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DST-AMRITA
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TRANSFORMING THE CASHEW VALUE CHAIN

A Roadmap for Sustainable Modernization

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INTRODUCTION

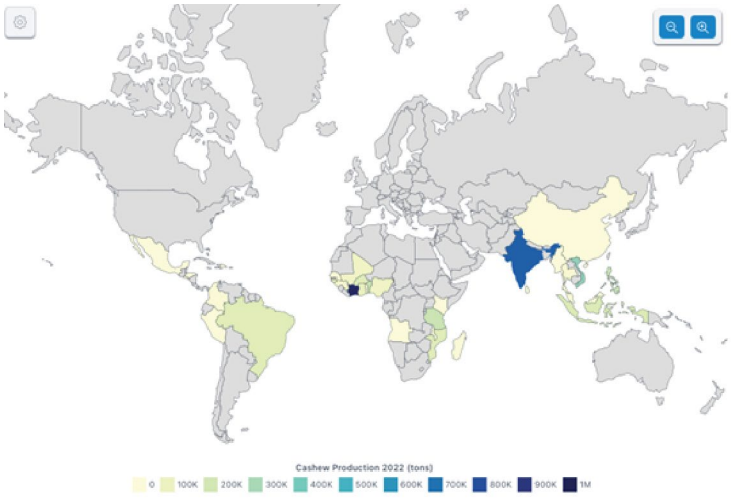
Cashew (Anacardium occidentale L.) originated in the tropical regions of the Americas, particularly northeastern Brazil, where it was cultivated and consumed by the Tupi people, who called it acajú. The Portuguese and Spanish explorers introduced cashew trees to Asia and Africa around 1500 AD as part of the Columbian Exchange, a major process of biological and cultural transfer following European exploration. The first recorded mentions of cashew by European sailors date back to the 16th century, with French explorer Andre Thevet illustrating it in his 1557 book, Les singularitez de la France Antarctique. In Africa, cashew was initially introduced along the east coast in Mozambique before spreading to the West Coast. In India, the Portuguese planted cashew along the Malabar Coast in the 16th century, primarily for soil erosion prevention. Over time, cashew cultivation expanded to other regions of the country and Southeast Asia, adapting well to local climates. India became the first country to develop a modern cashew processing industry and held a strong position in the global market for an extended period, significantly influencing the global cashew trade.

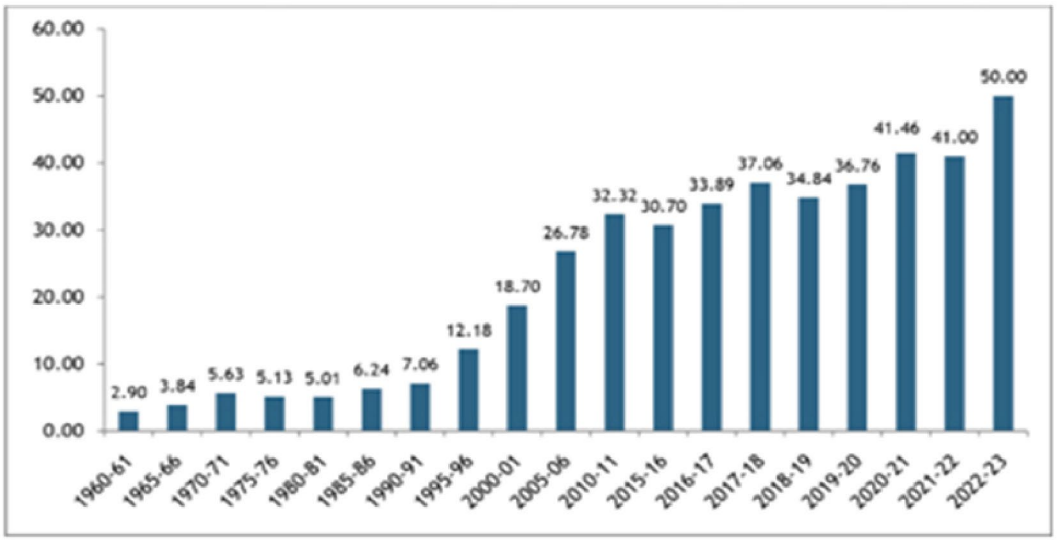
India ranks second globally in cashew kernel exports, holding an 8.72% market share, and is also the world's second-largest importer of raw cashew nuts. The country's cashew production has shown consistent growth, increasing from 779,000 tonnes in 2021-22 to 810,000 tonnes in 2022-23, marking a 4% growth rate. While traditionally cultivated in Kerala, Karnataka, Goa, Maharashtra, Tamil Nadu, Andhra Pradesh, Odisha, and West Bengal, cashew farming has now expanded to non-traditional regions such as Chhattisgarh, the Northeastern states (Assam, Manipur, Tripura, Meghalaya, Nagaland), and the Andaman & Nicobar Islands, broadening India's cashew cultivation footprint.

There is an ever-increasing demand for cashew kernel both in international market and in the domestic market. The industry faces challenges such as reliance on imported raw cashew nuts to meet demand.

INTRODUCTION

Global cashew production has experienced significant shifts over the past five decades, with notable changes in the leading producing countries. In the early 1960s, Mozambique was the world's largest cashew producer, but its output declined sharply in the 1970s. Similarly, Tanzania faced a downturn in production during the 1970s and 1980s, though it has seen a revival since 2010. Vietnam did not engage in significant cashew cultivation before the 1980s; however, government initiatives have since propelled it to become a major player in the industry. India maintained steady growth in cashew production from the 1960s but has recently faced increased competition from emerging producers. Today, cashew cultivation is concentrated in Africa, Asia, and South America. Africa leads in raw cashew nut (RCN) production, accounting for more than half of the global output, with countries like Côte d'Ivoire, Tanzania, Benin, and Ghana being major contributors. Notably, Côte d'Ivoire has emerged as the largest producer of RCN, surpassing traditional leaders such as India and Vietnam. Asian countries, including India, Vietnam, Cambodia, and Indonesia, also play significant roles in cashew production and processing. In recent years, there has been a concerted effort among African nations to enhance local processing capabilities, aiming to add value within the continent rather than exporting raw nuts for processing elsewhere.





Global Production of Raw Cashew Nuts (RCN) (Quantity in Lakh MT): Source: Statistical database of Food and Agriculture Organization (FAO) & Statistical Yearbooks published by International Nut & Dried Fruit Council (INC).

Country	**Raw Cashew Nut Production (in Tonne)**
Ivory Coast	970,000
India	752,000
Vietnam	341,680
Philippines	217,583
Tanzania	216,907
Benin	215,000
Indonesia	163,083
Brazil	147,137
Burkina Faso	145,246
Mozambique	144,823

Cashew Production by Country 2024 Source: worldpopulationreview.com

CASHEW CROP SEASON

The cashew crop season varies across regions, ensuring a continuous global supply of raw cashew nuts. West African countries, including Côte d'Ivoire, Guinea-Bissau, Nigeria, Benin, Ghana, Burkina Faso, Senegal, Guinea, Mali, Togo, and Gambia, experience their peak harvesting season during the first half of the year. This period aligns with favorable climatic conditions, allowing for efficient harvesting and processing.

In contrast, East African countries, such as Tanzania, Mozambique, Kenya, and Madagascar, have a later harvesting cycle, extending into the second half of the year. This complementary cycle ensures that cashew nuts remain available in global markets beyond the West African season, supporting continuous processing and trade. India, as a key producer, follows a harvesting pattern that overlaps with other regions, further stabilizing supply chains and meeting both domestic and export demands. This staggered global harvesting cycle plays a crucial role in maintaining a consistent flow of raw cashew nuts for processing industries worldwide.

The cashew tree grows in tropical areas with an annual rainfall ranging from 400 to 4,000 mm, and it grows from sea level to an altitude of 1,000 m.

SL No.	Country of Origin	J	F	M	A	M	J	J	A	S	O	N	D
1	Cote d' Ivoire			■	■	■	■						
2	Guinea- Bissau					■	■	■	■				
3	Nigeria		■	■	■	■							
4	Benin	■	■	■	■								■
5	Ghana		■	■	■	■							
6	Burkina Faso			■	■	■	■						
7	Senegal					■	■	■	■				
8	Guinea	■	■	■	■								■
9	Mali					■	■	■	■				
10	Togo		■	■	■	■							
11	Gambia	■	■									■	■
12	Tanzania	■									■	■	■
13	Mozambique	■	■	■	■							■	■
14	Kenya	■	■									■	■
15	Madagascar					■	■	■	■				
16	India		■	■	■	■	■						

CASHEW PRODUCTION IN INDIA

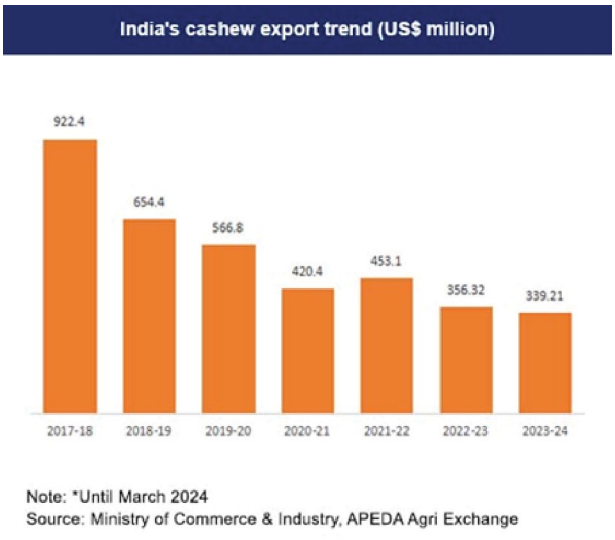
India is a global leader in cashew production, with Maharashtra, Andhra Pradesh, and Odisha playing pivotal roles. These states benefit from favorable climates and longstanding farming traditions, making cashew cultivation vital for many farmers. Maharashtra leads with ideal climatic conditions, followed by Andhra Pradesh, known for its extensive orchards. Odisha emphasizes cashew farming, while Karnataka's diverse agriculture supports significant cultivation. Tamil Nadu has a strong tradition of cashew farming, and Kerala is historically recognized for processing. Chhattisgarh is emerging with increased cultivation, while West Bengal contributes modestly but shows growth potential. Meghalaya benefits from unique climatic conditions, and Gujarat, though the smallest among the top ten producers, remains part of India's agricultural landscape. The following table lists the top 10 cashew-producing states in India, along with their respective production figures:

Rank	State	Cashew Production (in tonnes)
1	Maharashtra	199,700
2	Andhra Pradesh	127,200
3	Orissa	121,300
4	Karnataka	77,900
5	Tamil Nadu	77,300
6	Kerala	76,800
7	Chhattisgarh	21,400
8	West Bengal	11,500
9	Meghalaya	10,000
10	Gujarat	6,700

EXPORT TREND

India is one of the largest producers and processors of cashew in the world. However, in the last decade, India's cashew export dropped drastically from 43 per cent to 8 per cent. The decline has hurt the Indian cashew industry.

India primarily exports Cashew Kernels and very small quantities of Cashewnut shell liquid. Between April 2023 to March 2024, the cashew exports by value stood at US$ 339.21 million as against US$ 356.32 million in April 2022 to March 2023, registering a decline of 4.80%.In terms of volume, India's cashew exports declined from 80,366.25 MT in 2021-22 to 76,824 MT in 2022-23 from and increase to 79,030.65 MT in 2023-24.



Note: *Until March 2024
Source: Ministry of Commerce & Industry, APEDA Agri Exchange

PROCESSING OF RAW CASHEW NUT (RCN)

The processing of raw cashew nuts into edible cashew kernels follows a systematic approach to ensure high quality and food safety. The traditional method consists of the following key steps:

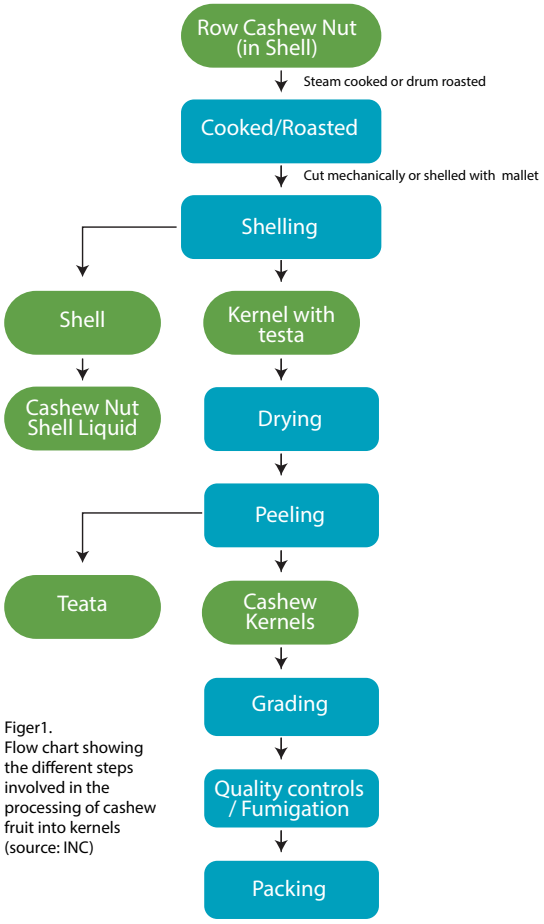
1) Roasting: The raw cashew nuts are either steam-cooked or drum-roasted to soften the shells and loosen the kernels inside. This process also facilitates the extraction of Cashew Nut Shell Liquid (CNSL), a valuable byproduct used in various industries.

2) Shelling: Once roasted, the cashew nuts are mechanically cut or manually shelled using a mallet. This step separates the outer shell from the kernel.

3) Drying: The shelled kernels, still covered with a thin protective skin called testa, undergo drying to reduce moisture content. This step ensures easier peeling and extends shelf life.

4) Peeling: The dried kernels are peeled to remove the testa, revealing the clean, edible cashew kernels.

5) Grading: The kernels are sorted based on size, shape, and appearance. The grading process ensures uniformity and categorizes the kernels into different quality standards suitable for various markets.



Figer1.
Flow chart showing the different steps involved in the processing of cashew fruit into kernels (source: INC)

6) Quality Controls & Fumigation: To maintain food safety and meet export regulations, the cashew kernels undergo quality checks for defects, contamination, or pests. Fumigation is performed to prevent infestation and ensure long-term storage.

7) Packaging: The final step involves carefully packing the graded cashew kernels in vacuum-sealed or nitrogen-flushed containers. This preserves freshness and prevents oxidation or spoilage.

CASHEW GRADES

Cashew Kernels are graded into white / scorched wholes, splits, butts etc. Depending on the shape, size & colour of the kernel. There are various different grades of cashew kernels, but few grades are commercially available and traded. They are:

Grades	Types
White Wholes(WW)	WW-180, WW-210, WW-240, WW-320, WW- 450, WW- 500, Large White Pieces (LWP), Small White Pieces(SWP), Butts, Splits
Scorched Wholes(SW)	SW-180, SW-210, SW-240, SW-320, SW- 450, SW- 500, Scroched Splits (SS), Scroched Pieces(SP), Large Scroched Pieces(LSP), Scroched Small Pieces(SSP)

White Wholes are priced higher than Scorched Wholes due to their superior appearance, even though both grades offer a similar taste. Butts, splits, and pieces are more affordable, with Scorched grades having a duller color. These lower-priced grades are ideal for cooking, preparing sweets, and savory snacks, where visual appeal is less important than taste and texture.

VALUE-ADDED PRODUCTS FROM CASHEW

Cashew processing results in a variety of valuable products beyond just the edible nuts. Below is a list of cashew-derived products along with a brief description of each.

1 CASHEW KERNEL-BASED PRODUCTS

Cashew Butter: A creamy spread made from ground roasted cashews, similar to peanut butter. It is used in sandwiches, baking, and as a healthy alternative to other nut butters.

Cashew Milk: A dairy-free alternative to cow's milk, made by blending cashews with water and straining the mixture. It is popular among vegans and lactose-intolerant consumers.

Cashew Cheese: A plant-based alternative to dairy cheese, made by blending soaked cashews with water, nutritional yeast, and seasonings to create a creamy consistency.

Cashew Flour: A gluten-free flour made by grinding cashews into a fine powder. It is used in baking recipes like cakes, cookies, and bread.

2 CASHEW APPLE-BASED PRODUCTS

Cashew Apple Juice: Extracted from the cashew apple, this juice is rich in vitamin C and antioxidants. It is often mixed with preservatives for extended shelf life.

Cashew Apple Squash: A concentrated version of cashew apple juice with high sugar content, diluted before consumption.

Cashew Apple Syrup: A thick, sweet syrup made by boiling cashew apple juice with sugar and citric acid, used as a beverage base.

Cashew Apple Wine: Fermented cashew apple juice that undergoes processing similar to grape wine. It is mildly alcoholic and has a fruity taste.

Cashew Fenny: A distilled alcoholic beverage made from fermented cashew apple juice. It is famous in Goa, India, and has a distinct flavor.

3 CASHEW BY-PRODUCTS AND INDUSTRIAL USES

Citric Acid from Cashew Apple: Cashew apple juice can be processed to extract citric acid, which is used as a preservative in the food and beverage industry.

Cashew Shell and Pulp for Animal Feed & Bioethanol: Cashew shell waste and pulp are used in animal feed formulations and bioethanol production.

Cashew Nut Shell Liquid (CNSL): A valuable industrial by-product extracted from cashew shells, used in the production of paints, varnishes, lubricants, and resins.

Cashew Gum: A natural polymer obtained from cashew trees, used in food processing, pharmaceuticals, and cosmetics.

Antioxidants from Cashews: Cashews are a source of antioxidants like lutein and zeaxanthin, which help in eye health and disease prevention.

GOVERNMENT INITIATIVES FOR CASHEW PROCESSING

The Indian government has launched various initiatives to support the cashew processing industry, focusing on **modernization, automation, financial assistance, and export growth**. These efforts aim to improve efficiency, reduce costs, and enhance India's global competitiveness in cashew processing and trade.

1 POLICY REFORMS FOR SMOOTHER TRADE

To streamline sourcing and improve trade policies, the government has introduced:

- **Revised Import Policy** – Adjustments in import regulations for cashew kernels (both broken and whole) to facilitate smoother imports.
- **Updated Standard Inputs Output Norms (SION)** – Changes in SION ensure better input-output efficiency for cashew exporters.
- **Duty-Free Tariff Preference (DFTP) Scheme** – Allows duty-free import of raw cashew nuts from Least Developed Countries (LDCs), reducing input costs for Indian processors.

2 FINANCIAL SUPPORT FOR MODERNIZATION

Recognizing the need for automation in cashew processing, the government has allocated significant financial resources:

- **Medium-Term Framework Scheme** – Approved with a ₹60 crore (US$ 8 million) budget to help cashew processing units adopt automation and mechanization.
- **APEDA's 40% Subsidy on Machinery** – APEDA (Agricultural and Processed Food Products Export Development Authority) is offering a 40% subsidy on cashew processing machinery, encouraging the adoption of advanced technology.

3 EXPORT PROMOTION & MARKET EXPANSION

The government is actively working to increase India's cashew exports by expanding into new markets:

- **Financial Assistance for CEPCI** – The Cashew Export Promotion Council of India (CEPCI) has been funded to conduct buyer-seller meets (BSMs) and participate in international trade fairs under the Market Access Initiative (MAI) scheme.
- **Expanding Export Destinations** – APEDA has strengthened cashew exports to Qatar, Malaysia, and the USA, while also exploring new markets in Japan, Saudi Arabia, the UK, Spain, Kuwait, and other European countries.

4 INDUSTRY ENGAGEMENT & MODERNIZATION

To tackle industry challenges and enhance processing efficiency, the government has taken several steps:

- **Stakeholder Meetings Across Seven States** – APEDA has conducted discussions with Cashew Associations, Exporters, and Industry Stakeholders to address key industry trends and challenges.
- **Automation and Training Initiatives** – Plans are in place to improve processing automation, offer professional training, and register cashew processing units to ensure global competitiveness.
- **Implementation of a Traceability System** – A system is being developed to ensure quality compliance and traceability for exported cashews.

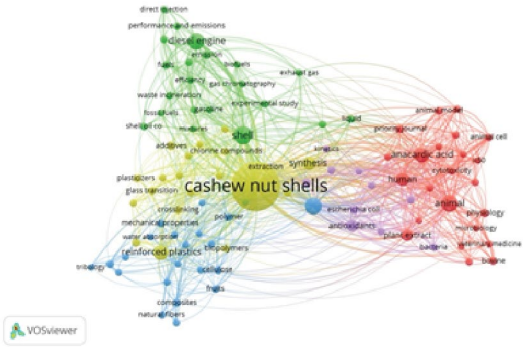
5 RESEARCH & DEVELOPMENT FOR BETTER CASHEW VARIETIES

The Indian government is actively supporting research efforts to develop improved cashew varieties, enhancing productivity and quality in the sector. As part of these initiatives, Prime Minister Narendra Modi launched two new hybrid cashew varieties, 'Netra Jumbo-1' and 'Netra Ganga,' developed by the Directorate of Cashew Research (DCR), Puttur. These hybrid varieties have been specifically designed to provide higher yields, greater climate resilience, and superior nut quality, ultimately benefiting both farmers and processors by ensuring better returns and improved market competitiveness.

RESEARCH TRENDS IN CASHEW INDUSTRY

The cashew industry, long recognized for its economic significance, is now emerging as a hub for scientific research and technological innovation.

Beyond conventional processing, extensive studies are being conducted to explore new applications of cashew by-products, particularly cashew nut shells, in biofuels, sustainable materials, pharmaceuticals, and environmental sustainability. These research efforts aim to maximize value extraction, minimize waste, and enhance eco-friendly industrial practices.



Cashew Nut Shell Liquid (CNSL) is being explored as a renewable biofuel additive with the potential to improve diesel engine efficiency, reduce emissions, and enhance combustion performance. Studies utilizing gas chromatography and experimental combustion analysis indicate that CNSL-based biofuels can act as an alternative to fossil fuels. Additionally, research on waste incineration of cashew shell residues highlights its potential for energy recovery and sustainable industrial use. These advancements contribute to the growing movement toward eco-friendly fuel alternatives in the automotive and energy sectors.

In chemical processing and material science, researchers are working on crosslinking techniques and polymer modification to create sustainable adhesives, coatings, and heat-resistant materials. The mechanical properties of CNSL-based biopolymers and cellulose fibers are also being studied for use in eco-friendly packaging, construction materials, and automotive components. These developments align with global efforts to reduce dependence on petroleum-based plastics and promote bio-based materials with enhanced durability and performance.

Research into antioxidants derived from cashew by-products suggests their potential use in food preservation, extending shelf life, and reducing synthetic additives in the food industry. Studies on microbial interactions, particularly with Escherichia coli and other bacteria, are helping to improve food safety and processing hygiene.

These research trends demonstrate how cashew nut shells are being utilized beyond traditional processing, unlocking opportunities in biofuels, sustainable materials, pharmaceuticals, and environmental sustainability. By integrating advanced technologies and innovative applications, the cashew industry can transition towards a circular economy, reducing waste, enhancing value-added products, and promoting a more sustainable and competitive market.

START UPS IN CASHEW INDUSTRY

The number of startups in the Indian cashew industry is very limited compared to other agricultural and food processing sectors Despite India being a global leader in cashew production and processing, innovation and investment in cashew-based startups remain minimal. However, there is significant potential for startups in several key areas, particularly in value-added products, sustainable processing, fair-trade farming, and automation. The development of cashew-based dairy alternatives such as cashew milk, cheese, and yogurt, along with high-protein snacks and cashew nut butter, can cater to the growing demand for plant-based nutrition. Additionally, utilizing cashew apples for products like juices, fermented beverages, and vinegar can help reduce waste and create new revenue streams. Sustainable cashew processing presents another opportunity, where startups can introduce eco-friendly technologies to minimize water and energy consumption, extract Cashew Nut Shell Liquid (CNSL) for biofuels and biodegradable plastics, and convert processing waste into biogas or organic fertilizers.

A unique example of innovation in this space is Eatery Malabarikas LLP, which is transforming cashew processing using Japanese retort technology. This advanced method enhances the quality, shelf life, and safety of cashew-based products while preserving their nutritional value. The innovation converts discarded wet cashews into high-value sprouted products, reducing waste and increasing market potential. By adopting such cutting-edge techniques, the company is setting new standards in sustainable and efficient cashew processing, paving the way for other startups to explore similar technological advancements.

Moreover, fair-trade and organic cashew farming initiatives can ensure ethical sourcing and better market prices through blockchain-based traceability systems while promoting pesticide-free cultivation. Lastly, automation and smart supply chain solutions can revolutionize the industry with AI-powered sorting and grading systems, cost-effective processing machinery for small-scale enterprises, and direct-to-consumer (D2C) platforms to sell premium cashew products online. By addressing these areas, startups can drive innovation, improve efficiency, and create sustainable growth in the cashew sector.

PROBLEM STATEMENTS IN CASHEW INDUSTRY

PROBLEM STATEMENT: TECHNICAL CHALLENGES IN CASHEW PROCESSING

The cashew processing industry is constrained by outdated technology, inefficiencies in shelling and peeling, inadequate drying methods, and poor mechanization in grading and sorting, all of which lead to low productivity, high operational costs, and inconsistent product quality. Despite being a leading producer and processor, India struggles to compete with countries like Vietnam, where advanced automation and integrated processing units have significantly improved efficiency, reduced labor dependency, and enhanced product quality.

Picture taken during visit to cashew processing industry for problem statement analysis

1 OUTDATED PROCESSING TECHNOLOGY & MANUAL DEPENDENCE

The majority of Indian cashew processing units still rely on traditional roasting, manual shelling, and hand grading, which are labor-intensive and inefficient. Drum roasting methods do not allow for uniform heat control, resulting in inconsistent shell hardening that affects subsequent shelling efficiency. In contrast, modernized fluidized-bed or controlled-temperature roasting can enhance productivity while reducing kernel breakage.

The dependence on manual labor for sorting and grading limits scalability and increases processing costs. Manual sorting is subjective and inconsistent, leading to variations in kernel color, size, and appearance, which impact export quality. AI-driven grading and laser-assisted sorting technologies are underutilized in India, despite their proven efficiency in competitor nations.

2 HIGH BREAKAGE RATES IN SHELLING

Cashew nuts have a hard outer shell containing Cashew Nut Shell Liquid (CNSL), which makes mechanical shelling a major challenge. Existing semi-automated shelling machines in India have a breakage rate of 10-15%, reducing the proportion of whole kernels that fetch premium prices. Vietnamese processors have adopted fully automated laser-guided shelling machines, which reduce breakage rates to less than 5%, allowing them to dominate international markets.

Inadequate automation also results in low throughput and higher processing costs, making Indian cashew processing units less competitive. The lack of investment in precision-engineered shelling machines has prevented many Indian factories from achieving economies of scale.

3 INEFFICIENT MOISTURE CONTROL & DRYING METHODS

The quality of shelling and peeling depends heavily on proper drying and moisture control. Traditionally, cashew nuts are sun-dried, a method that is weather-dependent and inconsistent. Some units use batch dryers, but these lack precision in controlling moisture levels (which should ideally be maintained at 8-10%). Improper drying leads to:

- Inconsistent shell hardness, making shelling inefficient.
- Higher kernel breakage rates due to over-drying.
- Difficult peeling, as improperly dried kernels retain their testa skin more firmly.

Advanced continuous drying systems with real-time moisture monitoring are necessary to standardize processing efficiency and ensure uniform quality across batches.

4 INEFFECTIVE PEELING MECHANISMS

Post-shelling, cashew kernels must be peeled to remove the testa layer. Most Indian processing units still rely on manual peeling or heat-assisted peeling, both of which lead to:

- Kernel discoloration and surface damage, reducing product value.
- Higher labor costs and slower processing speeds.
- Inconsistent peeling efficiency, affecting overall yield.

Steam-assisted or vacuum peeling technologies, widely used in advanced processing units, significantly reduce surface damage and enhance kernel brightness, making them more attractive for premium export markets.

5 LACK OF MECHANIZATION IN GRADING & SORTING

Cashew grading is a critical step that determines price and market segmentation. Manual grading is time-consuming, subjective, and inconsistent, leading to variability in product quality. India still relies heavily on manual sorting for whole cashew grades (W180, W240, W320), whereas leading competitors have adopted AI-based optical sorting and automated grading machines with 99% accuracy. Without mechanized sorting, Indian processors:

- Experience higher labor costs and lower throughput.
- Face inconsistencies in kernel size and quality, leading to rejections in premium markets.
- Lose opportunities to fetch higher prices in European and North American export markets that demand uniformity in grading.

6 POOR UTILIZATION OF BYPRODUCTS (CNSL & CASHEW APPLE)

Cashew Nut Shell Liquid (CNSL) is a valuable byproduct used in industrial coatings, resins, and biofuels, yet many Indian cashew units either discard it as waste or use inefficient extraction methods. With advanced solvent extraction, CNSL yield can be increased by 40-50%, adding a lucrative revenue stream for processors.

Similarly, cashew apples, which are rich in antioxidants, vitamins, and bioactive compounds, are underutilized in India. While countries like Brazil and Vietnam produce cashew apple juice, syrup, and bioethanol, most Indian cashew farms allow cashew apples to rot without being processed.

6 FRAGMENTED & INEFFICIENT SUPPLY CHAINS

The cashew processing industry in India is not fully integrated, with different steps—drying, shelling, peeling, grading, and packaging—often conducted at separate locations. This fragmentation leads to:

- Higher transportation costs between processing stages.
- Increased handling losses, reducing overall yield.
- Longer processing times, delaying order fulfillment for exports.

A shift toward fully integrated cashew processing units with automated workflows can streamline operations, reduce losses, and enhance competitiveness.

PROBLEM STATEMENTS IN CASHEW INDUSTRY

The cashew industry in Kerala, a significant contributor to the state's economy, has been facing multiple challenges, including declining productivity, rising labor costs, and the inability to meet international quality standards due to traditional manual grading processes. The heavy reliance on labor-intensive methods has resulted in inconsistencies in product quality, high operational costs, and reduced competitiveness in the global market. With increasing competition from countries like Vietnam and Tanzania, Kerala's cashew sector urgently required technological advancements to modernize its processing capabilities and ensure sustainability.

To address these pressing issues, the DST-Amrita Technology Enabling Centre (TEC) has developed an innovative cashew grading machine, designed to automate the sorting process based on size and quality parameters. This technology-driven solution significantly enhances efficiency, reduces material wastage, and increases overall throughput. By eliminating the inefficiencies of manual grading, the intervention ensures cost-effective processing, maintains uniform product quality, and allows cashew processors to command higher prices in both domestic and international markets. Additionally, the adoption of this automated grading system reduces labor dependency, alleviates physical strain on workers, and fosters a safer and more productive work environment, making it a vital step towards the industry's modernization.

This initiative aligns with global sustainability objectives by promoting decent work conditions, economic growth, and industrial innovation. By introducing automation into a traditionally labor-intensive sector, the intervention not only boosts Kerala's cashew industry but also strengthens its position in the global supply chain. With this transformative intervention, Amrita TEC continues to lead efforts in driving innovation and sustainability in India's cashew industry, ensuring long-term economic resilience, enhanced productivity, and global competitiveness.

SUSTAINABLE VALUE CHAIN PRACTICES IN CASHEW PROCESSING

- 90% of Indian cashew workers are women but earn less than men.
- 95% of cashew apples are wasted due to perishability and poor processing.
- Poor waste management leads to soil and water contamination.
- High Water Usage: Cashew processing consumes 14,218 m^3 of water per ton.
- Health Risks: CNSL exposure causes skin burns, eye damage, and respiratory issues.
- Carbon Footprint: 1.56 kg CO_2 per kg of cashews.
- Low Wages: Maharashtra's cashew workers earn 3x less than the rural living wage.

A sustainable cashew value chain integrates ethical sourcing, responsible processing, and efficient distribution to mitigate environmental and social risks while enhancing economic resilience. Ethical procurement must ensure traceability to the farm-gate level, engage directly with smallholder farmers, uphold fair-trade policies, and comply with environmental and labor rights. Reducing reliance on harmful agricultural inputs, such as pesticides and fertilizers, and utilizing cashew apple by-products instead of discarding them can significantly lower environmental impact.

Processing facilities should adopt sustainable energy solutions to reduce dependence on fossil fuels and biomass, which contribute to carbon emissions. Workplace safety, fair wages, and gender equity are essential, particularly for women, who dominate the cashew processing workforce. Protective measures against cashew nut shell liquid (CNSL) exposure, automation, and innovations like carbon scrubbers and food safety certifications can enhance efficiency and sustainability. Streamlining distribution with eco-friendly logistics and adopting biodegradable or FSC-certified packaging further reduces the carbon footprint. By implementing these practices, cashew processors can strengthen sustainability credentials, align with global environmental policies, and contribute to the United Nations Sustainable Development Goals (UNSDGs) related to responsible consumption, climate action, and poverty alleviation.

SWOT ANALYSIS OF INDIA'S CASHEW PROCESSING INDUSTRY

Strengths (India's Competitive Advantages)

1 STRONG DOMESTIC MARKET

- India has a vast and growing consumer base for cashews, driven by increasing demand for premium nuts in urban and rural areas.
- The rising health consciousness among consumers and the preference for nutrient-rich snacks have boosted cashew consumption.

2 PREMIUM QUALITY CASHEW EXPORTS

- India is renowned for producing high-quality cashew kernels with superior taste, texture, and appearance.
- Indian cashews command a premium price in international markets due to their superior processing methods and adherence to food safety standards.

3 GOVERNMENT SUPPORT & APEDA SUBSIDY

- The Agricultural & Processed Food Products Export Development Authority (APEDA) and the Ministry of Food Processing Industries (MoFPI) provide financial incentives for exporters.
- Various government schemes support infrastructure development, technology upgrades, and participation in international trade fairs.

4 WELL-ESTABLISHED PROCESSING TRADITION

- India has decades of experience in cashew processing, with skilled labor and traditional techniques passed down through generations.
- The industry is well-integrated with suppliers, processors, and exporters, ensuring consistency in product quality.

5 STRATEGIC LOCATION FOR MIDDLE EAST EXPORT

- India enjoys a geographical advantage for exports to the Middle East, a key market with high cashew consumption.
- Proximity to major shipping routes helps facilitate faster and cost-effective exports to Gulf countries

WEAKNESSES (CHALLENGES IN INDIAN CASHEW PROCESSING)

1 SMALL-SCALE PROCESSING UNITS

- A large portion of India's cashew processing industry comprises small and medium enterprises (SMEs), which lack economies of scale.
- These units struggle with inconsistent supply chains, outdated equipment, and lower productivity.

2 HIGH LABOR COSTS

- Cashew processing in India is still labor-intensive, leading to high production costs.
- Wages have increased over the years, making India less competitive than countries with lower labor costs, such as Vietnam and African nations.

3 LIMITED AUTOMATION

- Many cashew processing units in India still rely on manual shelling and grading, reducing efficiency and increasing production costs.
- Investments in modern machinery are limited due to financial constraints among small processors.

4 HIGHER FREIGHT & LOGISTICS COSTS (US, EUROPE)

- Exporting to the United States and Europe incurs higher logistics costs, making Indian cashews less competitive in these markets.
- Delays in port operations and container shortages also impact trade.

5 HIGHER LOAN INTEREST RATES

- Indian cashew processors often face higher borrowing costs compared to competitors in Vietnam and Africa.
- The lack of subsidized financing for working capital and machinery purchases makes modernization difficult.

OPPORTUNITIES (GROWTH POTENTIAL FOR INDIAN CASHEW INDUSTRY)

1 EXPANSION OF CASHEW PLANTATIONS

- Increasing domestic cultivation of cashew trees in Kerala, Karnataka, Maharashtra, and Odisha can reduce dependence on raw cashew imports from Africa.
- Research into high-yield cashew varieties can improve production and farmer income.

2 ADOPTING LARGE-SCALE PROCESSING & AUTOMATION

- Encouraging the adoption of fully automated processing lines can significantly enhance productivity and reduce labor dependency.
- Government subsidies for mechanization can accelerate this transition, improving India's global competitiveness.

3 STRENGTHENING MIDDLE EAST & US MARKET SHARE

- The Middle East is a key market with strong demand for premium nuts, and India's proximity provides a trade advantage.
- Expanding market penetration in the United States with branding strategies and trade agreements can increase India's export share

4 POSITIONING "PREMIUM INDIAN CASHEW" AS A GLOBAL BRAND

- India can differentiate itself by branding its cashews as a premium product with a focus on superior taste, nutrition, and sustainability.
- Marketing campaigns emphasizing GI-tagged cashews can enhance international recognition.

5 CASHEW VALUE-ADDED PRODUCT DEVELOPMENT

- There is a growing demand for cashew-based value-added products like cashew butter, cashew milk, flavored cashews, and cashew-based confectionery.
- Strengthening the processing of cashew apple juice, syrup, and wine can create new revenue streams.

6 TAX INCENTIVES & FINANCIAL SUPPORT

- The Indian government can introduce tax benefits and financial schemes to encourage modernization and expansion.
- Financial incentives can be provided for cashew processing parks to encourage large-scale, organized processing.

THREATS (EXTERNAL CHALLENGES & RISKS)

1 VIETNAM'S DOMINANCE & COMPETITIVE EDGE

- Vietnam has established itself as the largest exporter of cashews, with significant advantages in automation and cost-efficient processing.
- The country benefits from lower processing costs, faster production times, and extensive global supply chain networks.

2 GROWING CASHEW PROCESSING IN AFRICA

- Traditionally, India imported raw cashews from Africa (Ivory Coast, Ghana, Benin, Tanzania) for processing, but these countries are now developing their own processing industries.
- African nations are offering incentives to investors, reducing raw cashew exports and increasing domestic value addition.

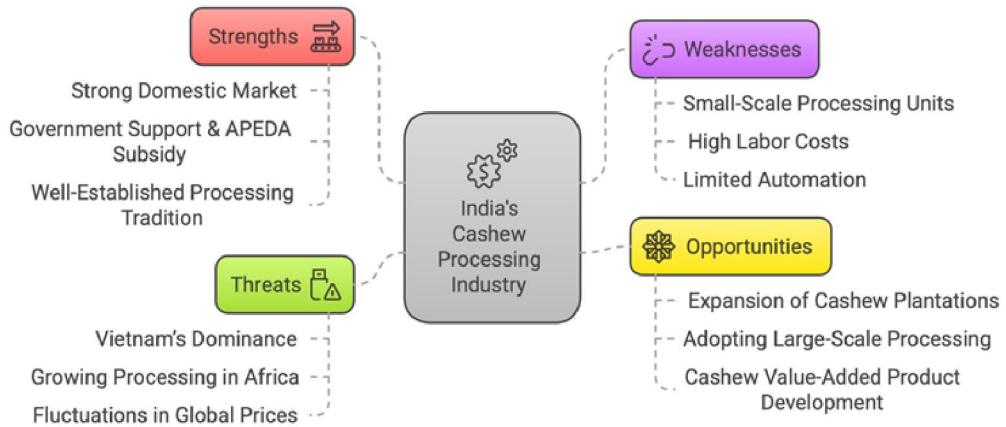
1 FLUCTUATIONS IN GLOBAL CASHEW PRICES

- International cashew prices are volatile, impacted by factors like climate change, demand fluctuations, and trade policies.
- If global cashew supply increases, India may struggle to maintain profit margins due to higher production costs.

2 FREIGHT & LOGISTICS CHALLENGES

- Rising shipping costs, container shortages, and port inefficiencies impact India's ability to export cashews competitively.
- Geopolitical factors, such as disruptions in Sea shipping routes, can increase transportation costs.

SWOT ANALYSIS OF INDIA'S CASHEW PROCESSING INDUSTRY



CONCLUSION

The Indian cashew industry stands at a pivotal juncture, balancing its rich heritage in production and processing with emerging challenges and opportunities. Despite being one of the world's largest cashew producers and exporters, the industry faces hurdles such as reliance on raw cashew imports, outdated processing technology, labor-intensive operations, and increasing global competition, particularly from Vietnam and African nations. Addressing these challenges requires a strategic shift toward scaling domestic production, mechanizing processing units, adopting automation, and reducing dependence on imported machinery.

The adoption of sustainable value chain practices is crucial to mitigating environmental and social risks associated with cashew processing. Issues such as high water consumption, excessive cashew apple wastage, and hazardous Cashew Nut Shell Liquid (CNSL) exposure highlight the need for waste management strategies, eco-friendly processing technologies, and improved worker safety standards. Strengthening ethical sourcing, ensuring fair wages for workers (especially women, who form 90% of the workforce), and promoting sustainability initiatives will enhance India's position in the global cashew trade while aligning with the United Nations Sustainable Development Goals (UNSDGs).

To sustain long-term growth, India must increase domestic cashew farming, develop large-scale processing units, (invest in indigenous machinery, and target high-value export markets like the Middle East and North America. Government interventions such as lowering interest rates for cashew businesses, providing financial incentives for modernization, and promoting research in advanced processing techniques will be critical in ensuring the sector's competitiveness. By implementing these strategic actions, India can reinforce its dominance in the global cashew market, drive innovation, and transition toward a more sustainable and efficient cashew industry.

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