made into paste by adding some water. 500 g of dry chillies have to be soaked for 8-10 h in water. Neem seed should be powdered and soaked for 8-10 h in water. All the ingredients are mixed and water is added to prepare a solution. Then diluted to 50 liter with water and sprayed, controls thrips and caterpillars.

h. **Chilly + Garlic**: One kg of green chilly along with 3 garlic bulbs is crushed to make a paste and soaked in five liter of water for 8-10 h. This solution is dissolved in 18 liter water and sprayed. Effective against leaf hoppers and grass hoppers.

**Note**: All the sprays are to be carried out during either morning or evening hours.

Before the arrival of chemical pesticides, there were several traditional methods of insect and disease control, which slowly disappeared. Off late, they are gaining importance once again. Such organic control measures have been collected from various sources and listed here for the benefit of the organic farmers. Some of them have been tried in cashew cultivation. Hence, farmers are suggested to try appropriate combinations on a small scale and extend the successful results to other plants in the orchard.
Annexure – 2
Organic inputs and their conditions of use
To market products with organic label, it has to be certified by appropriate certification agency. There are several certifying agencies in India. The names and address of the recognized certifying agencies operating in India is listed in APEDA website (Annexure-4). A Few are internationally recognized.

The organic inputs, which could be used in a certified organic farm, are listed in the tables below. Organic wastes available in certified plantations are permitted to be used as inputs in organic cultivation. Certain other products are allowed for use in organic agriculture for the control of pests and diseases (plant protection). Such products should only be used in absolute necessity and should be chosen after taking the environmental impact into consideration.

Many of these products are restricted for use in organic production. In the table “restricted” means that the conditions and the procedure for use shall be set by the certification programme.

1. Substances of plant and animal origin

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Conditions of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow dung, slurry, cattle urine</td>
<td>Should be used as composts or used by adding water</td>
</tr>
<tr>
<td>Human excrement</td>
<td>Should not be directly used on edible portion of the plant. - Restricted</td>
</tr>
<tr>
<td>Vermi compost/ vermi tea</td>
<td>✓</td>
</tr>
<tr>
<td>Bone meal, Meat meal, Blood meal, Feather meal</td>
<td>Restricted</td>
</tr>
<tr>
<td>Crop residues, green manures, straw, other mulches</td>
<td>✓</td>
</tr>
<tr>
<td>Saw dust, wood shavings, Ash, Coal (without coating of chemicals)</td>
<td>✓</td>
</tr>
<tr>
<td>Extraction from different plant parts</td>
<td>✓</td>
</tr>
<tr>
<td>Organic composts (animal waste, poultry waste etc.)</td>
<td>Restricted</td>
</tr>
<tr>
<td>The items produced outside the organic farm unit - Animal excrement, poultry manure etc.</td>
<td>Restricted</td>
</tr>
<tr>
<td>Fish meal</td>
<td>Restricted</td>
</tr>
<tr>
<td>Sea weed and its products</td>
<td>Restricted</td>
</tr>
<tr>
<td>Town and house hold waste compost</td>
<td>Restricted</td>
</tr>
<tr>
<td>Plant waste compost</td>
<td>✓</td>
</tr>
</tbody>
</table>
## 2. Minerals

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Conditions of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium carbonate of natural origin (chalk, lime stone, gypsum, phosphate)</td>
<td>Restricted</td>
</tr>
<tr>
<td>Megnesium sulphate</td>
<td>Restricted</td>
</tr>
<tr>
<td>Potassium (mineral), sulphate of potash etc.</td>
<td>Should not have undergone chemical treatments</td>
</tr>
<tr>
<td>Gypsum (calcium sulphate)</td>
<td>Restricted</td>
</tr>
<tr>
<td>Rock phosphate</td>
<td>Restricted</td>
</tr>
<tr>
<td>Sodium chloride (table salt), calcium chloride</td>
<td>Restricted</td>
</tr>
<tr>
<td>Micro nutrients (Bo, Cu, Fe, Mn, Md, Zn etc.)</td>
<td>Restricted</td>
</tr>
<tr>
<td>Sulphur</td>
<td>Restricted</td>
</tr>
<tr>
<td>Vermiculite</td>
<td>Restricted</td>
</tr>
</tbody>
</table>

## 3. Others

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Conditions of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microbiological preparations</td>
<td>✓</td>
</tr>
<tr>
<td>Bio fertilizers</td>
<td>✓</td>
</tr>
<tr>
<td>Biodynamic preparations</td>
<td>✓</td>
</tr>
<tr>
<td>Byproducts of sugarcane industry</td>
<td>Restricted</td>
</tr>
<tr>
<td>Byproducts from oil palm, coconut and cocoa (including empty fruit bunch, palm oil mill effluent (pome), coco peat and empty cocoa pods)</td>
<td>Restricted</td>
</tr>
<tr>
<td>Byproducts of industries, processing ingredients from organic agriculture</td>
<td>Restricted</td>
</tr>
</tbody>
</table>

## I. Plant based or animal based products in organic plant protection

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Conditions of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neem oil</td>
<td>Restricted</td>
</tr>
<tr>
<td>Gelatin</td>
<td>✓</td>
</tr>
<tr>
<td>Pesticide of plant origin (including neem)</td>
<td>Restricted</td>
</tr>
<tr>
<td>Pyrithrins (of chrysanthemum origin)</td>
<td>Restricted</td>
</tr>
<tr>
<td>Tobacco Tea (apart from pure nicotine)</td>
<td>✓</td>
</tr>
<tr>
<td>Casin (milk protein)</td>
<td>✓</td>
</tr>
<tr>
<td>Sea algae, sea weeds/ sea salt/ products derived from salt water</td>
<td>Restricted</td>
</tr>
<tr>
<td>Mushroom based products</td>
<td>✓</td>
</tr>
<tr>
<td>Products of chlorella</td>
<td>✓</td>
</tr>
<tr>
<td>Products from fermentation of Aspergillus</td>
<td>Restricted</td>
</tr>
<tr>
<td>Natural acids (vinegar)</td>
<td>Restricted</td>
</tr>
<tr>
<td>Decoction of plant origin (neem, garlic, pongamia)</td>
<td>✓</td>
</tr>
<tr>
<td>Predators</td>
<td>Restricted</td>
</tr>
</tbody>
</table>
II. Products of mineral origin

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Conditions of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lime or sodium chloride</td>
<td>Restricted</td>
</tr>
<tr>
<td>Burgundy mixture</td>
<td>Restricted</td>
</tr>
<tr>
<td>Clay (Perlite, vermiculite, zeolite)</td>
<td>Restricted</td>
</tr>
<tr>
<td>Cu salts/ inorganic salts (bordeaux mixture, copper hydroxide, copper oxychloride)</td>
<td>Restricted</td>
</tr>
<tr>
<td>Light mineral oils</td>
<td>Restricted</td>
</tr>
<tr>
<td>Potassium permanganate</td>
<td>Restricted</td>
</tr>
<tr>
<td>Lime sulphur (calcium polysulphide)</td>
<td>Restricted</td>
</tr>
<tr>
<td>Silicates</td>
<td>Restricted</td>
</tr>
<tr>
<td>Sodium bicarbonate</td>
<td></td>
</tr>
<tr>
<td>Sulphur (fungicide, miticide or acaricide)</td>
<td>Restricted</td>
</tr>
</tbody>
</table>

III. Microbes for biocontrol of pests

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Conditions of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>From virus, fungal or bacterial preparations (bio control agents like Trichoderma, Bacillus thuringiensis, Granulosis virus etc.)</td>
<td>✓</td>
</tr>
</tbody>
</table>

IV. Others

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Conditions of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterilized insects</td>
<td>✓</td>
</tr>
<tr>
<td>Carbon dioxide and nitrogenous gas</td>
<td>Restricted</td>
</tr>
<tr>
<td>Soft soap (potassium soap)</td>
<td>✓</td>
</tr>
<tr>
<td>Homeopathic and Ayurvedic preparations</td>
<td>✓</td>
</tr>
<tr>
<td>Herbal and Biological/Biodynamic preparations</td>
<td>✓</td>
</tr>
</tbody>
</table>

V. Traps

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Conditions of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nets, Traps</td>
<td>Restricted</td>
</tr>
<tr>
<td>Pheromones, light traps</td>
<td>✓</td>
</tr>
</tbody>
</table>

Note: ✓ Indicates permitted to use

The procedure for getting organic certification is quite complex. To obtain certificate, the organic growers should maintain necessary documents and follow strict guidelines and have to undergo periodical inspections from the certifying agencies. In a way it makes the farmers disciplined and handle their produce as per the international standard. If there is no assured market with premium price, certification is of no value. This requires a lot of patience and hard work. The main objective of this book is to make the farmers take up organic and sustainable agriculture. Regarding organic certification only introduction is given in this book and there are still a lot of things left uncovered.
Annexure – 3

References


20. Yadukumar, N. 1998. *Intercropping and mixed cropping in cashew*. NRCC, Puttur-574 202, India


23. Yadukumar, N., *Soil and water management practices on cashew* - NRCC, Puttur-574 202, India


**Annexure – 4**

**Websites**

1. Varanashi Research Foundation  
   www.varanashi.com

2. National Research Centre for Cashew  
   http://www.nrccashew.org

3. Directorate of Cashew and Cocoa development council:  
   http://dacnet.nic.in/cashewcocoa/dccd.htm

4. AuroAnnam - research & demonstration farm-organic Cashew nut cultivation:
http://www.auroville.org/research/auroannam_research_farm.htm
5. Sri Lanka’s Organic Cultivation of Cashew Nuts
   http://www.unescap.org/DRPAD/VC/conference/bg_lk_7_soc.htm
6. Cashew in - The Cashew Nut WWW Database
   http://www.cashew.in
7. International Federation of Organic Agriculture Movement
   http://ifoam.org
8. APEDA-National programme for organic farming

Annexure – 5

Our gratitudes
The Authors wish to extend their heartfelt thanks to those people who have contributed in providing relevant informations, by giving published articles or photographs and also those who have helped us indirectly. The names of the persons are listed below.

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NOTE: This Article is prepared by condensing Hand book on organic Cashew Cultivation (2007) Published by Varanashi Research Foundation, Adyanadka, 574 260, India. Hard copy of the same is available for sale with the Publisher.
Varanashi Publications
Handbook on organic Cashew Cultivation

Authors: Dr. Varanashi Krishna Moorthy
Dr. Yadukumar. N
Mr. Shankar Raj. N.S

Handbook on organic cashew nut cultivation, the most informative book on production of cashew is published by Varanashi Research Foundation, a well known institution working for the promotion of eco friendly organic agriculture. The book is indemi 1/8 size with 71 pages. The highlight of the book is simple narration about the sequences of events in the cultivation of cashew. It is a modified package of practices for cashew with a new outlook. The beautiful color photographs and neat drawings totaling 48, perfectly match the illustrations. Mixed crops and inter crops have been explained with layout plans. Utilisation of organic inputs in the place of chemical inputs and the resultant benefits have been explained. The authors have taken pains in gathering information on every minute aspect of organic cashew production. Facts regarding soil and water conservation and organic plant protection means have been effectively discussed. The Book has many tips to boost the cashew production and to achieve sustainability. It intends to create awareness among the farmers, students, Scientists and public about the eco friendly organic agriculture. The book is the outcome of an advisory project at Cambodia financed by GTZ, Germany. four editions have came out in a short period of 1½ years!!

Price:
1. English Indian version Rs. 150/- (for Indian buyers) US $ 35/- (for International buyers)
2. English International version US $ 35/-
3 Kannada Rs. 75/-

Contact Address: Varanashi Research Foundation
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Value Addition in Cashew Nut Through Improved Technology
-Perspectives and Recent Developments

Dr. K.A. Retheesh
MD, Kerala State Cashew Development Corporation Ltd., Kerala.

Though India is exporting to more than 60 countries of the world, over 99.5% of India’s cashews go in bulk packaging and as plain cashew kernels in 4-gallon prime tins or plastic containers with a net weight of 25 lbs or 11.34 kg flushed with carbon dioxide or nitrogen. It is quite unfortunate that even after 7 decades of experience in international trade in cashew kernels, exports of the commodity in value added forms/consumer packs constitute less than 0.5% of total exports per annum or in value terms less than US$1 million. Most cashews are either oil or dry roasted. They are marketed to the consumers in a mixture with other nuts, as 100% nuts and also in confectionery products. Raw cashews are also sold in health food and dry fruits stores. India currently has different varieties of cashew kernels including roasted and salted, sugar coated, spiced and masala fried. However, no serious efforts have been taken by Indian exporters to market these types of products in branded consumer packs in foreign markets.

Value addition in the cashew industry can be evolved in three forms:
A. Incremental value addition to the commodity in its existing form itself
B. Finding new uses: Programmes to promote cashew as a healthy, friendly nut, ideal as a snack food, with high calories and polyunsaturated fat contents have been initiated. Expanding the use of cashew kernel in sweets, biscuits and confectionary preparations is also being attempted.
C. Innovative value added products.

Kerala State Cashew Development Corporation (KSCDC) being the biggest processor of cashew in the world is taking initiative to produce value added products from cashew. Now KSCDC has introduced 4 value added products from cashew.
1. **Cashew Soup**: It is in powder form. It can be added to boiled water, delicious soup is ready. No other ingredient is necessary to make soup.

2. **Cashew Powder**: This is targeted to housewives. This powder can be used as thickener in dishes and will add taste to food items.

3. **Cashew Vita**: Is a health drink targeted to growing children. It can be added to boiled milk.

4. **Cashew Bitz**: As everybody knows cashew is a good combination with hot drinks. This is a mixture of masala with cashew bitz.

These products are research outcome of Central Food Technological Research Institute (CFTRI), Mysore the premier institute in food technology in India. The brand name of these products is “CDC Cashews.”

These products are true value added products. The global launch of the product was done at Dubai on 22nd April 2008. The market response is very good. KSCDC envisages to lead Indian Cashews in the global market as value added product.
High Yielding Varieties of Cashew

Dr. M. Abdul Salam
Professor and Chairman - Department of Agronomy and Cashew Expert
Kerala Agricultural University, College of Agriculture
Vellayani, Kerala, India

India is the pioneer in cashew research and development. They have a history of five decades in cashew research. Indian researchers have developed a large number of varieties and technologies capable of increasing the production and productivity of the crop.

Crop improvement work undertaken under the Indian Council of Agricultural Research at National Research Center for Cashew, Puttur (NRCC) and eight State Agricultural Universities {Kerala Agricultural University (KAU), Konkan Krishi Vidyapeeth (KKV), Acharya N.G. Ranga Agricultural University (ANGRAU), Tamil Nadu Agricultural University (TNAU), University of Agricultural Sciences (UAS), Bidhan Chandra Krishi Vishwavidyalaya (BCKVV), Orissa University of Agriculture & Technology (OUAT)} during the past five decades led to the development of 40 high yielding varieties capable of yielding 2 to 4 tons of raw nuts per hectare (Table-1). Of these 40 varieties, 14 are hybrids and 26 are selections. These varieties possess desirable attributes like medium to bold nuts, high shelling percentage, high kernel weight and preferred export grades. The important characteristics of the 40 high yielding cashew varieties are summarized in the Table-1.

Selection of appropriate varieties and adoption of suitable agronomic practices are of utmost importance to realize better output from cashew plantations. Care should be taken to choose good quality planting materials (soft wood grafts) of high yielding varieties suited to the specific location, planting grafts at recommended spacing and management in scientific lines, in order to exploit the best potential.

Cashew - an effective bio-agent for eco-restoration
Cashew is a very hardy and drought tolerant crop with deep and prolific root system. It can well tolerate moisture stressed and nutrient stressed environments compared to other similar species. The abilities of cashew roots to penetrate through the hard pans of the soil profile, permitting more water infiltration, promoting biological activity in the soil and
converting a less productive soil to a more productive one, are very well known. In many areas, cashew is effectively used as a potential bio-agent for CO$_2$ sequestration, establishing green belts and eco-restoration purposes. While promoting cashew for eco-restoration utilization of wastelands and less endowed environments, seedlings can be used as a planting material rather than grafts. The planting density can also be high. In such efforts, there is an incidental bonus in the form of cashew nuts as well.

The salient characteristics of few high yielding varieties of cashew are given below.

**Madakkathara –1**

<table>
<thead>
<tr>
<th>Year of release</th>
<th>1990</th>
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<tr>
<td>Hybrid / Selection</td>
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<tr>
<td>Canopy type</td>
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</tr>
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<td>Flowering</td>
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<td>Fruiting</td>
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<td>72</td>
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<tr>
<td>Nut weight</td>
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<tr>
<td>No. of nuts / kg</td>
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<td><strong>Special character</strong></td>
<td>Bold nut variety, mid season, and drought tolerant</td>
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<td><strong>Shelling percentage</strong></td>
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**Dhana (H 1608)**

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<td>Mean nut yield / tree</td>
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H 1600

A high yielding cashew hybrid from Kerala Agricultural University
### Table 1. Salient characters of cashew varieties released in India

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<th>Name of the variety</th>
<th>Parentage</th>
<th>Institution</th>
<th>Release</th>
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<th>Nut wt. (gm)</th>
<th>Kernel wt. (gm)</th>
<th>Shelling%</th>
<th>Export grade</th>
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<td>2.08</td>
<td>30.58</td>
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<td>2.44</td>
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<td>Dhansaree (H3-17)</td>
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<td>Akshaya (H-7-6)</td>
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Note: NRCC - National Research Center for Cashew, KAU - Kerala Agricultural University, KKV - Konkan Krishi Vidyapeeth, ANGRAU - Acharya N.G Ranga Agricultural University, TNAU - Tamil Nadu Agricultural University, UAS - University of Agricultural Sciences, BCKVV - Bidhan Chandra Krishi Vishwavidyalaya, OUAT - Orissa University of Agriculture & Technology
Cashew Apple Products

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Cashew apple is highly nutritious and is a valuable source of sugars, minerals and vitamins. The chemical composition of cashew apple is: moisture 87.8%, protein 0.2%, fat 0.1%, carbohydrate 11.6%, crude fibre 0.9%, calcium 10.0 mg/100g, phosphorous 10.0 mg/100g, iron 0.2 mg/100g, vit C 261.0 mg/100g, minerals 200.0 mg/100g, thiamin 0.02 mg/100g, riboflavin 0.5 mg/100g, nicotinic acid 0.4 mg/100g and vitamin A 39.0 IU. Thus cashew apple is compared with several other fruits in the content of most of the nutrients but superior in vitamin C and riboflavin.

However it is quite unfortunate that such an excellent fruit is currently wasted completely, causing economic loss to cashew farmers and the country. Large numbers of technologies are available at present for the economic utilization of cashew apple for various purposes. Cashew apple processing can generate substantial employment opportunities, especially to women and can contribute appreciably towards income enhancement of cashew farmers.

Uses of cashew apple
An overview of the uses of cashew apple is given hereunder.

I. Fresh consumption
Cashew apple is widely eaten raw as fresh fruit.

II. Uses in food processing

1. Beverages
a. Fresh apple beverages: Several nutritious and refreshing beverages like clarified and cloudy juice, juice concentrate, syrup, squash and ready-to-serve can be made from the unfermented juice of cashew apple.

b. Fermented beverages: Wine, vinegar, liquor and alcohol are the fermented products that can be manufactured from cashew apple.
2. Pulp products: Jam, mixed jam, fruit bar, leather and sweet are some of the pulp products prepared with cashew apple.

3. Confectioneries: Candy and tutti fruitty are the important products. Frozen deserts and dairy confectionary items like milk shakes, ice creams and ice candy could be prepared from cashew apple juice by optimization of juice concentration and spray drying. Dehydrated cashew apple powder can be used for preparation of various value added products like biscuits, doughnuts, cake, soup, chocolates and breads.

4. Culinary preparations: Pickle can be prepared from matured but green cashew apple. Chutney can be prepared from ripe cashew apple.

5. Canned products: Canned cashew apple

III. Medicinal uses
Extensively used for traditional preparations for several ailments. It is used as a curative against scurvy and stomach ailments like dysentery and diarrhoea.

IV. Uses in neutraceutical extractions
Cashew apple contains ascorbic acid, fibre, carotenoid pigments, minerals and host of other elements, which are of significance to human health and hence can be used in neutraceutical extractions.

V. Agricultural uses
The cashew apple as well as its residue can be utilized as animal feed and for the preparation of vermin-compost. Cashew apple extract can be used in pest management as bait for catching crustaceans.

VI. Energy productions and industrial uses
Cashew apple can be used for the production of biofuel, biogas and tannin.

Commercial cashew apple products
Cashew Research Station, Madakkathara under Kerala Agricultural University, Thrissur, India have done commendable works on the utilization of cashew apple and development of several products like squash, syrup, pickle, candy, chutney, jam, wine, liquor and vinegar. An FPO licensed
A cashew apple processing unit has been established at Cashew Research Station, Madakkathara during 1997 for the manufacture of cashew apple products. It is the first ever unit established in India for cashew apple processing. The unit has been producing cashew apple syrup and cashew drink for the past few years. These are sold through various sales centres of the university. It has recently started commercial production and sale of three new products viz., mixed cashew apple- mango jam, cashew apple pickle and candy.

1. Cashew apple syrup and drink
Selected cashew apples are cleaned thoroughly, juice extracted and clarifying agent, preservative and citric acid are added immediately. The clarified juice is siphoned out and this serves as the raw material for the preparation of syrup and drink. Sugar and citric acid are added to the clarified juice in required quantity to produce syrup and drink as per demand.

The nutrients, Vitamin C and riboflavin, which are high in cashew apple, are preserved in these beverages also. Cashew apple syrup contains 276 mg Vitamin C and drink contains 140 mg vitamin C/ 100g. These are natural products and price is comparatively less. Taste is better if served chilled. Syrup has a storage life of one year.

Cashew apple drink, which is the second commercial product from Cashew Research Station, Madakkathara, is an RTS (Ready – To -Serve) beverage. Drink is marketed both in glass bottles and in attractive food grade pouches. Pasteurized drink in glass bottles has a storage life of three months under ambient storage conditions.

2. Cashew apple- mango mixed jam
The ripe apples are collected from the farm, selected, cleaned and soaked in salt solution for three days to remove tannin. Apples are again washed in water, cooked, made into pulp and mixed with equal quantity of mango pulp. Pulp is mixed with sugar and citric acid to prepare jam. Vitamin C content of the product is 18 g/ 100g. It is marketed under the trade name Cashewman mixed jam.

3. Cashew candy
It is a sweet product. For preparation of this candy, quality apples with good shape are selected. As like jam preparation, tannin is removed
from apples, cooked, pierced using fork and dipped in sugar solution. Concentration of sugar solution is gradually increased so as to reach 70\(^{\circ}\) brix. After two weeks of soaking, sugar solution is drained out and candy is dried in shade. It takes about 2-3 weeks for making the final product. About 745 g candy can be obtained from one kilogram of cashew apple. Vitamin c content of the product is 28.4 mg/100g.

4. Cashew pickle
Mature but unripe cashew apples are collected directly from plant carefully without disturbing the flowers and tender nuts. After cleaning, the fruits are cut into small pieces and astringency is removed by immersing in salt water. After removing from salt water, it is again washed and the pickle is prepared using oil, chilli powder, fenugreek powder, turmeric powder, chilli and ginger garlic paste.

**Transfer of technology on cashew apple processing**
The Cashew Research Station, Madakkathara is organising national and international programmes to popularize and transfer the technologies for cashew apple processing. The stakeholders include scientists from universities and central institutes, development officials, farmers, unemployed youth, member of Self Help Groups and women. The persistent transfer of technology initiatives of the Madakkathara centre for the economic utilization of cashew apple, which is currently wasted, totally causing huge national loss, has started bearing fruits. A trainee who got preliminary training on cashew apple utilization at this centre has started the first ever cashew apple processing unit in private sector at Iritty, Kannur, Kerala under the trade name “TOMCO PRODUCTS”. He is using the technology developed by the Madakkathara centre for the production of cashew apple syrup and cashew apple drink. The KVK, Kannur under KAU gave him vocational training and post training assistance and guidance in the establishment of the unit starting from project preparation and obtaining FPO license up to marketing. Few more units are in the initial stages of establishment with the technical assistance of Madakkathara Centre.
The increase in merchandise trade around the world has resulted in various tools for measuring value of the produce traded. The division of labour and specialisation that induced increase in global production and consumption is due to the introduction of economic efficiency. All factors of production are priced in such a way that the economic gains are derived up to the stage of consumption.

The development of knowledge has contributed to increasingly arithmetic and econometric tools where producers, traders and consumers can measure the value. These are called as benchmark prices.

The most popular and known benchmark is the Brent Crude and WTI which is a reference for and discussion of cost and/or pricing of petroleum.

The term benchmark originates from the chiseled horizontal marks that surveyors made, into which an angle-iron could be placed to bracket (“bench”) a leveling rod, thus ensuring that the leveling rod can be repositioned in exactly the same place in the future (Wikipedia)

Purpose of benchmark price
Benchmark price is a reference price for an entire industry for a particular unit of produce. It will serve producers, manufacturers, traders and consumers to arrive at cost and pricing of various units and classification of produce.

Arriving at benchmark price for Cashew kernels
The time has come to create a benchmark price for cashew kernels. The trade is increasingly internationalized and now is ready to be exposed to more economic inputs and managerial competencies. Cashew kernels are derived from raw cashew nuts (anacardium occidentale). Currently, global consumption is concentrated in OECD countries but increasingly shifting to middle-income countries as well as countries of production.
Cashew kernels are classified into grades, which have increasing and decreasing value depending on colour, size, shape, wholes and broken and other distinguishing characteristics. There are 25 grades in cashews, which are in published standards, and there are derivatives from these grades based on customer preferences and distinction made by producers on quality and value.

Global trade in Cashews is now bilateral. Manufacturers and traders enter into contracts through intermediaries. The characteristics of the produce are understood on given standard and regulated by common trade practices. Third parties are unusual in Cashew now.

Cashew trade was pioneered and developed by US importers in the 1920s to date and therefore globally it is a standard developed which offers convenience of trade.

Trade is conducted universally in US Dollars per lb. This is based on the American standard.

**How can we define a benchmark prices?**

It must be global: A benchmark price must be global in nature. The benchmark prices need to be arrived at scientifically based on costs and value.

It must be accessible to all: Benchmark prices must be made available at a definite time and accessible to all traders.

Definite in Terms: The benchmark price must be in an internationally accepted currency and designated for a unit of produce and a fixed point.

It must be easy to refer in a way that will enable participants in physical trade to measure the following:

- **Time differences** - e.g. present to forward price reflecting storage and interest cost
- **Place differences** - e.g. the cost of transportation from place of reference to the destination
• Quality differences - e.g. to establish the differential of a superior grade over the reference price and a inferior grade to the reference price

• Value Differences - When there is a perception of value by the customer, which needs to be referred to against the standard, grade e.g. specialty, organic, taste, value added etc.

• Classification - Enable participants to reduce or increase value based on nature and classification of produce. When there is a perception of value by the customer, which needs to be referred to against the standard grade, e.g. specialty etc., this can be referred to as a premium over the benchmark prices. Similarly, when there is a value reduction, it will be at a discount to the benchmark price.

The evolution of a benchmark price requires understanding and cooperation amongst all members of the cashew value chain and stakeholders. It has to evolve and then accepted. The world is increasingly dominated by the market economy and economic efficiency will be a rule than an exception. Sufficient resources must be devoted to develop a mechanism for benchmark pricing and it will be hugely positive for the cashew economy, which can be considered as a “growth” industry.

Benchmark price Cashew commodity India/ ggp /26.5.2008
A value chain is a concept developed in modern business management, which describes the flow of a product from the producer to consumer. The conversion of agricultural produce from primary stage of production of raw cashew and delivery to the secondary stage of manufacture involves purchasing, processing, logistics, manufacture, trading and preparation for selling to final consumer.

Each operator who handles the product needs an intermediary and a stakeholder who provides the needed service. Intermediaries are traders, brokers and handlers who buy, hold and sell the produce till it reaches the final consumer. The produce is transformed at each stage of handling.

Cashew in its raw form is a tropical produce. It is produced in three prominent nations India, Vietnam and Brazil. About 20 other countries, mostly tropical produce the rest of raw cashew production. Further process is required to make it fit for consumption and is valued across the world. It is consumed in almost all nations, but heavily in OECD countries and now recently, in India and China.

Brief History of Intermediation
India was a prominent exporter (99% of world production) and USA was a prominent consumer till the late 1960s. Therefore, world market was dominated by Indian and US interests. There was sufficient rivalry and information to ensure a semblance of “perfect competition”.

Cashew exporter was a manufacturer exporter in India. A broker was called an agent who was an intermediary in USA who acted as an exclusive agent for the Indian exporter and sold the cashews to importers in USA. Importers were traders who imported and paid for the cashews, stored them in warehouses and in turn sold it “users”. Users, were companies who engaged in roasting, salting, canning and distributing the cashews into chains for consumption. The business flourished through the cable. It was direct or coded depending on the intricacy of the trade and how it needed to be conveyed. Telephone was not in vogue at all as international calls commenced from Quilon and Mangalore only in the late 70s.
The agents used to visit India once in a year to renew their ties and make assessments and if the exporter could afford it, he would make trips to New York. It was sufficient to have an introduction to a good broker and the good broker introduced you to the range of importers.

An important fact to note is that the brokerage system was exclusive by agreement.

This enabled the relationship to develop with all the importers. The competition amongst brokers was sufficiently good enough to support the large number of shippers. Before the Brazilian industry emerged, India was the sole supplier to the USA. There were sufficient numbers of large and small cashew factories to provide a stream of cashews.

Price fluctuations were also the order of the day as much as they are now but they were neater and orderly.

The market for all grades was established in hierarchy. The law of contracts operated. Prices were on the basis of offers and acceptance. When market for buying was overactive, buyers issued bids, which were a good basis for the sellers to make their decisions.

The standard of trading developed was in US Cents per lb or US D per lb. Eg., 270 indicated in cents and 2.7 indicated in Dollar. The standard of packing was two tins of 50 lbs each. Initially wooden crates were used and sent in break bulk in steamers. Containers became the vogue in the 1980s and then standard since then.

Whenever a person in the trade, refers to what’s the market? It was always the pivotal grade W-320 and the rate was mentioned as 260 it means 2.6 USD per lb.

The trade became universal in that currency as any trader anywhere in the world would prefer to trade in the same currency as the USA. This system has been in vogue since then.

The American system worked in a very simple way. The business itself was hard though. If you had cashew to sell for any month from today to the 10th month, you could offer it. It could be at the same price or the variable
price. The Agent issued a telegram confirmation, which was as good as a valid contract. The Contract followed. Agents, importers and users were members of the Association of Food Importers (AFI), and followed the AFI standard Contract and rules.

The invoice showed a deduction of 5% from invoice value. Two and half% was paid on acceptance of the cargo and two and half% was the deduction of commission paid for by the seller but remitted by the buyer from the proceeds of the invoice.

The prices fluctuations were on 5-cent ticks. For instance if the price today is 270 then the price declined it was in the range of 265, 260, 250 and so on. Rarely business took place on decimals if there was a fight between buyer and seller. The payment stipulation was LC to be opened one day prior to the beginning of the month.

The cashew economy till the late 1970s was dominated by USA and interrupted by bilateral trade with Russia. Eventually, Brazil came into the picture and USA had another source along with Mozambique and Tanzania who became processors. In 1980s manufacturing in Africa declined and India began to grow in world supplies. This was due to the emergence of around 24 nations who began to cultivate cashews and India became the world’s dominant buyer. Today the number of players in cashew globally has multiplied.

Currently intermediation is done in different ways. It serves bilateral interests but also generates problems, which affect standardization and homogeneity. A new order in intermediation is called for. This has to be done by all stakeholders communicating effectively.

**Intermediation:**
Intermediation takes place in the following ways – trader, broker, manufacturer, logistics provider, value added process and final outlet to consumer. The trader, brokers and logistics provider may be multiple in the chain and usually manufacturer, value added process and final outlet remain in the chain for the produce.

**Traders:**
Traders buy and sell. They buy produce from agriculturists and sell to
the manufacturer. Another group buys cashew kernels and sells to the merchandiser or retailer as the case may be. Traders perform time and place functions. The trader earns the margin (or may lose it) when there is a transaction of selling and buying. A trader physically handles the merchandise or has a third party who handle it. Traders take their place between:

- Agricultural producer and another trader or manufacturer
- Manufacturer to processor
- Manufacturer to another trader or retailer

**Brokers:**
Brokers are individuals or firms who act as intermediaries between two firms and arrange the information prior to a sale. Brokers take a fee called brokerage, which usually is a percentage of sale value. Brokers can have a role in any transaction between buyer and seller in the entire value chain. There can be a minimum of two brokers from agricultural produce stage to final consumer or more.

**Manufacturers:**
Making cashew kernels out of raw cashew is manufacture. Many believe it’s merely a “process”. Manufacturers buy raw cashew nuts and convert it into cashew kernels in an elaborate process. They are the key intermediaries between agricultural producers to final consumer. Manufacturers incur the highest cost in terms of value added at the secondary stage.

**Processors:**
Processors are intermediaries who handle the produce of kernels and add value. Adding value can be in the form of roasting and other forms of value addition, which make it acceptable to the end consumer. They can be as small as 2 kgs a day to 150 tons per day.

**Retailers:**
Retailers buy from traders or processors and are the last point to the consumer. In OECD countries the highest value is in retailing which takes off up to 45 to 50% of the shelf price of a cashew pack.

**Factors in intermediation:**
“One can eliminate the middleman but not his functions” is a commercial saying. How crucial is the value of intermediation at each point in the
Cashew value chain needs to be determined. Currently, it looks minimal in terms of intermediation costs, as net margins at each stage of process are not very high, as it seems.

Cashew is a high value product. Currently, the wholesale value of cashew is Rs.350,000 per metric ton and retail value is anywhere between Rs.700,000 to Rs.900,000 per metric ton. Therefore, liquidity is easier in cashew as it is a sought after material. There is a long way to go to generate sufficient surpluses in cashew that can lead to marketing. We therefore need to go into all aspects of the Cashew Value Chain.

**Conclusions:**
Cashew is a paradox where we can say that bilateral trade is highly efficient but inefficiencies exist in the value chain apparently when one looks holistically. The justification at each level of intermediation and handling makes reasoning that at the bilateral level trading is highly efficient and cost effective. We need to reconcile both and bring in effectiveness.

- Gains will accrue from consolidation in an industry which is fragmented in origin.
- Information flow, encouraged from producer to consumer and vice versa will improve value to all stakeholders in the cashew value chain.
- Cashew value chain stakeholders need to make a holistic understanding of the product, its nature and the behaviour of participants in various contexts.
- There will be a drastic change in the way cashew is handled three years from now.
Cashew is an important agricultural commodity in India, earning about Rs. 2500 crores (US $ 570 Million) of foreign exchange per annum. This amounts to 0.35% of the total foreign exchange earnings of the country through exports.

The industry provides employment to more than 10 lakh workers in the trading, processing and the farming sectors. India is the largest producer, processor, exporter and consumer of cashew kernels in the world. Our cashew kernels are exported to more than 60 countries in the world, mainly to USA, Netherlands, UK, Germany, Japan, Australia, UAE, etc.

The total world exports of cashew kernels was 2,93,077 tons during 2007, of which India’s share was 1,15,265 tons constituting 39.33% of the total. Until a decade back, India and Brazil were the major players in the world cashew market. Of late, Vietnam has also entered into the fray. The percentage share of Indian cashew in the international market has come down from 44% in 2003 to 39% in 2007.

The main factors affecting our market share and export performance are insufficient production of domestic raw cashew nuts and competition from other cashew producing countries mainly Vietnam. The entry of Vietnam has caused a fall in international prices. Competition from other nuts like almonds, macadamias, pistachios, etc., which are promoted on the basis of health claims, un-remunerative international prices, high cost of production etc., are the other reasons for the decline in export performance.

The Directorate of Cashew nut and Cocoa Development (DCCD) under the Ministry of Agriculture is the organization looking after the production development of raw cashew nut in India.
The Cashew Export Promotion Council of India (CEPCI) was established by the Govt. of India in 1955, with the active co-operation of the cashew industry, with the object of promoting exports of cashew and allied products from India. The Council provides the necessary institutional framework for performing the different functions that serve to intensify and promote India’s exports of cashew and allied products.

At present, the CEPCI has 162 cashew exporters as its members from various parts of India. The Registration-Cum-Membership Certificate (RCMC) given by the Council enables the members to avail all eligible assistances/incentives provided by the GOI from time to time.

CEPCI acts as a nodal agency for implementation of Government supported schemes for development and promotion of export of Indian Cashews. The Govt. of India has recognized the economic and social importance of this traditional and labour intensive industry. It has been extending financial assistance to undertake various promotional activities for the upgradation and modernization of the cashew processing units and improving the quality of the product. Thereby generating more demand for our cashew kernels and increased price realization for Indian cashews in the world markets.

The CEPCI undertakes various programmes / activities like participation in the international food fairs, international conventions and seminars, sponsoring trade delegations, market surveys, disseminating trade enquiries, market information, publishing statistics, journals, etc., organizing buyer-seller meets, implementing schemes for assisting exporters to improve quality of cashew kernels exported etc., under the Marketing Development Assistance (MDA), Market Access Initiative (MAI), Assistance to State for Infrastructure Development of Exports (ASIDE) and Five Year plan schemes of the GOI. These programmes help the Indian cashew exporters to be more competitive in international markets.

Since raw cashew nut production in the processing states is not adequate, raw nuts are being sourced from other cashew growing states. The raw nuts so purchased attract a CST @ 3%. In order to enable our cashew processing/exporting industry compete with low priced kernels from other countries, the Govt. of India could consider exempting raw cashew nuts from the levy of CST. Walnuts have been exempted from VAT in
order to help the farmers in Jammu and Kashmir. Removal of CST and VAT for cashews would help thousands of farmers and processors in more than 10 states and also lakhs of workers in the farm and factories.

There has hardly been any incentives/ special benefit from the Govt. of India for export of cashew kernels as compared to most of the other similar agro products in India. Domestic prices for cashew kernels are generally higher as compared to the international prices. Though the raw material cost and cost of production has increased considerably in the recent years, processors are persisting with exports mainly because they don’t get buyers for large quantities and higher-grade varieties in the domestic market. As the margins are very thin, they have to do huge volumes and for this they have to depend on exports. The industry is highly labour intensive and provides direct employment in the factories to more than 5 lakhs workers, mostly women from the economically and socially backward sectors.

The cashew processing industry in India thus deserves encouragement from the Govt. of India in the form of sufficient export incentives in view of its huge employment generating potential. One ton of Cashew kernels exports would roughly generate 400 man-hours of work.

The incentives currently available to cashew exporters are:
1. DEPB @1.5% or Drawback @ 1% of FOB value of exports of Cashew Kernel
2. VKGUY @5% of FOB value of exports of Cashew Kernel, CNSL and Cardanol.

The export of cashew kernels from India during 2007-08 was 1,14,430 tons valued at Rs.2288.90 crores as against an export of 1,18,540 tons valued at Rs.2455.15 crores during 2006-07. There was a decrease in the export price of cashew kernels during the year. The average unit export price realized during the year was Rs.200.18 per kg compared to Rs.207.12 per kg during 2006-07 recording a decrease of 3.35%.

The processing facilities in India being relatively old and lack the modern technology. Due to restrictive guidelines and rules for MDA from the Government, the Council was not able to undertake much promotion activities during the period 2003-06. The continued fall in the value of US
$ during the last one year or so has affected Indian cashew exports very severely, leading to drop in exports.

The Foreign Trade Policy (FTP) 2005-09 has announced important export promotion schemes like the ‘Focus Product’ scheme with a view to incentivise export of products which have high employment intensity in rural and semi urban areas. This offsets the inherent infrastructure inefficiencies and other associated costs involved in marketing these products. VKGUY is to promote export of fruits, vegetables, flowers, minor forest produce, etc. and their value added products by incentivising exporters of such products. Even though cashew qualifies for both the schemes in all aspects, it was left out from both these schemes. The Council had taken up this at all levels and the Government has been kind enough to allow VKGUY for cashew for the period 2004-05 and from 01-04-2007.

As an initiative to develop exports, the Govt. has abolished the export cess. This has come as a relief to the cashew industry.

To create more demand and make Indian cashews more competitive in the International markets, the Council implements various programmes under the MDA and MAI schemes of the Ministry of Commerce, Government of India. The programmes include sponsoring trade delegations, participating in international fairs, conducting market studies, creating awareness through advertisements on the health and nutritional aspects of cashews and free sampling of the products in trade fairs, etc. The Council participates in major international food exhibitions in selected destinations to retain our existing buyers, to explore new markets, to identify potential buyers and to project India as the worlds largest and reliable supplier of cashews who can supply any grade, any quantity at any time of the year, irrespective of the fact that cashew is a seasonal crop.

During 2007-08, the Council participated in three international fairs viz. Fancy Food Show, New York, USA; World Food, Moscow, Russia and Anuga fair, Cologne, Germany utilizing the MDA assistance of the Govt. of India. Member exporters participated in these fairs through the Council stall and generated good business for their products.
Under the MAI scheme the Council conducted has two market studies, one in USA and the other in Japan during the year 2002-2003. These studies were conducted by top consultancy agencies viz. M/s. Tata Consultancy Services and M/s. KPMG respectively at a combined cost of Rs.107 lakhs. The study results were circulated among the members of the Council and to the Govt. of India for approval to conduct health and nutrition studies.

The Govt. had extended assistance, under the MAI scheme to conduct buyer seller meets in India/abroad which facilitated renewal of existing contacts, building new ones, generation of new business and dissemination of our products, quality etc. During 2001, the Council had organized world’s first ever “World Cashew Congress” in Kochi bringing all the cashew related countries, producers, processors and buyers in one place. In September 2006, the Council organized KAJU INDIA 2006, the first buyer seller meet at Kovalam, Trivandrum. 245 delegates including 45 foreign delegates participated in the meet.

The CEPCI along with national associations of other major cashew producing countries viz. VINACAS of Vietnam and SINDICAJU of Brazil is in the process of formation of the Global Cashew Alliance to promote cashew in the global markets based on the nutrition and health advantages of cashew.

Another initiative from the Govt. is to encourage manufacture and export of value added products, which would increase the value realization as well as job opportunities in the country. A proposal to provide financial assistance to exporters of cashew kernels in value added consumer packs for undertaking intensive marketing campaign in UAE market has been submitted by the CEPCI for Govt. approval under the MAI scheme. Once this proves successful, the proposal can be extended to other potential markets.

The Five Year Plan schemes of the Govt. of India extending assistance to cashew exporters for upgrading and modernizing their processing and packaging facilities, for acquiring latest packaging facilities, for acquiring internationally accepted quality certification like ISO/HACCP etc. This has proved very effective in empowering the exporters to improve their productivity, quality standards and preparedness to face the emerging
challenges in the international marketing. The Council has been preparing and operating the Five Year Plan schemes for the benefit of the cashew industry and during the IX and X plan period, 180 units have upgraded their facilities availing a total grant of Rs.5.93 Crores.

For the XI plan, the ‘Modernisation and Diversification Scheme’ is available for modernization of cashew processing factories. The scheme has a total outlay of Rs.19.36 crores for 2008-09 to 2011-12. It has the following four components:

i) Process upgradation/ modernization of Cashew processing units
ii) Setting up facilities for value addition / consumer packing of cashew kernels
iii) Adoption of new packaging systems
iv) Implementation of internationally accepted quality systems like ISO, HACCP, Organic, etc.

Quality has emerged as the key factor deciding whether a product gets into the mainstream global market or falls by the wayside. Only with long-term commitment to quality can exporters survive and grow into today’s intensely competitive environment. Understanding the need of the hour, the Govt. of India has extended full support to the CEPCI’s move to establish the CEPCI laboratory and technical division at Kollam in 1997. The Govt. has provided financial assistance under the Five Year Plan Schemes for establishing the laboratory. Assistance under the ASIDE scheme was also granted for upgradation of the division and for construction of ‘Cashew Bhavan’ at Kollam for housing the CEPCI laboratory and R&D center.

India has been the largest producer, processor and exporter of cashew kernels in the world. Even though our share has come down considerably, we are still the largest in cashew trade. With the assistance of the Govt. of India, the industry has been trying to overcome the difficulties in developing our markets in the domestic as well as the international sectors. However, the industry needs more encouragement, assistance and support to survive and to retain its No. 1 position as a world leader in the cashew trade.
A Comparative Study of the Specifications of CEPCI and AFI for Cashew Kernels

P. R. PRASANNAKUMARJI (BABU)
Founder & CEO, Quality Assurance (Qas-India), Quilon-13, India

The cashew industry in India was started in a very small way in 1920s. A small consignment was shipped to U.S, which was packed in wooden containers lined with newspaper. From this stage the industry has grown in various sections like production, processing, packing, shipment etc. Quality was considered as the supreme point for the development of this industry. In 1995, under the Ministry of Commerce Government of India has formed ‘The Cashew Export Promotion Council of India (CEPCI). The CEPCI has stipulated certain specifications for shipment of cashew kernels from India. In 1964 Govt. of India has formed “The Export Inspection Agency” (EIA) which took over the pre-shipment inspection and certification of cashew kernels from CEPCI and made it Mandatory with effect from 1st April 1966. In early 90’s the compulsory pre-shipment inspection was revoked due to the liberalization policy of the Govt. of India; but the specification for cashew kernels meant for export remained the same. The Association of Food Industries (AFI) of U.S. had also stipulated certain standards for the imported raw cashew kernels to US. Both the standards are almost the same. Here is a comparative study on both the standards:

Nomenclature:
The nomenclature of different quality grade varies in the two standards. In CEPCI standard the terminologies used are white wholes, white broken, scorched wholes, scorched broken, dessert wholes and dessert broken. These broad quality grades have further been sub-divided.

AFI standard uses the following nomenclature: “First quality, second quality, spotted / scorched, third quality / special scorched, fourth quality, dessert, butts, splits, large pieces, small pieces, small Brazilian pieces and granules.”
A comparative statement of different quality nomenclatures are given below:

<table>
<thead>
<tr>
<th>AFI</th>
<th>CEPCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole / First quality</td>
<td>First quality / Fancy</td>
</tr>
<tr>
<td>Extra-class/ Fancy</td>
<td></td>
</tr>
<tr>
<td>Scorched / Second quality</td>
<td>Second quality</td>
</tr>
<tr>
<td>Class I</td>
<td>Scorched</td>
</tr>
<tr>
<td>Dessert/Third/Fourth quality</td>
<td>Third quality</td>
</tr>
<tr>
<td>Class II</td>
<td>Special Scorched</td>
</tr>
<tr>
<td>Third quality</td>
<td>Dessert</td>
</tr>
<tr>
<td>Fourth quality</td>
<td></td>
</tr>
<tr>
<td>Dessert</td>
<td></td>
</tr>
</tbody>
</table>

For the same quality different nomenclatures are recognized in all the two standards so that at least one nomenclature is common for the same main quality grade.

In the case of broken the nomenclature and the size of the pieces are same in all the two standards. In AFI standards, an optional grade viz., small Brazilian pieces also has been included in between small white pieces and baby bits, with the size of pieces as same.

**Size Grade:**

<table>
<thead>
<tr>
<th>AFI</th>
<th>CEPCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td>Count/lb</td>
</tr>
<tr>
<td>W180</td>
<td>120-180</td>
</tr>
<tr>
<td>W240</td>
<td>220-240</td>
</tr>
<tr>
<td>W320</td>
<td>300-320</td>
</tr>
<tr>
<td>W450</td>
<td>400-450</td>
</tr>
</tbody>
</table>

The size grade and count ranges are same except in the case of W 180. There is one more grade viz. W150 in CEPC standard. Size grade is compulsory in white wholes, in all the standards. In all the standards under scorched size grading is optional.
The tolerance for different defects is tabulated below (in percentage)

<table>
<thead>
<tr>
<th>No</th>
<th>Type</th>
<th>Quality</th>
<th>AFI Tolerance</th>
<th>CEPCI Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Moisture</td>
<td>5%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Brokens</td>
<td>5%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Grade</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1st Quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1st Quality - Fancy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2nd Quality - 5%</td>
<td>SW180, W210</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Quality - 1.5%</td>
<td>W240, W320</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4th Quality - 0.5%</td>
<td>W450, W500</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dessert Quality - 0.5%</td>
<td>B, IWP, SWP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.5%</td>
<td>BB</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2nd Quality - 5%</td>
<td>SW, SW180</td>
<td></td>
<td>1% (Cashew Powder)</td>
</tr>
<tr>
<td></td>
<td>3rd Quality - 1%</td>
<td>SW210, SW240</td>
<td></td>
<td>NLSG + NL (7.5%)</td>
</tr>
<tr>
<td></td>
<td>4th Quality - 2.5%</td>
<td>SW320, SW450</td>
<td></td>
<td>NLSG + NL (7.5%)</td>
</tr>
<tr>
<td></td>
<td>Dessert Quality - 2.5%</td>
<td>SSP</td>
<td>DSP (5%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SW500, SB, SS, SP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Quality - 5%</td>
<td>SW, SW180</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4th Quality - 1%</td>
<td>SW210, SW240</td>
<td></td>
<td>NLSG + NL (7.5%)</td>
</tr>
<tr>
<td></td>
<td>Dessert Quality - 2%</td>
<td>SSP</td>
<td>DSP (5%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SW320, SW450</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dessert Quality - 2%</td>
<td>SSP</td>
<td>DSP (5%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SW500, SB, SS, SP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4th Quality - 1%</td>
<td>SW, SW180</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Quality - 2%</td>
<td>SW210, SW240</td>
<td></td>
<td>NLSG + NL (7.5%)</td>
</tr>
<tr>
<td></td>
<td>Dessert Quality - 2%</td>
<td>SSP</td>
<td>DSP (5%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SW320, SW450</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dessert Quality - 2%</td>
<td>SSP</td>
<td>DSP (5%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SW500, SB, SS, SP</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| IV  | Superficial Damage (Scrapes) | 1st Quality - 1.0% | Scared kernels also permitted provided such scrapings does not affect the characteristic shape of the kernels |
|     |                             | 2nd Quality - 2.0% |
|     |                             | 3rd Quality - 5.0% |
|     |                             | 4th Quality - 1.0% |
|     | Dessert Quality - no limit  | (For all grades)   |
| V   | Adhering Testa             | 1st Quality - 1.5% | Nil |
|     |                             | 2nd Quality - 1.5% | Nil |
|     |                             | 3rd Quality - 1.5% | Nil |
|     |                             | 4th Quality - 1.5% | Nil |
|     | Dessert Quality - 5.0%     | Nil |
| VI  | Insect Damage              | 1st Quality - 0.5% | Infestation not allowed. |
|     |                             | 2nd Quality - 1.0% |
|     |                             | 3rd Quality - 1.0% |
|     |                             | 4th Quality - 1.0% |
|     | Dessert Quality - 1.0%     | Not allowed |
| VII | Mold Rancidity Decay       | 1st Quality - 0.5% | Not allowed |
|     |                             | 2nd Quality - 1.0% |
|     |                             | 3rd Quality - 1.0% |
|     |                             | 4th Quality - 1.0% |
|     | Dessert Quality - 1.0%     | Not allowed |
| VIII| Foreign Matters            | FQ, SQ, TQ, EQ, Des Q (All grades) - 0.05% | Not allowed |
| IX  | Speckled/Spotted Kernels   | 1st Quality - not allowed | (WW, SW, B, LWP, SB, SS, SP, SSP) |
|     |                             | 2nd Quality - no limit |
|     |                             | 3rd Quality - no limit |
|     |                             | 4th Quality - no limit |
|     | Dessert Quality - no limit | (SSW, SPS, DW, DP) No limit |
CEPC: For ‘whole’ kernels that have been size graded, the quantity of kernels of Next Lower Size Grade (NLSG) shall not exceed 5% by weight for white, scorched and dessert at the time of packing. For ‘whole’ kernels, the quantity of brokens and pieces together shall not exceed 5% by weight for white, scorched and dessert at the time of packing.

For ‘butts’ and ‘splits’, the quantity of pieces present shall not exceed 5% by weight for white, scorched and dessert at the time of packing. For ‘pieces’ grades, the quantity of the NLSG shall not exceed 5% by weight for white, scorched and dessert, at the time of packing.

In the standard formulated by CEPC, if 7/8 portion of the kernel is intact the same is considered as “wholes”. In the case of splits also the same concept is being applied. There is no tolerance prescribed for this defect and even if the entire kernels are broken at the tip to the extent mentioned, such kernels are being considered as whole and splits as the case may be.

AFI: The quantity of broken kernels or pieces in “whole” kernels shall not exceed 10% by weight. The quantity of pieces present in “butts” and “splitted” shall not exceed 10% by weight. The quantity of the next lower size grade in “pieces” shall not exceed 5% by weight.

Broken:
AFI allows a tolerance of 10% in “whole” “butts” and “splits”. In the case of pieces next lower grade is allowed up to 5%. CEPC standards permit 5% tolerance uniformly.

Presentation:
AFI: New, clean, dry, leak proof, lead free containers with airtight seal. Packaging should be sufficiently strong. Outer container shall be new cardboard cartons free of infestation, visual mold and sealed without using staplers. The contents shall be uniform.

CEPC: Packed under inert gas or vacuum. Either consumer pack specified by the buyer or bulk packs in 10 kg., 11.34 kg. (25 lbs. or 20 kg). In each package contents shall be uniform in quality and size.

Each package shall be marked with:
- Name of the product
- Grade or trade name or brand name
• Name and address of the packer
• Buyer’s name or marks
• Net weight
• Origin of product
• Destination.

AFI standards specifically state to use only lead free containers. CEPC standard does not mention this specifically. Other details with regard to packaging, type of product and marking are practically same. AFI standards even though does not mention vacuum / inert gas, it is implied and states that the kernels have to be packed in hermetically sealed containers.

Others: AFI specification stipulates that all shipments should be inspected prior to loading and shall be carried on conveyances suitable for transporting food products in good condition i.e., free of odours, insect or mold damage, rodent activity and all other foreign materials.
Mozambique Cashew Industry
Challenges for 2008

Mr. Carlos Costa
President Executive committee, African Cashew Alliance

Mozambique has a huge challenge ahead to catch up other African countries, particularly with the West African countries, which are the major cashew producers in Africa, in producing raw cashew nuts in greater quantities and better quality.

Unfortunately the efforts developed to reorganize the cashew sub-sector in Mozambique have been damaged by several natural calamities. This year the cyclone “Jokwe” that struck the Northern part of Mozambique in particular Nampula, the most important cashew producer province and Zambézia province, destroyed thousands of homes, several health posts, classrooms, and mosques, and knocked down electricity pylons, cutting of the power supply to the main villages in the coastal zones. The cyclonic winds has also destroyed partially two of the main cashew processing units from Miranda industrial and a farm of 150 ha, causing losses calculated to be about USD 250 thousands, besides the damages on the raw cashew nuts due to the heavy rains that followed the winds. So far it is not known the extension of the cashew orchard losses, but it is reported that in some areas most of the trees fell down and the farm plots were completely devastated, announcing difficult times ahead for the rural families.

In Mozambique, virtually there is no entrepreneurial cashew orchards. Therefore, this kind of disasters aggravate the already precariously position of the smallholders, the main cashew producers, within the cashew value chain. On the other hand, due to the geographical dispersion of the smallholders, normally possessing in average 0.5-2 hectares with some cashew trees, it has been difficult to implement programs that can have a positive impact on the income of the rural families involved in this activity, what drives to a very slow recovering of the raw cashew nut production.

In fact, presently productivity among farmers is still very poor and profits are low:
- Per tree cashew yields average 2.5-3 kilograms; this explains the low production volumes registered by Mozambique in the last decade, in average 60,000 tons.
• In average smallholder sells less than 100 kilograms per year. In average the price to the producer this season 2007/08 was around 55 US cents per kg.
• Farmers sell into commodity markets at US $0.35-0.60 per kilogram; average annual farmer income from cashew thus ranges from US $35-60.
• Outturn is one of the poorest in Africa 42-46 against 50-56 from India, Vietnam and some countries from West Africa.

To overcome this situation, it is necessary to take into account two issues that seem to be determinant in preventing the recovering of cashew production which are:

1. Farmers rely upon single export market (India) and since West African raw nut is available with better quality, demand for Mozambican production is declining.

2. Lack of buy-side investment in farmers’ output because of Distance between Mozambican farmers and their primary market (Indian processors) prevents mutually beneficial relationships being developed. Limited incentive or ability for smallholders to invest in productivity and/or to improve the quality of their crop, and Labor-intensive shelling method suitable for small & medium-scale factories (1000-2500 tons) to mechanized shelling and peeling adjusted to small-scale processing more appropriate for larger units able to provide economies of scale with a minimum capacity of 5000 tons.

3. Lack of financial support for small and medium scale planting, bush fires etc.

First trials proved the efficiency of the new mechanized peeling equipment from Oltremare but for shelling the level of efficiency of mechanized equipment is still far from being acceptable when compared with the manual shelling in use. Efforts are now being done with Oltremare to improve the small medium scale mechanized shelling to achieve better performance, meanwhile most of the existing processing units will adopt the mechanized peeling equipment this year.

Besides the adoption of up-dated technology in a certain way dictated for the need to lower down the labor costs to accommodate the statutory minimum wage enforced by Government for 2008, processors in Mozambique are now discussing with the Government to approve
the payment by productivity, which provides important incentives to processing workers. On the other side processors will sign an agreement with the national cashew workers union to improve workers’ welfare by numerous non-wage related measures, such as guaranteeing minimum safety and hygiene conditions and ensuring uniformity and transparency in factory operations. This measures together with the gradual introduction of quality systems such as HACCP, being done in a couple of factories will allow the international certification of the processing units, a crucial step to build industry reputation.

Before this picture, for 2008 Mozambican processors decided to place efforts together with other cashew stakeholders mainly the Government specialized institutions, in addressing the following key issues:

a) Restructuring of production base with export tax review and promotion of replanting within commercial and family sectors.

b) Defining the labor environment on the basis of productivity and competition with other countries. Improving infrastructures (roads, water, energy) and procedures on export

c) Investing on improved warehouses for raw material to be used in warehouse receipt scheme as bank guaranty.

d) Investing in quality systems, including hygiene and labour security.
Bio-Fuel Production Potential of Cashew Apple

Dr. M. Abdul Salam
Professor and Chairman -Department of Agronomy and Cashew Expert
Kerala Agricultural University, College of Agriculture
Vellayani, Kerala, India

Bio-ethanol: Researchers all over the world are looking for alternative sources of energy, to meet the energy requirements of the population, as the renewable energy sources are depleting fast. USA and Brazil have already gone ahead in research and commercial production of bio-energy in a major way. In the recent years bio-ethanol is identified as an important renewable source of energy, which is clean and usable in combustion engines. Today bio ethanol is considered as the fuel of the future and United States is the world’s biggest bio-ethanol manufacture. It is true that ethanol is more expensive than the fossil fuels. However, it is an uncontaminated fuel, producing only smaller quantity of air pollutants and safer and greener to the environment. Ethanol is an alcoholic fuel prepared from the sugars found in corn, sorghum, wheat, potato, cassava, rice, sugarcane, sugar beets etc.,

Utilization of food crops for the production of bio-fuel often invite severe criticisms as it may hamper the food security of billions of people. Today, the whole world is passing through a very critical phase as the human race as a community is facing serious threats of food security, drinking water security, energy and environmental security. The effect of global warming coupled with increase in water scarcity poses many challenges to food security of our planet. Hence, utilization of non-food crops and resources for the production of bio-fuel would be a more rational approach to address the energy issues. In this context, cashew apple, an important organic resource generated in cashew plantations and wasted in large quantities becomes a very attractive substrate to produce ethanol.

Cashew nut production: Cashew cultivation in the world is centered around the equator and spread over in 30 nations. Food and Agriculture Organization statistics indicate that the total world production of raw cashew nuts is 2.34 million tons from a global area of 3.09 million ha. The details regarding country wise cashew nut production is presented
in Table-1. Vietnam, Nigeria, India, Brazil, Indonesia, Philippines, Ivory cost, Tanzania, Guinea-Bissau and Mozambique are the first ten major cashew nut producing countries of the world. Vietnam produces 0.9 million tons of cashew followed by Nigeria (0.6 million tons) and then India (0.6 million tons).

In India, cashew is grown in an area of 0.84 million ha. mainly in the states of Andhra Pradesh, Maharashtra, Tamil Nadu, Orissa, Karnataka and Kerala. Cashew industry today uses only the raw nuts for the manufacture of cashew kernels and almost the entire quantity of the cashew apple remain wasted in the plantation itself, except in certain places like Goa.

**Cashew apple production:** Cashew is grown mainly for its highly nutritious and delicious kernel, which has got great demand in the international market. The cashew apple is a pseudo fruit containing sizable amount of starch and the same can be effectively used for the production of ethanol. In Goa, cashew apple is utilized for the production of *fenni*, which is a liquor containing 40 to 45% ethanol. A small quantity of cashew apple is also used for the production of various products like juice, jam, candy, pickle etc.,

The ratio of raw cashew to apple generally varies from 1:5 to 1:10. Taking a modest ratio of 1:7, it is estimated that the cashew plantations in the world can generate about 21.7 million tons of cashew apple. The estimated potential of cashew apple production in Vietnam is 6.59 million tons (Table-1), that of Nigeria is 4.45 million tons and that of India is 4.01 million tons.

**Potential for bio-ethanol production from cashew apple:** Fresh cashew apple contains 9.5 to 10% carbohydrates, in addition to varying quantities of fats, minerals and vitamins. It is estimated that cashew apple can yield 8 to 10% of ethanol. Every kilogram of raw nut generates apple equivalent to produce 500 to 600 ml of ethanol of about 70% purity. This indicates that there is a huge potential of generating ethanol from cashew apple. As such, the use of cashew apple for ethanol production assumes greater significance. Technology for the production of ethanol from cashew apple is available and the same can be utilized for ethanol production. However, it is necessary to take up further research to evolve an efficient technology for getting a better recovery of ethanol from cashew apple.
The estimated potential of ethanol production in 10 major cashew nut producing countries is shown in Table-1. It can be seen that the cashew apple produced in the world can generate about 1.7 million tons of ethanol. The ethanol production potential of Vietnam is estimated at 0.5 million tons, that of Nigeria is 0.4 million tons and that of India is 0.3 million tons. In India, Andhra Pradesh, Maharashtra, Tamil Nadu, Orissa, Karnataka, Kerala and Goa are the major cashew growing states with excellent potential for ethanol production (Table-2). Maharashtra has a potential to produce 1,02,000 tons of ethanol, followed by Andhra Pradesh (52,000 tons) and then Tamil Nadu (31,000 tons). It is quite possible to utilize at least 50% of the apple generated and as such cashew apple offers tremendous scope to meet the energy crisis without affecting the food security concerns.

The Government of India has already approved 10 to 20% mix of ethanol with petrol in the automobiles. Efforts are being made in the country for the large-scale production of bio-fuels from various organic sources like sorghum, wheat, maize, sugarcane etc. But attempts are meager or none to utilize the cashew apple for ethanol production, although technology is very much available for the same. Participation of private sector entrepreneurs must be encouraged for the production of ethanol and Governments must initiate appropriate action in this direction. In India, the main cashew growing states should initiate action to utilize cashew apple in a big way. Impediments if any exist in our way for the translation of this possibility to action, Governments must take suitable actions to eliminate such constraints so that large quantities of bio-fuel can be generated from bio-waste namely cashew apple.
Table-1. Cashew nut production and estimated potential of cashew apple and ethanol yield - country wise

<table>
<thead>
<tr>
<th>Countries</th>
<th>Cashew nut (tons)</th>
<th>Apple (tons)*</th>
<th>Ethanol yield (tons)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vietnam</td>
<td>941600</td>
<td>6591200</td>
<td>527296</td>
</tr>
<tr>
<td>Nigeria</td>
<td>636000</td>
<td>4452000</td>
<td>356160</td>
</tr>
<tr>
<td>India</td>
<td>573000</td>
<td>4011000</td>
<td>320880</td>
</tr>
<tr>
<td>Brazil</td>
<td>236140</td>
<td>1652980</td>
<td>132238</td>
</tr>
<tr>
<td>Indonesia</td>
<td>122000</td>
<td>854000</td>
<td>68320</td>
</tr>
<tr>
<td>Philippines</td>
<td>113071</td>
<td>791497</td>
<td>63320</td>
</tr>
<tr>
<td>Côte d'Ivoire</td>
<td>93970</td>
<td>657790</td>
<td>52623</td>
</tr>
<tr>
<td>Tanzania</td>
<td>90400</td>
<td>632800</td>
<td>50624</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>85200</td>
<td>596400</td>
<td>47712</td>
</tr>
<tr>
<td>Mozambique</td>
<td>68328</td>
<td>478296</td>
<td>38264</td>
</tr>
<tr>
<td>Benin</td>
<td>41000</td>
<td>287000</td>
<td>22960</td>
</tr>
<tr>
<td>Thailand</td>
<td>25861</td>
<td>181027</td>
<td>14482</td>
</tr>
<tr>
<td>Ghana</td>
<td>16000</td>
<td>112000</td>
<td>8960</td>
</tr>
<tr>
<td>Malaysia</td>
<td>13910</td>
<td>97370</td>
<td>7790</td>
</tr>
<tr>
<td>Kenya</td>
<td>11225</td>
<td>78575</td>
<td>6286</td>
</tr>
<tr>
<td>Madagascar</td>
<td>6816</td>
<td>47712</td>
<td>3817</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>6810</td>
<td>47670</td>
<td>3814</td>
</tr>
<tr>
<td>Senegal</td>
<td>4500</td>
<td>31500</td>
<td>2520</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>3500</td>
<td>24500</td>
<td>1960</td>
</tr>
<tr>
<td>El Salvador</td>
<td>2810</td>
<td>19670</td>
<td>1574</td>
</tr>
<tr>
<td>Peru</td>
<td>2213</td>
<td>15491</td>
<td>1239</td>
</tr>
<tr>
<td>Belize</td>
<td>1931</td>
<td>13517</td>
<td>1081</td>
</tr>
<tr>
<td>Honduras</td>
<td>1800</td>
<td>12600</td>
<td>1008</td>
</tr>
<tr>
<td>Mexico</td>
<td>1165</td>
<td>8155</td>
<td>652</td>
</tr>
<tr>
<td>Angola</td>
<td>1076</td>
<td>7532</td>
<td>603</td>
</tr>
<tr>
<td>China</td>
<td>1000</td>
<td>7000</td>
<td>560</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>973</td>
<td>6811</td>
<td>545</td>
</tr>
<tr>
<td>Guinea</td>
<td>850</td>
<td>5950</td>
<td>476</td>
</tr>
<tr>
<td>Togo</td>
<td>300</td>
<td>2100</td>
<td>168</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>1</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>3103450</td>
<td>21724150</td>
<td>1737932</td>
</tr>
</tbody>
</table>

* Estimated Cashew apple production potential at 1:7 nuts: apple ratio
** Estimated ethanol production potential at 8%
Table-2. Cashew area, raw nut production, and estimated cashew apple and alcohol yield in different states of India

<table>
<thead>
<tr>
<th>State</th>
<th>Area (000ha)</th>
<th>Production (000 tons)</th>
<th>* Apple yield 1:7 ratio (000 tons)</th>
<th>**Ethanol yield (000 tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andhra Pradesh</td>
<td>170</td>
<td>92</td>
<td>644</td>
<td>52</td>
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* Estimated Cashew apple production potential at 1:7 nuts: apple ratio
** Estimated ethanol production potential at 8%
Annexure
Almond

Global Almond status

1. USA leads global almond industry- be it production (45% share), global trade (84%), branding and promotion (California Almond Association) and almond consumption. This is unlike Cashew, which is produced largely by developing or under developed countries. The difference is perceptible. Combinely, the three major producers of cashew do not spend even 50% of what is spent by California Almond Association on generic promotion and health related research on almonds.

2. The supply chain of almond is relatively simple compared to Cashew. Cashew moves around the globe before being consumed. In an environment of increasing energy price and therefore high transportation costs, it may be an unsustainable model. New ways need to be evolved.

3. The focus on health benefit of almond has been one of the reasons for the spectacular growth in the demand. It is important that cashew industry recognizes this and carries out extensive clinical research to establish health benefit of cashew. This would create a long-term sustainable demand for cashew.

Area under almond in major growing countries (in hectares)

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Source: FAO STAT

- Spain leads the acreage under Almonds with a share of 36% of the total acreage. Lower productivity in recent years has lead to a marginal decline in the growth in acreage under almond during the last 5-years.
- Sharp drop in acreage has been witnessed in Greece despite higher yield levels compared with global average.
- Sharp increase in acreage (over 13% CAGR in the last 5-year) has been seen in Iran.
- USA, the world leader in almond production, has been reported the CAGR of 2% during last 5-years.
### Production of in-shell almond in major growing countries (in tons)

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Source: FAO STAT

- Concentration in Almond production could be noticed during the period between 1995 and 2006, with USA accounting for 40% of the production. However, there are concern in recent times about the decline in productivity of almond in USA, which has shown a negative growth of 0.6% CAGR over the last 5-year.
- Spain with one tenth productivity level as that of USA, shares only 12% of the world production despite its leadership in acreage.

### Production of shelled almond in major countries (in tons)

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Source: Foreign Agricultural Service, USDA

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Source: Foreign Agricultural Service, USDA
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Source: Foreign Agricultural Service, USDA

- USA dominates international trade in almond with 84% share.
- Spain comes second with a 14% share; however, exports from Spain are growing at a slower pace.
- Italy and Greece though have a minor share have seen impressive growth rates.

## Domestic Almond consumption by major producing countries (in tons)

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Source: Foreign Agricultural Service, USDA

- USA dominates in almond consumption among producers.
- Among the non-producers, India dominates with a consumption of over 28000 tons. India also happens to be one of the fastest growing markets for almonds.

## Almond imports by India (in tons)

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Source: DGFT, India

- Almonds both in shell and shelled have shown impressive growth in imports.
- Favourable policy for import, availability of labour near port and good demand are major reasons for increase in almond imports by India.
Pistachio

Global pistachio status

1. Pistachio originated in Iran. Kerman region, the southern heart of Iran has special composition of soil, which imparts nutrients to the pistachio. Traditional agriculture connected with modern methods provides pistachios from Iran with a guarantee of full taste and preserves their natural taste.

2. Pistachio production is cyclical, with alternative heavy and light crop years. The industry operates on a two-year marketing cycle in which processors generally hold enough inventory from on-year harvests to supply for demand during the off-year.

3. The leading countries growing pistachios are Iran, Turkey, and USA (the San Joaquin Valley in California). Approximately 98% of American pistachios were grown in California. The remaining produce comes from Arizona, New Mexico and limited quantities from Western Texas.

4. Pistachio nuts from Iran are considered to be best in the world due to their delicious taste. Since 1982, the export of Iranian pistachios has shown an increasing trend, which is easily available throughout the world.

5. Researchers at Penn State University (a study supported by the California Pistachio Commission), found that pistachios can reduce the body’s response to stresses caused by everyday life. The consumption of these nuts has been increasing significantly in the past few years. According to USDA food study, pistachios are among the best sources of antioxidants, which are thought to fight cancer, heart disease and Alzheimer’s diseases.

Pistachio area in major growing countries (in hectares)

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Source: FAO STAT

- Iran leads in the area under Pistachio cultivation in the world with a share of 74% and it has showed a CAGR of 11.5% from 2001-2006.
- USA and Turkey accounted for 7% each of total area under pistachio cultivation.
### Pistachio production in major growing countries (in tons)

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Source: FAO STAT

- Iran accounted for 40% of the total production of Pistachio followed by USA and Turkey.
- USA and Turkey occupied 21% and 19% of total pistachio production.

### Pistachio exports from major producing countries (in tons)

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Source: FAO STAT

- Iran dominates the international trade in Pistachio with a 53% share but growth rate in the last five years was 7.1% only. Though the acreage was higher in Iran, its productivity was much lower against the second largest producer USA.
- US export has witnessed CAGR of 16.6% from 2001 to 2005.

### Pistachio imports by major countries (in tons)

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Source: FAO STAT
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Source: FAO STAT

- Iran dominates in acreage, production and consumption of pistachio.
- The other major consumers of pistachio around the world were Turkey, Spain, China and USA. In terms of consumption, Spain has showed a tremendous growth of 27% (CAGR) from 2000 to 2005. Iran has witnessed a growth of 6% over the same period.
- China and USA have witnessed a negative consumption growth of 3% and 6.5% respectively from 2000 to 2005.

### Pistachio imports by India (in tons)

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Source: DGFT, India

- Iran was the major supplier of pistachio into India i.e., it has supplied nearly 3857 tons (81.67% to the total import) of pistachio to India followed by Afghanistan (11.28 %), USA (3.67 %), United Arab Emirates, Pakistan and other countries.
- Pakistan has also supplied higher quantity of pistachio into India in 2006-07.
### Pistachio imports by India (in million Rs)

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</table>

Source: DGFT, India

- In terms of value of pistachio imports by India, per unit cost of pistachio from Iran was cheaper i.e., Rs.256/kg when compared with Rs.390/kg for Afghanistan origin and Rs.405/kg from Pakistan during 2006-07.
- The countries other than Iran, which were supplying pistachio more into Indian markets were not major producer and they involved in re-export of pistachio. Hence, the cost of per kg produce from other countries was higher.
Global Walnut Status

The origin of walnut was considered as Greece but the superior cultivated variety came from Persia to Greece. It was cultivated first in Southeast Europe, it slowly spread up to Himalayas of Asia. The harvest of this nut commences from the beginning of August to the end of September. Walnuts are the fourth largest tree nut produced in the world after cashew, almond and hazelnut.

1. At global level, China is the leading producer of walnut at 425,000 tons followed by USA (317,500 tons), Turkey (75,000 tons), France (41,000 tons), India (36,000 tons) and Chile (18,500 tons). These six countries have contributed most of the global production during 2006-07. The productivity in USA was higher and hence the output also higher with lesser area under walnut cultivation.

2. China occupied first position both in production and consumption on global level. The country exports a small portion only about 7.8 %, as its domestic consumption rules higher.

3. China occupied the major portion i.e., nearly 63% of the global consumption, which is estimated at 4,00,400 tons out of the total global consumption of 6,45,621 tons. The other major consuming countries were USA, Turkey, France and India.

4. The share of export to production was very higher in case of Chile i.e., nearly 92% of its output gets exported. France and USA are also exporting much of their production to other countries.

Walnut area in the major growing countries (in hectares)

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Source: FAO STAT

- China leads in the area under walnut with a share of 28% of the total acreage. Higher productivity in recent years has resulted in higher area under walnut during the last 5-years.
- USA has 13% share in global area under walnut with CAGR of 1% from 2001-02 to 2006-07.
Walnut production in major growing countries (in tons)

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Source: Foreign Agricultural Service, USDA

- China is the major producer of walnut with a share of 46.5%. USA has the share of 34.8% of output with having less than half of the area compared to China.
- The productivity of walnut was very less in Turkey i.e., produced 980 kg/ha against USA productivity of 3650 kg/ha.

Walnut exports by major countries (in tons)

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Source: Foreign Agricultural Service, USDA

- USA dominates international trade of walnut and 68.47% share in total global exports from USA alone.
- France has witnessed higher annual export growth of 20% from 2001-02 to 2006-07.

Walnut consumption (in tons)

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Source: Foreign Agricultural Service, USDA
• China is the largest walnut consuming country with a share of about 62% of the world consumption.
• India’s consumption has been increasing over the years; hence its exports have been declined.

**Walnut imports by major countries (in tons)**

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</table>

Source: Foreign Agricultural Service, USDA

• Turkey is the major importer of walnut, which has constituted 50% of total global imports.
• India not involved in walnut import and the second major producer USA also not importing much.
Macadamia Nut

The macadamia nut originated in Australia, but commercial production is concentrated in Hawaii.
1. Australia is the world’s largest macadamia nut producer.
2. The top four producers are Australia, United States, South Africa and Guatemala. Other key producers include Costa Rica and Kenya. It is also grown in New Zealand, Zimbabwe, Malawi, Israel, Guatemala, Brazil and Mexico.
3. In the continental United States, Macadamia trees are found in California and Florida.
4. Macadamia nut, with rich flavor and their oil are considered delicious and are served as dessert nuts.

Macadamia nut production (in tons)

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<td>93613</td>
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</table>

Source: Foreign Agricultural Service, USDA

- Australia accounted 37.79% of the Macadamia nut production in 2005-06. CAGR of the production is 5% over the last five years.
- USA has contributed 26% to the nut production with the annual growth of 2.8% from 2001-02 to 2005-06.
- South Africa’s Macadamia nut production has shown an annual growth of 12.8% for the same period.

Exports of Macadamia nut (in tons)

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Source: Foreign Agricultural Service, USDA
Australia was the major exporter of Macadamia nut, its exports has grown by 9% (CAGR) from 1995-96 to 2005-06.
Guatemala and Kenya’s exports have been growing 15% and 4.8% annually.
Overall, the macadamia nut exports have shown an annual growth of 9.6% between 1995-96 and 2005-06.

Domestic Macadamia nut consumption (in tons)

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</table>

Source: Foreign Agricultural Service, USDA

USA was the major Macadamia nut consumer in the world, which consumed 79% of the total world consumption in 2005-06.
South African macadamia nut consumption has shown an increasing trend over the years.

Imports of Macadamia nut (in tons)

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</table>

Source: Foreign Agricultural Service, USDA

USA is the major importer of Macadamia nut, as it is the major consumer and production is less compared with the domestic consumption.
Learnings and Indications from Consumer Survey on Cashew Consumption in Bangalore City.

As the first step towards strengthening the domestic consumption, a study on the qualitative aspects of cashew consumption in Bangalore households was taken in 2005. The study inquired into the attitude and disposition of the household consumers towards cashew and the retailers’ mindset towards cashew purchases with an aim to give a lead to the promotional/marketing campaigns and identification of new growth opportunities.

Respondents’ Profile
The study has been conducted in the city of Bangalore. About 90% of the respondents were women falling under the age group of 25-40 years as desired since cashew being used in food preparation, women would be the ideal persons to give a clear picture about the usage of cashew.

As in line with the general fact that the consumption of high value commodities show distinct characteristics with the income level, the respondents of the study were classified mainly into three groups based on their income level. The groups were i. crawlers who have an annual income of less than 2 lakhs, ii. climbers with an annual income of about 2-5 lakhs and iii. achievers with an annual income of more than 5 lakhs. Majority of the respondents (about 42.97%) fall under the category of climbers followed by 35.39% of the respondents falling under the category of crawlers. Here is the outcome of the study.

Frequency of purchase:
In all the income group categories, majority of the respondents, purchased cashews once in a month followed by occasional purchases. The quantity purchased during the festival times were two to five times higher than the quantity purchased normally.

**Awareness about grades and difference in prices:**

Awareness about different grades and prices are high in the achiever category. The climber category behaved in a different way from the other two categories.

**Reason for purchase:**

Taste is found to be the main driver behind cashew purchase. Across the three categories, percentage of respondents who buy cashew for its nutritional value is significant which is a positive sign for the industry. Meanwhile, purchase based on doctor’s recommendation show a negligible percentage. There lies a huge
scope where doctors’ recommendation can be used to reinforce the purchase based on the nutritional value of the commodity. If the commodity is purchased for its nutritional value then it finds a place in the list of necessities ultimately.

**Place of purchase:**

![Chart showing place of purchase]

Achievers purchase cashews more in the departmental stores than in the shopping malls and local retail shops. Climbers purchases equally in departmental stores and local retail shops. Across the categories, purchase from shopping malls is less indicating that the best point to put the products is departmental stores and local retail shops.

**Purpose of purchase:**

![Chart showing purpose of purchase]

Even in the achievers category, cashew purchase for sweet preparation is on the higher side.

**Form of consumption:**

Most of the consumption takes place in raw form as it goes with usage in the
sweet preparation. Masala cashew (When consumed as snack food,) is consumed more when compared with salted cashew.

The above two findings strongly calls the attention that usage of cashews as snack food need to be promoted.

To whom you intend to serve?

About 70% of the housewives of all the income groups serve cashew to all their family members. Thus it can be concluded that there is no misconception that cashews should not be served to aged people. Another view is that even though the purchase decision may be taken based on the crazyness of their kids towards cashew, once the product is brought, it is consumed by all and not only by children. In order to increase frequency of purchase, cashews can be kept in major eye points in a shop that too at a height of the kids in local retail shops and in departmental stores, it can be placed near to the racks where necessary grocery items like atta. This can induce on the spot decision to purchase cashew.

Distance of purchase: Across the three income groups, percentage of purchase at walking distance is higher than the purchase at a distance of 2-5 kms and above 5 km distance. It can be inferred that people did not find any quality difference between the cashews sold in local retail shops and department stores or the speciality products which caters to the niche segment is yet to come.
Importance of cashew:

In all the three income groups, majority of the people feel that cashew is important in maintaining the health of their family. But, we already saw that the major driver behind cashew purchase is “taste” followed by nutrition. This means that not all the people who are aware of the importance of cashew act on that particular fact. This puts forth the idea that when nutrition based promotion and taste-based trigger are compared, the immediate and adoptable option would be taste-based trigger.

Awareness about zero% cholesterol:

Awareness level on cashew as a zero cholesterol nut is surprisingly low among the achievers. Some of the respondents who were aware of the fact did not believe it. There is a category of people who did not give any response regarding the cholesterol level in cashew. If the fact that cashew has zero cholesterol is communicated to this group, there is good scope to increase the offtake.
Given the costs, efforts and time required to take up clinical trials in order to strongly communicate the message of health claims, it needs to be studied in detail whether the consumers, who are aware about the zero cholesterol level of cashew are really concerned about taking low cholesterol food?

**Cashew in comparison with almonds and pistachios:**

![Health benefit preference chart]

Perceptual mapping was done for cashews, almonds and pistachios with respect to the following criteria viz, health benefit preference, color preference and affordability. On the health front, almonds were weighed more than cashews and pistachios by crawlers and climbers whereas achievers posed cashew as the preferable nut. With regard to colour, crawlers preferred cashew and climbers and achievers preferred pistachios. Cashews enjoy the privilege as the most affordable one when compared with almonds and pistachios.

People feel that communicating the high health benefits, free samples and mass media as the effective promotion methods.

Apart from the usage of cashews as a food ingredient, promoting the usage as snack food would have considerable impact on the off take. According to Ac–Nielson survey, in the fiscal 2004-05, the branded packaged namkeens market had grown by a whopping 34%.
Pictures
Cashew tree with flowers

Cashew tree with nuts
Cashew nut in tree

Steam boiled RCN
RCN with cutter

Shelled kernels with testa
Kernel dryer with racks

Kernels inside the dryer
Peeling

Kernel grading
White wholes

Scorched wholes

Kernel split
Kernel Butts

Kernel pieces

Plastic pouch packing
Tin packing
Methodology
Methodology

1. Compound Annual Growth Rate

Growth is a measure of past performance of an economic variable. They are commonly used as summaries of trends in time series data. They are not always used to predict but to describe the trend in a variable over time. Policy decisions are often made based on such growth rates, which depends on the nature and structure of the data.

Methodology:
Annual compound growth rates were analyzed using the exponential growth function of the form,

\[ Y(t) = a b^t e^u \]

Where, \( Y(t) \) = Dependent variable for which growth rate is to be estimated.
\( a \) = Intercept.
\( b \) = Regression coefficient.
\( t \) = Time variable.
\( e \) = Exponent term (2.3018).
\( u \) = Disturbance term.

The logarithmic form of the equation \( Y(t) = a b^t e^u \) is,

\[ \ln Y = \ln a + t \ln b + e \]

The compound growth rate \( (g) \) in percentage is computed from the relationship,

\[ (g) = (\text{Anti log of } \ln b) - 1 \times 100 \quad \text{or} \quad (g) = (b - 1) \times 100 \]

The significance of the regression coefficients was tested using the student’s ‘t’ test.

2. Methodology of Markov Chain

Definition of Markov Analysis

The changes in the exports of cashew kernel to different countries were analyzed by developing a model with first order finite Markov chain property, which captures the net effect in change in the exports of cashew kernel over a period of time. The changes in import of RCN into India from different countries and CNSL export from India to different countries and the stable markets for the cashew kernels and CNSL also identified using Markov chain analysis.

LINGO package was used in analyzing and formation of transitional probability matrix for the present analysis.
We are often interested in characterising or summarising how economic parameters concerning cashew kernel exports have changed over time and predicting their behaviour in future. It is common feature and meaningful too to associate occurrence of present to being related to occurrence in the recent past, which in fact is the essence of Markov chain analysis.

Markov chain analysis is a method of analysing the current behaviour of some variable in an effort to predict its future behaviour also. Russian mathematician Andrei A. Markov developed this procedure in 1912. He first used it to describe and predict the behaviour of particles of a gas in a closed container.

**Theoretical framework**

There is growing awareness of the usefulness of this technique for analysis and forecasting in many fields such as export sector particularly in the process of constant but gradual change (Power and Harris, 1971 and Prasad et al., 1997).

The 'first order' finite Markov model is a stochastic process \( \{X_i\} \) which describes the finite number of possible outcomes \( S_i \) \((i = 1, 2, 3... r) \) and is a discrete random variable \( X_i \) \((t = 1, 2, 3...t) \). This is said to have the 'first order' Markovien property if the conditional probability distribution of \( X_i \) is dependent only on the state the system is in at step 'i' and not in steps 0, 1, 2, 3, i-1 (Dent, 1967, Lee et al., 1970). Mathematically the stochastic process \( \{X_i\} \) has Markovien property if,

\[
P( X_{i+1} = S / X_i = r , X_{i-1} = t_1... X_{i-2} = t_{i-2}, X_i = r) = P( X_{i+1} = S / X_i = r)
\]

Where, \( P( X_{i+1} = S / X_i = r) \) is the one step transitional probabilities of going from state ‘r’ at step ‘i’ to state ‘s’ at step i+1. Thus, these represents the conditional probability of \( X_{i+1} \) given \( X_i \). If for each ‘r’ and ‘s’, \( P( X_{i+1} = S / X_i = r) = P( X_{i+1} = S / X_0 = r) = P_{rs} \) for all ‘i’, then the one step transitional probabilities remain stationary.

One-step stationary transition probabilities takes into consideration one and only one state at each point of time i.e., this will be useful for estimating the share of market for one step (year) now only. As the present study uses annual export data for analysis for predicting the future exports of cashew kernel to different countries from n-step (year) now, the n-step stationary transitional probability property will be appropriate.

The n-step transitional probabilities are defined as,

\[
P_{rs}^{(n)} = P( X_{i+n} = S / X_i = r) = P( X_n = S / X_0 = r)
\]

Where,

\[
P_{rs}^{(n)} > 0 \text{ for all states } r \text{ and } s; \quad n = 1,2...
\]

\[
\sum_{s=0}^{n} P_{rs}^{(n)} = 1 \text{ for all states } r; \quad n = 1,2...
\]
The above equation assumes there are \( n+1 \) possible states. Note that if the system is currently in state ‘\( r \)’, it must be in some state ‘\( n \)’ steps from now. In general, the ‘\( n \)’ step stationary transition probabilities can be calculated as follows:

\[
\text{Pr}(n) = \sum_{j=0}^{n} \text{Pr}(j) P_j \text{Pr}(n-1)
\]

Where the possible states are 0, 1, 2, 3…\( N \). That is, probability of going from state ‘\( r \)’ to state ‘\( s \)’ in ‘\( n \)’ steps is the probability of going from state ‘\( r \)’ to state ‘\( s \)’ in one step times the probability of going from state ‘\( j \)’ to state ‘\( s \)’ in \( n-1 \) steps, summed over all \( j = 0, 1, 2, 3…n \).

### Specification of the Markov chain model

#### For RCN imports into India

The share of imports of RCN into India \((X_{ij})\) from a particular country \((j^{th})\) at time ‘\( t \)’ was considered as a random variable and this depends only on its past import from that country.

Following the first order stationary Markovian property as discussed above, the model can be specified as follows:

\[
X_{jt} = \sum_{i=0}^{n} X_{i,t-1} \cdot P_{ij} + e_{jt}
\]

Where,

- \( X_{ij} \) is the import of cashew kernel by India from \( j^{th} \) country during the year ‘\( t \)’.
- \( X_{i,t-1} \) is the import from \( i^{th} \) country during the year \( t-1 \).
- \( P_{ij} \) is the probability that imports will shift from \( i^{th} \) country to \( j^{th} \) country.
- \( e_{jt} \) is the error term independent of \( X_{i,t-1} \).
- \( n \) is the number of RCN supplying countries.

The transitional probability \((P_{ij})\) is the central to the Markov chain model analysis and will have the following properties.

\[
0 < P_{ij} < 1, \quad P_{ii} = 1, \quad \text{for all } i.
\]

The transitional probability \( P_{ij} \) indicates the possibility that imports will switch over from country ‘\( i \)’ to country ‘\( j \)’ with the passage of time. The probabilities \( P_{ij} \) for \( i \neq j \) indicate the gains or losses in supply of RCN of each of the RCN exporting country. The probability \( P_{ij} \) for \( i = j \) (diagonal probabilities) indicate probability of retention of an RCN exporting country (Atkin and Blanford, 1972).

In the similar way the specification of Markov chain model has been carried out for CNSL exports from India and Cashew kernels exports from India. The
Markov chain analysis also been carried out for cashew kernels import by USA from major kernels supplying countries.

For kernels export from India
The share of export of cashew kernel from India \((X_{ij})\) to a particular country \((j^{th})\) at time ‘t’ was considered as a random variable and this depends on only on its past export with that country. Following the first order stationary Markovian property as discussed above, the model can be specified as follows:

\[
X_{jt} = \sum_{i=0}^{n} X_{i+1} \cdot P_{ij} + e_{jt}
\]

Where,

- \(X_{jt}\) is the export of cashew kernel from India to \(j^{th}\) country during the year ‘t’.
- \(X_{i+1}\) is the export to \(i^{th}\) country during the year t-1.
- \(P_{ij}\) is the probability that exports will shift from \(i^{th}\) country to \(j^{th}\) country.
- \(e_{jt}\) is the error term independent of \(X_{i+1}\).
- \(n\) is the number of importing countries.

The transitional probability \((P_{ij})\) is the central to the Markov chain model analysis and will have the following properties.

\[0 < P_{ij} < 1\]

\[P_{ij} = 1, \text{ for all } i.'\]

The transitional probability \(P_{ij}\) indicates the possibility that exports will switch over from country ‘i’ to country ‘j’ with the passage of time. The probabilities \(P_{ij}\) for \(i \neq j\) indicate the gains or losses in exports of each of the importing country. The probability \(P_{ij}\) for \(i = j\) (diagonal probabilities) indicate probability of retention of an importing country (Atkin and Blanford, 1972).

Estimation of Markov chain model
There are several approaches to estimate the transitional probabilities of the Markov chain model such as unweighted restricted least squares, weighted restricted least squares, Bayesian, Maximum likelihood, unrestricted least squares etc. In the present study, minimum absolute deviations (MAD) estimation procedure was employed to estimate the transitional probabilities, which minimizes the sum of absolute deviations (Fisher 1961, Wagner 1959). The conventional linear programming (LP) technique was used as this satisfies the properties of transitional probabilities of non-negativity restrictions and row sum constraints in estimation.

The linear formulation is

\[
\text{Min } OP^* + I e
\]

Subject to,

\[
XP^* + V = Y
\]
GP* = 1
P* > 0

Where,

- \( O \) is the vector of zeroes.
- \( P^* \) is the vector of the probability \( P_{ij} \).
- \( I \) is an appropriately demonstrated identity matrix.
- \( e \) is a vector of absolute errors, \( IVI \).
- \( Y \) is the vector of exports of each country.
- \( X \) is the block diagonal matrix of lagged values of \( Y \).
- \( V \) is the vector of errors.
- \( G \) is the grouping matrix to add row elements of \( P \) arranged in \( P^* \) to unity.

**Goodness of fit**

To test whether the observed shares of exports to different countries and the predicted shares from the Markov chain model follow similar distributions, the chi square statistics of the following type was used (Kendall and Stuart, 1961).

\[
\chi^2 = \sum_j \sum_i N(t) \left( Y_{ij}(t) - y_{ij}(t) \right)^2 / y_{ij}(t)
\]

Where,

- \( Y_{ij}(t) \) is the observed proportion of \( j^{th} \) country’s share at time \( t \).
- \( y_{ij}(t) \) is the predicted proportions of \( i^{th} \) country’s share at time \( t \).
- \( N(t) \) is the total number of countries at time \( t \).
- \( r \) countries.
- \( t \) year.

**References**


