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Unveiling the Export Potential of Northeast India Pineapple: A Revealed Comparative Advantage

Ram Singh[1], Hehlangki Tyngkan[2] and Winsaphisha Diengdoh[1]

This study provides a comprehensive analysis of India's pineapple production and trade dynamics, with a specific focus on the notable performance of Northeast India. Utilizing secondary data from various government publications, the research employs methodologies such as the exponential function for temporal growth analysis, the Cuddy-Della Valle Index for measuring instability, the Balassa method for Revealed Comparative Advantage (RCA), and Lafay's Index for trade competitiveness. The results indicate that while India's pineapple production has stagnated, the Northeast region exhibits positive growth rates attributed to favourable agro-climatic conditions and government support. Despite the region's commendable production, higher instability underscores the need for strategic interventions. Regarding trade, India has maintained a net exporter status, with North East India consistently contributing to meeting export demands. RCA and TSC (Trade Specification Coefficient) values affirm India's competitiveness in the global market. Notably, North East India consistently maintains a trade surplus, highlighting its potential in the global pineapple trade. The study emphasized the need for continuous efforts to enhance quality, competitive pricing, market understanding, and supply chain optimization to strengthen India's position in the international pineapple market. North East India's success in pineapple farming is a valuable model for achieving resilience, sustainability, and competitiveness in the broader context of India's pineapple industry.

Horticultural Development and Inclusive Growth in Assam: A Secondary Data Analysis

R. Nidhishree[3], Rinumoni Burgohain[4], Nivedita Deka[3] and Sandeep Indurthi[5]

The paper explores the contribution of various horticultural crops to Assam's economy, focusing on the period from 2011 to 2020. It aims to quantify the economic impact of major fruits, vegetables, spices, and plantation crops on the state's Gross State Domestic Product (GSDP) and Gross State Value Added (GSAV). Using secondary data from government publications and websites, the research applies econometric techniques like the Cuddy-Della Valle Index to measure instability and percentage analysis to determine the contribution of the horticulture sector to the

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state's economy. Key findings reveal that in 2020, major fruits and vegetables contributed significantly to Assam's GSDP (3.91 per cent at current prices and 3.82 per cent at constant prices) and GSAV (36.70 per cent at current prices and 36.10 per cent at constant prices). Spices and condiments also made notable contributions, although with lower percentages. The study shows that the horticulture sector in Assam has grown steadily, with fruits and vegetables being the major contributors. However, there is noticeable instability in the production of certain crops, highlighting the need for strategic interventions to stabilize and enhance production. The paper recommends improving infrastructure, post-harvest management, and contract farming to maximize the benefits of this sector.

Price Transmission and Spatial Market Integration in Major Apple Markets of India: A Transaction Cost Analysis

Mumtaz Ahmed, Naresh Singla and Vipal Bhagat[1]

The paper examines the dynamics of price transmission and market integration among major apple markets in India, focusing on the role of transaction costs. The study is motivated by the persistent issue of asymmetric price transmission in India's agricultural markets, which is particularly problematic in perishable crops like apples. The analysis uses various econometric techniques, including the Threshold Vector Error Correction Model (TVECM), to measure market integration and the speed of price adjustment across different markets. The findings reveal that Apple markets in India are generally well-integrated, with long-run relationships among them. However, transaction costs, such as transportation and marketing charges, create threshold effects that hinder efficient market performance and delay the adjustment of prices to long-run equilibrium. The study identifies Jammu as a central market that significantly influences price formation in other regional markets. The results also show that high transaction costs negatively impact the speed of price adjustment, particularly in markets farther from Jammu. Improving rural infrastructure, post-harvest storage, processing facilities, and transportation networks, as well as ensuring uniformity in market regulation, are crucial for enhancing the efficiency of apple markets in India. This would enable faster price adjustments and better integration of spatially separated markets.

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Quantitative Assessment of Post-Harvest Losses of Ber (*Ziziphus mauritiana*) and their Management in Rajasthan

Vikash[1]

This study was conducted in 2023 and quantitatively assessed post-harvest losses of *ber* in Rajasthan, focusing on the Jaipur district due to its highest production (990 MT) in the state. Data from 60 randomly selected farmers were used. At the farm level, total post-harvest losses of *ber* were 12.64 per cent. The highest losses occurred during the sorting process (8.65 per cent), followed by collection (1.79 per cent), grading (1.24 per cent), packaging (0.51 per cent), and transportation (0.45 per cent). At the wholesale level, an average of 2.74 per cent loss per day was recorded during the selling process, while retailers faced a 4.26 per cent loss. Experts recommended measures to reduce losses at various levels. Farmers should replace traditional harvesting methods by covering plants with nets to prevent fruit damage from direct ground impact. Additionally, labourers should handle the fruits carefully at the wholesale and retail levels to avoid injuries. Cold storage facilities were suggested for wholesalers and retailers to prolong the availability of the fruit by maintaining its perishability.

Estimating Growth Rates, Instability and Decomposition Analysis of Area, Production and Productivity of Apple in UT of Ladakh

Mansoor Hussain, Nazir Hussain and Nasreen Fatima[2]

The paper uses secondary time-series data to investigate the trends and variations in apple cultivation in Ladakh over 20 years from 2001 to 2021. The study is divided into two sub-periods: 2001-2010 (Period 1) and 2011-2021 (Period 2). The area under apple cultivation in Ladakh grew at an annual rate of 1.6 per cent, with a significant growth observed in Period 1 (4.7 per cent per annum). However, this growth declined sharply in Period 2 (-6.8 per cent per annum), accompanied by increased variability in area expansion. Apple production followed a similar trend, with an overall annual growth rate of 0.3 per cent. The instability in production also increased from Period 1 to Period 2, mainly due to the adopting of new cultivation practices like canopy management and high-density planting. Productivity trends showed a negative growth rate of -1.3 per cent per annum over the entire study period. The decomposition analysis revealed that area expansion was the primary contributor to increased apple production in Ladakh. However, the yield had a negative effect on production. The study concludes with a call for improving productivity through technological advancements, better canopy management, pest control, and the introduction of high-

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yielding apple varieties to enhance the sustainability and profitability of apple cultivation in Ladakh.

Economics of Major Vegetables in Periphery of Raipur District of Chhattisgarh

A.K. Gauraha, Devprakash, S. K. Joshi and V. K. Choudhary[1]

The paper provides an in-depth economic analysis of the production and marketing of major vegetable crops around Raipur city. The study aims to evaluate the cost and returns of key vegetable crops, understand the marketing patterns, identify the constraints faced by farmers, and suggest measures to enhance productivity and profitability. The study found that the total cost of cultivation per hectare varies across crops, with tomatoes having the highest net returns of Rs. 208,416.12 per hectare, followed by cabbage with Rs. 123,515.02 per hectare, and cauliflower with Rs. 118,352.06 per hectare. The study identified two main marketing channels: direct sales from producers to village merchants/retailers and then to consumers and commission agents and wholesalers before reaching retailers and consumers. Constraints identified in the production process include labour shortages, high labour costs, expensive inputs, and limited access to seeds and fertilizers. Price fluctuations, non-economical transportation, and lack of marketing information were significant challenges in marketing. The paper concludes that vegetable cultivation in Chhattisgarh is profitable. Still, improvements in marketing infrastructure, access to timely inputs, and better price stability could significantly enhance the economic returns for farmers.

Value Chain Analysis of Pea (Pisum sativum) in Himachal Pradesh

Divyanshu, Chandresh Guleria, Subhash Sharma, Nisha Devi and Samriti[2]

The paper provides an in-depth examination of the pea cultivation process, focusing on the region's input procurement, marketing channels, and value addition. The study aims to highlight inefficiencies and potential improvements in the value chain to enhance the economic outcomes for pea farmers in Himachal Pradesh. The study reveals that most farmers procure agricultural inputs such as seeds, fertilizers, and pesticides from open markets, while some engage in contract farming with processing firms. The research identifies five main marketing channels, with Channel-III (Producer → Wholesaler → Retailer → Consumer) being the most preferred, handling 40 per cent of the trade. This channel offers better market access and fair pricing for farmers compared to others. However, Channel-II (Producer → Trader → Processing Unit → Wholesaler → Retailer → Consumer) has the highest price spread

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and the lowest producer share due to the involvement of multiple intermediaries, making it the least efficient. The study also explores the economic benefits of processing peas into frozen products, which extend their shelf life and provide significant returns. The degree of value addition varies across the channels. The paper recommends cooperative farming and vertical integration to improve farmers' bargaining power and income.

Analysis of Resource Use Efficiency of Bottle Gourd Production with Low Tunnel Technology and Open Field

Priyanka Yadav[1], Vikram Yogi[2] and Sunil Kumar Jakhar[1]

The paper evaluates the resource use efficiency of bottle gourd cultivation in Bikaner, Rajasthan, comparing low tunnel technology with traditional open field methods. It focuses on understanding the impact of different cultivation techniques on productivity and economic returns. The study uses the stochastic frontier production function, incorporating a Cobb-Douglas specification to assess resource use efficiency. The analysis compares the Marginal Value Product (MVP) of inputs with their Marginal Factor Cost (MFC) to determine allocative efficiencies. Key findings indicate that low tunnel technology is more efficient than open-field cultivation, with a mean technical efficiency of 99 per cent compared to 84 per cent for open fields. The economic efficiency of low tunnel systems is also higher, with scores of 0.50 compared to 0.29 for open fields. The study found that efficient resource allocation could increase returns by 50 per cent in low-tunnel systems and 35 per cent in open-field systems. It concludes that low tunnel technology offers substantial technical, allocative, and economic advantages, making it a viable option for enhancing bottle gourd production in arid regions like Bikaner.

From Fields to Forks: Contrasting Food Production Shifts in Uttar Pradesh and Kerala

C.Vinodhini[3]

The paper explores the differences in agricultural practices, land use, and food production between Uttar Pradesh and Kerala states. With only 1.2 per cent of India’s land, Kerala has focused heavily on cash crops such as rubber, coconut, tea, coffee, and spices, occupying 82 per cent of its cultivated area. The shift towards cash crops has resulted in a significant decline in the area under food crops, increasing its dependence on neighbouring states for food supplies, making Kerala a food-deficit

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state. The state's agricultural policies have prioritized high-value crops for export, which, while economically beneficial, have contributed to food insecurity and a decline in food grain production. In contrast, with 7 per cent of India's land, Uttar Pradesh continues to focus on food crop production. Despite this, the state has also gradually shifted towards horticulture and commercial crops, driven by urbanization and the need for higher-value crops. The study concludes that while Kerala's focus on cash crops has boosted its economy, it has also increased its vulnerability to food shortages. Meanwhile, Uttar Pradesh's emphasis on food crops has helped it maintain food security, but at the cost of slower economic growth. The paper calls for reassessing agricultural policies in both states to address these challenges and ensure sustainable development.

Growth and Instability in Sunflower: A Spatio-Temporal Analysis in India

Neelam Kumari[1] and Dharmpal Malik[2]

The study analyses sunflower cultivation in India, focusing on growth trends and instability from 1970-71 to 2020-21. It reveals that the area and sunflower production has exhibited positive growth across these states and at the national level. However, the increase in production is primarily attributed to the expansion of the cultivation area, as productivity growth remains relatively low. Karnataka has emerged as a leading state, with the highest area and production but lower productivity than the national average. In contrast, Maharashtra has seen a decline in its share of sunflower production. The study also highlights significant regional shifts in sunflower cultivation, with a marked movement from the eastern (Odisha) and western (Maharashtra) zones to the southern zone (Andhra Pradesh and Karnataka). Instability in both area and production is high, particularly in Karnataka and Maharashtra, whereas productivity shows moderate instability. The findings underscore the challenges of maintaining stable sunflower production due to fluctuations in area, climate variability, and competition from other crops.

Value Chain Analysis of Apple in Shimla District of Himachal Pradesh

Ashish Kumar[3], Monika Sharma[4], Chandresh Guleria[5] and Mudit Gupta[6]

The study analyses the apple value chain in Shimla, examining marketing channels, market intermediaries, and post-harvest losses. The research involves a representative sample of traders, wholesalers, retailers, and consumers, revealing five

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distinct marketing channels. Channel-V, which focuses on value-added products such as apple jam, wine, and juice, contributes significantly to value addition (55.80 per cent). It highlights key losses at various stages of the Apple value chain, with wholesalers facing the highest losses due to transportation damage and weight loss. Additionally, input sources, primarily private suppliers, are crucial in enhancing apple production efforts. The study also evaluates apple storage and processing economics, with storage providing a net return of ₹140 per kg and processing yielding ₹13,333.59 per quintal. Recommendations include improving storage infrastructure and promoting the processing of C-grade apples to reduce wastage. The findings suggest that strategic improvements in storage, marketing, and processing are essential to optimize the Apple value chain and improve profitability.

Economic Analysis of Garlic (Allium sativum) in Southern Rajasthan

Sarla Meena and Latika Sharma[1]

The study examines the costs, returns, and overall economic viability of garlic cultivation in the region using primary data from 160 farmers with varying farm sizes in Pratapgarh and Chittorgarh districts. The study estimates the average cost of garlic cultivation at Rs. 123,524.36 per hectare, which rises on smaller farms due to the higher use of seeds, labour, and fertilizers. The return per rupee invested (RPR) stands at Rs. 1.74 on average, varying from Rs. 1.70 for small farms to Rs. 1.80 for large farms. While the gross income and total costs decrease with increasing farm size, net returns improve, suggesting that larger farms are more economically efficient. This efficiency is attributed to better resource management, including high-yield varieties, better irrigation, and technical support. The study concludes that improving input efficiency and resource management could enhance economic returns.

Assessment of Price Behaviour in North India's Major Green Pea (Pisum sativum) Assembling Markets

Divyanshu, Chandresh Guleria, Subhash Sharma and Samriti[2]

The paper examines the price dynamics of green peas in key North Indian markets of Shimla, Nahan, Kullu, Chandigarh, Delhi, and Ludhiana. It uses the Granger causality test, Johansen co-integration test, Vector Error Correction Model (VECM), and Impulse Response Function (IRF) to analyse the interactions and price movements from 2005 to 2022. The study reveals that the Delhi market acts as the primary price leader, influencing the prices in other markets. The results from the Granger causality test indicate a unidirectional price transmission from the Delhi market to other markets,

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while a bidirectional relationship is observed between Chandigarh and Ludhiana. The Johansen co-integration test confirms a long-term relationship among the selected markets, indicating strong market integration. There is significant seasonal and price instability in the markets. Several factors influence price variability, including weather conditions, production levels, and market demand. The Impulse Response Function (IRF) analysis demonstrates how price shocks in the Delhi market impact other markets, particularly in Shimla, Kullu, and Chandigarh. The study emphasises the need to develop robust storage facilities and supply chain management systems to manage price volatility and improve market efficiency. A robust monitoring mechanism is recommended for the Delhi market to prevent price manipulation and ensure fair returns to the farmers.

The Impact of Climate Change on Agricultural Production in Kerala: A Panel Data Approach

Katta Bhaswanth and P. Balamurugan[1]

Using a district-level panel data analysis, the study investigates the influence of climatic factors such as temperature, rainfall, and surface runoff on the production of major crops, including coconut, cashew nut, ginger, turmeric, cardamom, and tapioca. Rising temperatures have had a significant negative impact on several crops, and lower temperatures benefit the production of crops such as turmeric, cardamom, and tapioca. While generally expected to be beneficial, rainfall shows a minimal positive impact overall, with specific crops like areca nut and pepper experiencing adverse effects from changes in rainfall patterns. The study highlights the shrinking of agricultural land due to urbanization and population growth. The study underscores the need for adaptive strategies, including developing climate-resilient crop varieties and implementing flood management practices, to mitigate the adverse effects of climate change on agriculture. The research concludes by emphasizing the importance of sustainable agricultural practices and the need for region-specific crop assessments to understand better and respond to the challenges posed by climate change in Kerala.

Implications of Price Volatility on Farmers: A Case Study of Vazhakulam Pineapple

N. Arshad[2], Aswathy Vijayan[3], S. Anandhu[3] and K. Athira[3]

The paper examines the impact of price fluctuations on pineapple farmers in Vazhakulam, Kerala, particularly during the COVID-19 pandemic. The study uses time series data of daily pineapple prices from January 2017 to September 2022, divided

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into pre-COVID, COVID-19, and post-COVID periods. The analysis used the Autoregressive Conditional Heteroscedasticity (ARCH) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models to understand the volatility patterns. The findings reveal that price volatility was a persistent issue even before the pandemic but worsened significantly during the COVID and post-COVID periods. The lockdowns and restrictions led to severe disruptions in transportation and a sharp decline in demand, causing a steep drop in pineapple prices. The study highlights the critical need for better price risk management strategies to stabilize the pineapple market. It suggests that the government should consider revising the base price of pineapple to ₹20-22 per kilogram to ensure profitability for farmers. Additionally, developing value addition facilities and improved procurement processes by government organizations could help mitigate the impact of price volatility and provide more security for pineapple farmers.

Horticultural Diversification: A Pathway to Agricultural Resilience

Shivam, Kovuri Akash Yadav and Ramesh Golait[1]

The paper explores the role of horticultural diversification in driving agricultural growth and enhancing resilience in India from 1992-93 to 2021-22. Using the decomposition, the study analyses the contribution of various factors—such as yield, price, and diversification—toward agricultural growth over three decades. The study finds yield improvements and diversification to be the primary drivers of agricultural growth. Diversification, particularly towards high-value crops (HVCs) like fruits and vegetables, significantly sustained agricultural growth. The study also highlights a notable shift in cropping patterns, with small farmers increasingly allocating more land to horticultural crops compared to larger farmers. This shift is attributed to the higher profitability of horticultural crops and the growing demand for these products due to changing dietary patterns and increasing health awareness. The lack of adequate cold storage facilities and the dominance of single-commodity storage, primarily for potatoes, limit the potential for multi-commodity storage, which is crucial for preserving horticultural produce. The study calls for enhanced support for horticultural production, particularly in terms of infrastructure development, to fully realize the potential of this sector in contributing to sustainable agricultural growth in India.

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Sustainability of Organic Farming in the North Eastern Hill Region of India

Brota Sing Bey[1], Ram Singh[1], S. M. Feroze[2] and Snehal Athawale[1]

The paper explores the sustainability of organic farming practices across four districts in India's North Eastern Hill (NEH) region. It evaluates the sustainability of organic farming through three key dimensions: ecological security, economic efficiency, and social equity, using a set of 12 indicators derived from primary surveys and government reports. The research employs a multi-stage sampling design and uses Principal Component Analysis (PCA) to assess the contribution of each indicator to the Sustainable Livelihood Security Index (SLSI). Findings reveal significant variations in sustainability levels across the districts. West Kameng district scores highest in ecological security and social equity but lags in economic efficiency. In contrast, East Sikkim excels in economic efficiency due to high labour participation and organic fertilizer use but struggles with ecological security, attributed to its high population density. The study highlights a low composite sustainability level in organic farming across the NEH region, with considerable inter-district disparities. It concludes with a call for region-specific, systematic approaches to enhance the sustainability of organic farming in these regions, emphasizing the need for better infrastructure, increased female participation, and economic diversification to achieve balanced development.

Income Enhancement in Urbanising Rural Settlement through Vegetable Development Programme

V. Akhila[3], A.R. Durga[4], Adarsh B. Sajeev[4] and Divyapriya Rahul[4]

The paper examines the impact of the Vegetable Development Programme (VDP) on pumpkin farmers in Kerala, India. It focuses on resource productivity and cost efficiency among 120 farmers in the Malappuram district. The research reveals that the cost of pumpkin cultivation is slightly lower for VDP beneficiaries than for non-beneficiaries. This difference is attributed to the subsidies provided under the VDP for inputs like seeds and manures. Beneficiaries also achieved higher yields compared to non-beneficiaries. Combined with a subsidy, this yield advantage results in higher gross returns for beneficiaries (₹222,573.26/ha) compared to non-beneficiaries (₹191,955.36/ha). Using the Cobb-Douglas production function, the study finds that VDP beneficiaries efficiently utilize seeds, manures, plant protection chemicals, and family labour, increasing yields and income. In contrast, non-beneficiaries underutilize seeds and fertilizers while overusing manures and chemicals. The paper concludes that the VDP has positively influenced beneficiaries' income levels and farming efficiency.

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It recommends further support for group farming and improved coordination between extension officials and farmers to enhance vegetable cultivation in Kerala.

Transforming Horticulture for Sustainable Growth in India: 'Kilogram Curcumin System

Gurlal Singh[1] , Gurleen Kaur[1], S. M. Mouzam[1] and Sarvpriya Singh[2]

The paper explores the challenges and potential solutions in the marketing and production of turmeric in India. Despite India being the world's largest producer, the marketing of turmeric suffers from inefficiencies, primarily due to price volatility and inconsistent quality control. The study introduces the "Kilogram Curcumin System" (KCS), an innovative pricing mechanism based on the curcumin content of turmeric. Curcumin, the ingredient responsible for turmeric's health benefits, varies significantly across regions. The KCS proposes that turmeric prices be determined by curcumin content, ensuring better remuneration for farmers who produce higher-quality turmeric. The research highlights that the current marketing channels are inefficient, with several intermediaries capturing a significant share of the profits, leaving farmers with a meagre portion of the consumer's rupee. The study also identifies the lack of curcumin testing facilities as a major bottleneck in achieving fair pricing for farmers. The paper concludes with policy recommendations for implementing the KCS, enhancing curcumin testing infrastructure, and promoting high-curcumin turmeric varieties.

Enhancing Sustainable Horticulture in Chhattisgarh: A Study on Protected Cultivation and Precision Farming

Praveen Kumar Verma, V.K. Choudhry, Ashish Verma and D. Manoj Kumar[3]

The paper investigates the benefits of adopting Protected Cultivation and Precision Farming (PCPF) methods compared to traditional open-field cultivation for key vegetables in Chhattisgarh, India. The study focuses on productivity, cost efficiency, and economic returns under PCPF conditions. It was found that PCPF significantly enhances productivity due to improved labor-to-capital ratios. While PCPF involves higher initial fixed costs due to infrastructure investments, it reduces operational costs through efficient drip irrigation and lower expenditures on plant protection. The government’s support through subsidies and insurance further bolsters the economic viability of PCPF. Overall, the findings underscore the advantages of PCPF over traditional methods, particularly in terms of productivity and economic returns. The paper advocates for adopting modern agricultural practices and targeted policies to promote sustainable vegetable cultivation in Chhattisgarh, enhancing the region's food security and economic resilience.

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Predictive Modelling for Pineapple Price Forecasting: A Comparative Study of Time Series and Machine Learning Techniques

A.K. Arshida, Manju Mary Paul, Pratheesh P. Gopinath and Aswathy Vijayan[1]

The paper explores applying various forecasting models to predict the price of pineapples in Kerala, India. The study compares traditional time series models like ARIMA (Auto Regressive Integrated Moving Average) and GARCH (Generalized Autoregressive Conditional Heteroskedasticity) with modern machine learning models such as Prophet and Recurrent Neural Networks (RNNs). These models were trained and evaluated using historical daily price data of green and ripe pineapples from January 2006 to December 2023. The findings reveal that RNN models consistently outperform other techniques in terms of prediction accuracy. The flexibility and ability of RNNs to learn from sequential data make them particularly well-suited for modelling the complex temporal dynamics of pineapple prices. Among the traditional models, ARIMA and GARCH performed reasonably well, but their accuracy was lower than that of the machine learning models. The paper concludes that advanced machine learning models, particularly RNNs, offer a more robust and accurate tool for price forecasting, enabling better decision-making for stakeholders in the pineapple industry.

Growth and Export Performance of Horticultural Crops in India

Rohlupuii Ralte and Laishram Priscilla[2]

The paper analyses the growth trends, export performance, and contributing factors to the production of horticultural crops in India from 2004-05 to 2022-23. The study employs various methodologies, including Compound Annual Growth Rate (CAGR) analysis, Markov Chain Analysis, and Decomposition Analysis, to evaluate the area, production, and productivity of different horticultural crop groups and identify major export destinations. Most horticultural crop groups' growth in area, production, and productivity is significantly positive. The Markov Chain Analysis reveals that fruits have retained a dominant share in area under cultivation over the years, with minimal shifts to other horticultural crops. Decomposition analysis further highlights that yield effect is the primary contributor to output growth across most crop groups, except for spices, where the area effect played a more significant role. Further, the quantity and value of horticultural exports from India have been positive, with significant contributions from fruits and vegetables. The major export markets for India's horticultural products include the UAE, Netherlands, Bangladesh, and the USA. It emphasizes the need to develop a surplus in high-value horticultural crops through

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effective supply chain management, stakeholder collaboration, and improved pre- and post-harvest processing and storage.

Exploring the Role and Innovations of Agri-Tech Startups in Transforming Agri-Input and Services Markets: Viability, Success Factors, Sustainability, and Challenges in South India

Sarvesh Jayasree Prabhakaran Nambiyar and Natarajan Kiruthika[1]

This study investigates the transformative role of agri-tech startups in South India's agri-input and services markets, focusing on their viability, success factors, sustainability, and the challenges they face. Despite significant growth in venture capital funding, agri-tech startups encounter barriers such as limited access to financing, inadequate infrastructure, and varying levels of digital literacy among farmers. By employing a mixed-methods approach that includes surveys and qualitative interviews with 50-100 startups, 400-500 farmers, and other stakeholders, the research identifies key success factors, including technological innovation and stakeholder engagement, that drive startup performance and market penetration. Findings reveal that agri-tech innovations can enhance agricultural productivity and sustainability, with evidence showing yield increases of up to 20 per cent through precision farming techniques. However, financial constraints and regulatory hurdles remain significant obstacles. The study recommends strengthening financial support, improving technological infrastructure, enhancing regulatory frameworks, fostering collaboration among stakeholders, and promoting education and training initiatives to support the growth of agri-tech startups. Ultimately, the research contributes valuable insights into creating a resilient agricultural ecosystem in South India, paving the way for sustainable agricultural development and food security in the region.

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A Study on Socio-Economic Status of Cabbage Growers in Krishnagiri District of Tamil Nadu

V. Balaji and R. Selvakumar[1]

The paper explores the socio-economic conditions of cabbage farmers by using the primary data from 120 farmers from the Kelamangalam block of Krishnagiri district, focusing on understanding the factors affecting their livelihoods. Most cabbage farmers are middle-aged, married, and primarily engaged in agriculture, with a significant portion having only primary or secondary education. Most farmers belonged to backward or backward castes and lived in nuclear families. Many of these farmers were low-income, earning less than ₹2 lakh annually. The study highlights that most farmers have moderate experience in cabbage cultivation and rely heavily on irrigated land, primarily canal irrigation. Despite the small landholdings, livestock, especially poultry, is an important additional income source for these families. Access to extension services and formal organizational membership among farmers is limited. The paper concludes that understanding the socio-economic status of cabbage growers is crucial for designing effective policies and extension programs to improve their livelihoods and ensure sustainable agricultural practices in the region.

Cultivating Efficiency: An In-Depth Analysis of Technical Efficiency in Kerala's Organic Vegetable Farming

Deepa Palathingal[2] and N. Rajagopal[3]

The paper examines the factors affecting the technical efficiency of organic vegetable farmers in Kerala. The research uses a stochastic production frontier model with a Cobb-Douglas functional form to analyse data from 300 certified organic vegetable farmers. The average technical efficiency of organic vegetable farmers in Kerala is about 21.4 per cent, indicating significant inefficiency and a large potential for improvement. Labour, land, and organic manure are positively associated with production efficiency, while capital is not significant. Also, age and farming experience significantly impact inefficiency, with older farmers tending to be less efficient and more experienced farmers being more efficient. Education, however, does not have a significant impact on technical efficiency. Small-scale farmers and those involved full-time in farming generally exhibit higher levels of efficiency, although all groups show substantial room for improvement. The study suggests a reallocation of resources, enhanced training programs and better access to organic farming technologies to boost the efficiency of organic vegetables.

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Comparative Analysis of Turmeric Cultivation in Kerala and Andhra Pradesh

Akkidasari Venkatarao, F. Thasnimol and P. Karthika Pillai[1]

The paper examines the economics of turmeric cultivation in the Palakkad district of Kerala and the Visakhapatnam district of Andhra Pradesh by comparing the costs, returns, and overall profitability of turmeric farming. The analysis is based on primary data from 100 turmeric farmers, 30 from Palakkad and 70 from Visakhapatnam. There are significant differences in the cost structure and profitability between the two districts. The total cost of cultivation per hectare was higher than in Visakhapatnam, mainly due to higher labour costs in Palakkad. Despite the higher costs, turmeric cultivation in Palakkad yields a higher gross income and net returns. The benefit-cost (BC) ratio was identical in both districts at 1.32, indicating that for every rupee invested, farmers earn ₹1.32. The paper suggests that government interventions such as mechanization support, labour integration with employment guarantee schemes, and promotion of high-yielding varieties in Visakhapatnam could enhance profitability and sustainability in turmeric cultivation in both districts.

Economic Analysis of Raw Cashewnut Production in Kerala

C. Srilakshmi, A. Prema, Jalaja S. Menon and R. S. Manjusha[2]

The paper investigates the costs, returns, and profitability of raw cashew nut production, analysing the establishment and maintenance phases of cashew cultivation. The establishment cost of cashew plantations is ₹136,031 per hectare, covering the first four years of cultivation. Maintenance costs vary across the different phases of the plantation's lifecycle, with the yield-stabilizing phase incurring the highest costs. The cost of production is calculated to be ₹65 per kilogram on average, with variations depending on the yield phase. Despite the high costs, cashew farming in Kannur is profitable, with a net return of ₹32,236 per hectare and a benefit-cost ratio of 1.56. The constraints faced by cashew farmers were pest infestations, unfavourable weather conditions, high labour costs, and insufficient government support. The paper recommends policies to enhance cashew production, including replanting with high-yielding clones, adopting high-density plantations, and providing farmers with adequate financial and technical support. Such measures will mitigate the current challenges and improve the profitability and sustainability of cashew farming in Kerala.

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Exploring Economic Viability of Natural Farming Farmer Producer Company: A Focus on Himachal Pradesh

Rohit Kumar Vashishat, Subhash Sharma, Chinglembi Laishram, Rajeshwar Singh Chandel, Divyanshu and Manoj Gupta[1]

The paper examines the role and impact of Farmer Producer Companies (FPCs) focusing on natural farming practices in Himachal Pradesh. It evaluates the economic benefits, income equality, and value addition associated with FPCs, comparing these with non-FPC farmers engaged in conventional farming practices. Based on the primary and secondary data, the results indicate that FPCs provide significant advantages to farmers, including better market access, improved income, and greater financial stability. The FPCs also contributed to a more equitable distribution of income among farmers. The paper also highlights the importance of value addition in enhancing the profitability of natural farming. Farmers associated with FPCs benefit from reduced marketing costs and higher returns on their produce, particularly in channels where direct sales to consumers are possible. The FPCs were found to play a crucial role in promoting sustainable farming practices and improving the livelihoods of smallholder farmers. The study highlighted the need for greater financial and technical support, better infrastructure, and stronger market linkages to ensure the long-term sustainability of these farmer-led organizations.

Impact of Coconut-Based FPOs on Farm Income in Coimbatore District

L.T. Thirumarudhan and M. Anjugam[2]

The study explores the influence of Farmer Producer Organizations (FPOs) on the income of coconut farmers in Pollachi Taluk, Coimbatore district. It identifies key factors influencing FPO participation, assesses the costs and returns of coconut cultivation, and evaluates resource use efficiency. The study compares the economic outcomes for FPO and non-FPO farmers, finding that FPO membership positively impacts farm income, with FPO farmers earning significantly higher net income than their non-FPO counterparts. The total establishment cost for coconut cultivation over five years was ₹2.74 lakhs. FPO farmers incurred slightly higher costs but achieved better yields and prices, resulting in a net income of ₹111,658 compared to ₹79,323 for non-FPO farmers. A significant price difference of ₹1.1 per nut was observed, favouring FPO members. Despite the economic benefits, challenges such as marketing issues reduced interest in value addition activities. The study recommends enhancing training, capacity-building efforts, and field visits to strengthen the performance of FPOs and address these challenges.

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Equal Wages, Uneven Employment Rates, and Women's Role Amid Male Absenteeism: A Narrative from Darjeeling Tea Plantations

Kavya Sanjaya and G. Sridevi[1]

The paper explores the gender dynamics, employment conditions, and economic challenges faced by women working in the tea plantations of Darjeeling. The study is based on qualitative fieldwork, including interviews with workers, managers, and industry experts across eight tea gardens in Darjeeling. Despite the industry's claims of wage parity, with both male and female workers earning a daily wage of ₹232, the study reveals persistent gender inequalities in job roles and opportunities for advancement. Women are mainly absent from supervisory and managerial positions, and the hierarchical structure of the tea industry remains male-dominated, limiting women's career progression. Male absenteeism is significantly higher than female workers, accounting for 85.75 per cent of total absenteeism. While wage parity is a positive development, it is insufficient to address the broader issues of gender inequality in the tea plantation sector. To achieve true gender equity, the study suggests that the industry must go beyond equal pay to ensure women have access to career advancement opportunities and address the economic challenges female workers face.

Challenges of Crop Diversification for Small Farmers in India: A Case Study of Onion Market

Ranjana Roy and Raya Das[2]

The paper investigates the issues small onion farmers face in India, particularly concerning price discovery and realization. It focuses on the efficiency of various marketing channels, assessing how these affect the price realization for onion farmers. It also explores the impact of export bans on farmers' incomes, revealing that such bans often lead to significant financial losses for farmers due to reduced market access and depressed prices. The findings emphasize the need for strategic policy measures to improve market efficiency, ensure fair prices for farmers, and mitigate the risks associated with price volatility. It suggests that improving storage infrastructure, promoting alternative marketing channels like contract farming and farmer producer organizations (FPOs), and encouraging value addition through processing could help stabilize the onion market and secure better incomes for small farmers.

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Exposure and Vulnerability of Farm Households to Production Risks in Maharashtra: An Insight from Situation Assessment Survey

Prakash G. Athare, Dharam Raj Singh, Nalini Ranjan Kumar, P. Venkatesh and Girish Kumar Jha[1]

The paper investigates the various production risks farm households face in Maharashtra, using data from the 77th round of the National Sample Survey Office (NSSO). It focuses on the exposure and vulnerability of farmers to risks such as drought, floods, pest infestations, and other causes of crop loss, with a particular emphasis on regional disparities within the state. The drought is the most prevalent risk, affecting 41.64 per cent of farm households, with Marathwada and Vidarbha being the most affected regions. Insect pest damage is the second most common risk, impacting 10.64 per cent of households, especially in the Vidarbha region. While less frequent, floods cause significant per-hectare losses, with an average loss of ₹39,793 per hectare, followed by drought (₹14,142) and pest damage (₹9,356). The study also reveals that cereals, cotton, and oilseeds are most vulnerable to drought, while sugarcane and horticultural crops suffer significant losses due to pest infestations. Larger farm holdings tend to have higher exposure to risks, particularly in terms of pest damage and overall production losses. The study highlights the need to enhance climate risk management strategies, improve irrigation infrastructure, and promote resilient crop varieties to mitigate risks. It also recommends increasing investment in farm inputs to improve farm income and reduce vulnerability.

The Shifting Mosaic: Exploring Crop Diversification in Kerala's Midlands

G.B. Aiswarya[2]

The study investigates the extent and patterns of crop diversification in three midland districts of Kerala—Thiruvananthapuram, Kottayam, and Kannur—from 2005-06 to 2020-21. It employs various analytical tools, including the Simpson Index (SI), Modified Entropy Index (MEI), and Markov Chain Analysis, to measure crop diversification and examine transitions in crop areas over time. There is a significant shift from food crops like paddy and pulses to non-food crops, including coconut, rubber, and other plantation crops. Also, there is a consistent decline in the total cultivated area across all three districts. Kannur emerged as the most diversified district. In contrast, Kottayam experienced a slight increase in paddy area alongside growth in non-food crops. The Markov Chain Analysis highlights the transitions in land use, showing that land previously used for paddy and other labour-intensive crops has shifted towards less labour-intensive non-food crops like coconut and rubber. The

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study concludes by emphasizing the need for programs that encourage young people to view agriculture as a viable and profitable career and strategies to motivate existing farmers to return to food crop cultivation to ensure regional food security.

Enhancing Sustainable Horticulture in Chhattisgarh: A Study on Protected Cultivation and Precision Farming

Vijay K. Choudhary, Praveen Kumar Verma and Ashish Verma[1]

The study investigates the impact of Protected Cultivation and Precision Farming (PCPF) on the productivity and economic viability of vegetable farming in Chhattisgarh. It compares PCPF with traditional open-field cultivation for five vegetables: tomato, brinjal, cauliflower, knol-khol, and cabbage. The study reveals that PCPF significantly enhances productivity due to improved labour-to-capital ratios. The study employs a quadratic production function to analyse the relationship between labour and capital, demonstrating that PCPF is less labour-intensive and more cost-effective in the long term than open cultivation. Cost analysis indicates that while PCPF requires higher initial investments, particularly in infrastructure like drip irrigation and protected structures, it reduces operational expenses, particularly in plant protection and irrigation. Government subsidies and insurance schemes further enhance the economic feasibility of PCPF, making it a sustainable alternative to traditional methods. Overall, the study advocates for adopting PCPF in Chhattisgarh, emphasizing its potential to boost food security, enhance economic resilience, and promote sustainable agricultural practices in the region. The findings suggest that targeted policies and continued support for modern agricultural techniques are crucial for the sustained growth of horticulture in Chhattisgarh.

Forecasting the Growth Trajectory of Kinnow in Punjab: Trends, Evolving Market Landscape, and Economic Implications

Shruti Chopra, Amarpreet Kaur, Harsimranjeet Mavi, Arjinder Kaur, Shaikh Mohd. Mouzam and Avneet Kaur[2]

The study explores the current and prospects of kinnow cultivation in Punjab, using the Box-Jenkins ARIMA model to predict yield, production, and area under cultivation up to 2030-31. The area under kinnow is expected to expand from 46.26 to 59.57 thousand hectares and production from 12.16 to 16.37 lakh metric tons. Productivity is also expected to reach 339.98 quintals per hectare by 2030-31. The study highlights the role of government initiatives such as Punjab Agro Juices Ltd. in supporting kinnow farmers through processing and value addition. However, it also points to challenges such as climatic variability, market fluctuations, and infrastructure

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gaps, particularly in cold chain logistics and market access, which need to be addressed to sustain the momentum of kinnow farming. The evolving market landscape, especially in Southern India, plays a significant role in pricing and export strategies, with recent setbacks like increased customs duties in key export markets posing risks. The study concludes by emphasizing the need for continued investment in infrastructure, value addition, and market integration to solidify Punjab's position as a leading kinnow producer and exporter, ensuring sustainable agricultural development and economic resilience for rural communities.

Impact Assessment of Climatic and Technological Factors on Horticultural Production in India

Reshma Vattekad [1], Manikandan Krishnan[1] and Pradeesh Kunchu[2]

The study examines the effects of climate variables and technological factors on horticultural production in India from 1991 to 2020 by using the Auto-Regressive Distributed Lag (ARDL) model. The rainfall has a significant positive impact on horticultural production in both the short and long term. An increase in rainfall by 1 per cent is associated with a 0.24 per cent rise in horticultural output in the long run. An increase in fertiliser usage by 1 per cent raises production by 0.17. Temperature and area under cultivation positively correlate with horticultural production, although their effects are relatively smaller. Conversely, carbon dioxide emissions have a detrimental impact on horticultural production in the long term. In the short term, however, carbon dioxide emissions and rainfall show a positive but significant effect on production, while temperature and fertilizer usage negatively impact short-term horticultural yields. The study underscores the importance of optimizing technological interventions like precision farming and effective irrigation systems to enhance productivity while mitigating the adverse effects of climate change. The findings also suggest that policy support, such as market links, financial facilities, and subsidies, is essential for promoting sustainable growth in the horticulture sector.

Production, Marketing, and Pricing of Tomato Crop in Telangana State

M. Srinivasa Reddy[3] and Brajaraja Mishra[4]

The study analyses the tomato cultivation landscape in Telangana by using the primary data from 420 farmer households. Tomato cultivation was profitable during the kharif and summer seasons but not during the rabi season due to higher input costs and lower output prices. Access to irrigation is a key determinant of productivity across different seasons. The role of commission agents, collective selling arrangements, and the choice of marketing channels influence marketing behaviour. However, price

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volatility remains a significant challenge, driven by factors such as climate change, supply chain inefficiencies, and market manipulation by traders. This volatility often leads to financial distress among farmers, exacerbating issues like indebtedness and reduced access to credit. The study concludes that improving access to quality seeds, enhancing irrigation infrastructure, and strengthening extension services are crucial for supporting tomato farmers in Telangana. Additionally, stabilizing prices through better supply chain management and ensuring fair market access are essential steps towards promoting sustainable agricultural practices and improving the livelihoods of tomato farmers in the region.

Value Chain Analysis of Litchi: Evidences from Punjab

Shamylee Saini[1] Viney Kumar Sharma[1], Neha Manhas[1], Amit Guleria[1] and Pardeep Singh[2]

The study examines the intricate value chains in litchi cultivation in the Pathankot and Gurdaspur districts of Punjab. The focus was on understanding the pricing dynamics, value addition, and marketing efficiency within the Litchi value chains. About 79 per cent of litchi growers in the region sell through pre-harvest contractors due to high marketing risks and the fruit's perishable nature. The research categorizes the value chains into four types, each contributing differently to the form, place, and possession utilities at various stages of the market. While the first value chain, involving pre-harvest contractors, is the most common, the second, where farmers sell directly to the market, is more efficient, offering higher returns. The study highlights the challenges of weather volatility, pest and disease threats, perishability issues, and price fluctuations. These challenges necessitate cold storage and transportation infrastructure investments to reduce post-harvest losses and maintain fruit quality. The study recommends promoting direct marketing channels, improving market infrastructure, and developing processing and storage facilities. These interventions will ensure better prices for the farmers and reduce their dependence on intermediaries.

Analyzing India's Trade Balance of Horticultural Commodities: Trend and Policy Implications

Priya Brata Bhoi, Kamal Vatta, Pradipkumar Adhale, Sunny Kumar and Kashish Arora[3]

This study examines India's trade balance for fruits, vegetables, and processed products from 2000 to 2023, using trade data from UNCOMTRADE and descriptive analysis of export trends. A panel data model assesses how income, prices, and exchange rates affect these commodity groups. The findings reveal that developed

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nations dominate global exports in these sectors. India's export pattern shows that highly perishable products are mainly exported to Asian markets, while processed products reach a wider international audience. The panel data analysis indicates that currency devaluation could improve India's trade balance for these commodities. Exports and imports are found to be price elastic, highlighting the need for competitive pricing. Foreign income growth significantly influences the export of edible fruits and nuts, while domestic income affects imports under HS 07 and HS 20. To enhance its trade balance, India should focus on developing processing technologies for fruits and vegetables, reducing wastage and allowing India to capture a larger share of the global processed horticulture market.

Experiences and Obstacles: A Look at Almond Growers in Samangan, Afghanistan

Bashir Ahamad Esar and S. M. Mouzam[1]

The study explores the challenges faced by almond farmers in the Samangan province of Afghanistan by using primary data from 60 farmers. It identifies several critical issues affecting almond production, marketing, and sustainability. The primary production challenges include pest and disease management, insufficient inputs, lack of proper training, and water management problems. These issues are exacerbated by the region's reliance on traditional farming practices, limited access to modern machinery, and inadequate storage facilities. Farmers also struggle with marketing their products due to limited access to buyers, unfair pricing, and the dominance of intermediaries who offer lower prices. Additionally, financial constraints pose significant barriers to improving production and expanding operations. The farmers' trade unions suffer from weak management, lack of resources, and insufficient government and NGO support, leaving farmers without the necessary backing to tackle their challenges effectively. The study recommends the introduction of disease-resistant almond varieties, improved harvesting techniques, sustainable water management practices, and better post-harvest storage solutions. Strengthening trade unions, increasing government and NGO support, and providing farmers with the necessary training and financial resources are also critical steps towards enhancing the productivity and profitability of almond farming in the region.

Achieving Sustainable Breakthroughs in the Potato Supply Chain Amidst the COVID-19 Pandemic: A Case Study of Punjab

Avneet Kaur and Mini Goyal[2]

Using the primary data from 40 farmers and 40 intermediaries, the study examines the impact of the COVID-19 lockdown on the potato supply chain in Punjab,

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focusing on the challenges faced by different stakeholders, including farmers, commission agents, wholesalers, and retailers. The findings reveal that the lockdown led to significant disruptions across the supply chain. Farmers experienced a sharp decline in potato prices, with only a slight recovery post-lockdown. Marketing costs surged due to increased transportation expenses and spoilage. These factors significantly reduced farmers' net income by more than 55 per cent during the lockdown period. The quantity handled by commission agents and wholesalers dropped by 41.53 per cent, with a substantial fall in sale prices and marketing margins. The retailers also faced a decline in produce handled, a drop in retail prices and rising costs, leading to a decrease in net income during the lockdown. The recommendations included improving cold storage infrastructure, establishing dedicated marketing cells, enhancing transportation networks, and stabilizing wage rates to mitigate future disruptions.

Economic Feasibility of Coconut Cultivation in Tamil Nadu State of India

K. Gokula Kannan and Soumitra Chatterjee[1]

The study assesses the financial viability of coconut and copra production in Tamil Nadu by evaluating the cost-return structure and financial feasibility of coconut plantations of varying ages across 100 farm households. The study categorizes the coconut plantations into five age groups, ranging from 1-10 years to 41-50 years. It calculates key financial indicators such as Net Present Value (NPV), Internal Rate of Return (IRR), and Benefit-Cost Ratio (BCR). The initial establishment costs, which include land preparation, planting materials, and labour, contribute around 18 per cent to the total maintenance costs. The production of copra, a key product derived from coconut, yields approximately 30 quintals per hectare, generating net returns of around Rs. 100,000 per hectare. Among the different age groups, plantations aged 41-50 exhibit the highest financial viability. The study finds that all age groups of coconut plantations are financially feasible, with payback periods ranging between 10 to 11 years. Overall, the study concludes that coconut cultivation in Tamil Nadu is economically sustainable, with significant returns on investment, especially for mature plantations.

Bootstrap and Jackknife Resampling: A Methodological Approach to Estimate Orange Fruit Crop Production in Nagaland

Khangembam Romio Singh[2], Amod Sharma[2] and Jiaul Haque[3]

The study focuses on applying bootstrap and jackknife resampling to improve the accuracy and reliability of estimates related to orange crop production in Nagaland,

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India. It aims to provide a more precise assessment of the area under cultivation, production volumes, and the number of bearing and non-bearing orange trees across the state's 12 districts. The researchers surveyed 1,156 respondents using a standardized interview schedule for this study. During 2019-20, the study estimated the area under the orange crop to be 26,678.53 hectares, with production at 127,702.53 tonnes and 9,924,400 orange trees in bearing and non-bearing stages. To validate these estimates, the study employed bootstrap and jackknife resampling methods to calculate the coefficient of variation (CV), a measure of the precision of these estimates. Overall, the study demonstrates the effectiveness of bootstrap and jackknife resampling techniques in enhancing the accuracy of agricultural estimates, particularly in fruit crop production. These methods provide a robust statistical framework that can be applied to other crops and regions.

Spatial Market Integration and Price Transmission: A Case of Selected Pea Markets in Punjab

Ravneet Kaur and Namami Gohain[1]

The study explores the integration and price transmission among pea markets in Punjab by using the time series data from 2010 to 2021 and with the application of various econometric techniques such as correlation, Johansen co-integration, Granger causality tests, and the Vector Error Correction Model (VECM). The study finds that pea markets in Punjab are generally well-integrated with each other and the Azadpur market. It also confirms the existence of long-term equilibrium relationships among these markets. The price transmission is unidirectional from the Barnala market to other markets in Punjab, while the Azadpur market exhibits bidirectional causality with the Ludhiana market, indicating mutual influence. The VECM also supports long-term relationships, with adjustment rates indicating how quickly prices in one market adjust to changes in another. To enhance the efficiency of vegetable marketing in Punjab, the study recommends improving market infrastructure, strengthening market intelligence, and promoting better connectivity between regional and national markets.

Comparative Economics of Natural Farming and Conventional Farming Practices in Apple Cultivation in Himachal Pradesh

Subhash Sharma and Divyanshu Mandyal[2]

The study examines the economic viability of Subhash Palekar Natural Farming (SPNF) versus conventional farming (CF) methods in apple cultivation in Himachal Pradesh by using the data from 122 orchardists. The study reveals that SPNF, particularly with crop combinations involving apples, pulses, and vegetables (Crop Combination 4), consistently outperforms CF regarding net returns, CEY, and gross

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returns. This combination yielded the highest net returns of Rs. 500,555.09 per 100 plants during the main bearing stage, with a CEY of 68.64 quintals. The best-performing CF combination, Apple + Rajmah, produced lower net returns of Rs. 349,343.34 with a CEY of 52.05 quintals. The financial analysis further supports the superiority of SPNF, with Crop Combination 4 achieving an Internal Rate of Return (IRR) of 30 per cent and a Benefit-Cost Ratio (BCR) of 2.64, compared to the 22 per cent IRR and 1.78 BCR in the best CF scenario. The study highlights that diversified cropping in SPNF optimizes resource use, enhances soil fertility, and reduces risks associated with monocropping.

An Economic Analysis of Maize vis-à-vis Paddy Cultivation in Sub-Mountain Undulating Plain Zone of Punjab

Taranpreet Singh, Parul Barwal, Lavleen Kaur and Smiley Thakur[1]

The paper compares the economic viability and resource use efficiency between maize and paddy cultivation in the Hoshiarpur District of Punjab using primary data from 100 farmers. While the per-acre cost of cultivation for maize (Rs. 15,590.39) was significantly lower than for paddy (Rs. 23,462.66), the gross and net returns for paddy (Rs. 53,406.17 and Rs. 29,943.51, respectively) were higher than those for maize. The study employed the Cobb-Douglas production function and estimated that seeds and human labour had a positive and significant effect on maize yield, while fertilizers had a negative impact. For paddy, seeds and farmyard manure (FYM) were the significant positive contributors to yield. The study emphasizes crop diversification in Punjab, proposing maize as a viable alternative to paddy if supported by adequate Minimum Support Price (MSP) and assured procurement policies. This shift could be encouraged by developing industries that use maize as a raw material, thereby improving marketability and prices and generating employment in the region.

Market Participation of Smallholder Vegetable Growers in Northern Hills of Chhattisgarh: A Logistic Regression Approach

Payal Jaiswal[2] and V.K. Choudhary[3]

The paper explores the factors influencing market participation among smallholder vegetable growers in the northern hills of Chhattisgarh, India. Using data from 150 households, the research employs a binomial logit model to identify significant determinants of market participation. Age, farm size, distance from the market, and access to market information are critical factors influencing a farmer's market participation. Specifically, older farmers and those with larger farms are less

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likely to engage in market activities. Conversely, increased area under vegetable cultivation and access to timely market information significantly enhance market participation. Smallholder farmers, particularly those with more substantial vegetable production, are more inclined to sell their produce if they have adequate access to market information. Land ownership, gender, family size, income, and road conditions did not significantly affect market participation. The findings emphasize the need for targeted interventions to improve infrastructure, disseminate market information, and support older farmers and those with larger farms to enhance their market engagement.

Economic Feasibility of Lilium Cultivation in the Nilgiris District of Tamil Nadu

P. Balamurugan[1] and S. Senthilnathan[2]

The paper explores the economic viability of cultivating Lilium flowers under protected cultivation using the primary data collected from 30 farmers in six villages of Nilgiris district in Tamil Nadu. The results showed that Lilium cultivation in the Nilgiris district is financially viable, with a net return of Rs. 16.67 lakhs per 4000 m². The study also identified significant challenges faced by farmers, including the high cost of polyhouse materials, expensive seedlings, and the scarcity of skilled labour. These constraints underscore the need for continued technical guidance, improved access to affordable inputs, and enhanced support through subsidies and training programs. The study concludes that Lilium cultivation under protected conditions offers substantial economic returns and can contribute to sustainable growth in India's horticulture sector. However, addressing the identified challenges through policy interventions and capacity building is crucial for maximizing the potential of this high-value agricultural practice.

Financial Feasibility Analysis of Jasmine Flower in Madurai District of Tamil Nadu

B. Aishwarya and K. Sita Devi[3]

The paper examines the economic viability of jasmine cultivation in Madurai district by using the primary data from 112 jasmine growers and 68 FPO (Farmer Producer Organization) jasmine growers to compare costs, returns, and financial feasibility. The research reveals that the total establishment cost for jasmine farmers was lower for FPO jasmine farmers due to the bulk purchasing of materials, lowering their per-unit costs. The study concludes that FPO membership provides jasmine farmers with financial advantages, including lower costs and higher returns, making

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jasmine cultivation highly profitable and economically feasible. The research recommends that farmers be encouraged to adopt FPO models and invest in jasmine cultivation, supported by appropriate marketing facilities and bank finance to maximize returns.

Trade Performance and Export Competitiveness of Horticultural Commodities of North East India (NEI)

Jiaul Hoque and Ram Singh[1]

The study utilizes secondary data and applies various analytical tools like growth, instability index, Revealed Comparative Advantage (RCA) and Revealed Symmetric Comparative Advantage (RSCA) to evaluate trade performance and competitiveness of horticultural crops in NEI. While the export of horticultural commodities from NEI has shown positive growth, there is significant year-to-year instability in export volume. Fresh fruits and vegetables exhibit higher export percentages than processed products, although processed items show an increasing trend. The exports are more volatile in quantity than in value. The RCA and RSCA indices suggest that NEI is competitive in the global fresh fruit and vegetable market. However, processed horticultural products from NEI have shown less stability and lower comparative advantage, with some improvement in recent years. The paper concludes that despite the current challenges, NEI's horticultural sector has significant export potential, especially given the region's strategic location near several international borders. The study recommends the development of infrastructure and trained human resources to meet global standards and enhance the region's international trade capabilities.

International Trade Performance of Apple Crop in India

Madhulika Thakur[2], Subhash Sharma[2], Pardeep Singh[3] and Divyanshu[2]

The study analyses India's apple trade, focusing on the production, export, and import dynamics from 2009-10 to 2023-24. It highlights a declining trend in apple exports from India, both in quantity and value, with exports accounting for only 0.68 per cent of global apple exports. Conversely, apple imports have steadily increased, driven by insufficient domestic supply and rising consumer demand. The major apple-importing countries to India include Iran, Turkey, Afghanistan, Italy, and Poland, with Iran and Turkey being the largest suppliers. The study also revealed a high instability in apple exports, with more stability observed in imports, indicating a growing trade deficit in the apple sector. During the peak harvest season, Indian apples face less export competition, but the overall trade balance remains negative due to rising imports. While traditional exporters like the USA and China retain a significant share of the Indian

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market, new players like Iran and Turkey are gaining ground. The study emphasizes the need for policy interventions to boost domestic production and enhance the competitiveness of Indian apples in the global market.

A Comprehensive Analysis of Onion Price Volatility Using the FIGARCH Model to Account for Long Memory Effects

Chirajnit Mazumder[1], Pradip Kumar Sahu[2], Anbukkani Perumal[1] and T.N. Srinatha[3]

The study uses the Fractionally Integrated Generalized Autoregressive Conditional Heteroscedasticity (FIGARCH) model to examine the price volatility of onions in India by using minimum and modal onion prices from the Kolkata market from January 2014 to March 2020. Initial analysis using ARIMA models indicated the presence of significant autocorrelations in the residuals, suggesting the need for a more robust model to capture conditional heteroscedasticity in the data. The FIGARCH model, capable of handling such complexities, was fitted to the data. The results demonstrated that the AR (1)-FIGARCH (1 d 1) model effectively captured the long memory characteristics in the volatility of onion prices. The model's predictive performance was validated using RMSE (Root Mean Square Error) and MAPE (Mean Absolute Percentage Error), which showed strong forecasting accuracy. The paper concludes that the FIGARCH model is valuable for understanding and forecasting price volatility in agricultural markets, particularly for commodities like onions where long-memory effects are significant.

Growth Trends and Economic Interlinkages of Indian Horticulture Sector: A Comprehensive Analysis

Mareena Alex[4], Sanjeev Kumar[4] and Shaminder Kumar[5]

The study examines the evolution of India's horticulture sector from 2001-02 to 2022-23, highlighting its significant growth in area, production, productivity, and output value. The study underscores the increasing consumer demand for horticultural products, driven by rising incomes, urbanization, and shifting dietary preferences towards fruits, vegetables, and other high-value crops. It also discusses the infrastructural challenges the sector faces, particularly the inadequacy of cold storage facilities, which leads to significant post-harvest losses. The analysis reveals a long-run relationship between horticulture production, food grain production, and India's Gross Value Added (GVA), indicating that these sectors are economically interlinked. However, the study found no significant short-run relationship between these variables,

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likely due to structural differences in production and market dynamics. It concludes that while the horticulture sector has shown impressive growth, there is a need for continued policy support, investment in infrastructure, and adoption of advanced technologies to sustain and enhance its contribution to the Indian economy. Addressing these challenges will be crucial for the sector's long-term sustainability and ability to drive India's agricultural growth and economic development.

Adoption of Circularity Principles in the Horticulture Sector for Value Creation and Sustainable Development: Case-based Insights

Kavita Shrikant Vadrale and Priyanka Tarapurkar[2]

The paper explores how applying circular economy principles in horticulture can lead to economic and environmental benefits by focusing on seven nurseries in the Kolhapur and Sangli regions of Western Maharashtra, India. All seven nurseries implemented the 3R principles to varying degrees and reaped significant monetary and derived benefits. The study calculates both direct and derived monetary benefits from these practices. Furthermore, the study highlights that the adoption of these circularity practices directly contributes to seven of the 17 Sustainable Development Goals (SDGs), including no poverty, clean water and sanitation, affordable and clean energy, decent work and economic growth, industry innovation and infrastructure, sustainable cities and communities, and responsible consumption and production. It advocates for wider adoption of circular economy principles in horticulture, emphasizing that such practices support sustainable development and create significant economic value for nurseries.

Horticulture for Agrarian Transformation? A Case of Kinnow Cultivation in Indian Punjab

Gurpreet Singh[3] and Nivedita Sharma[4]

This paper offers insights into the dynamics of crop choices, economic considerations, and marketing structures, emphasizing the complex interplay between environmental concerns and farmers' risk perceptions in crop selection. Focusing on Kinnow and comparing it with paddy, the study assesses its cultivation prospects and challenges as an alternative and sustainable crop. It unveils the persistent adoption of paddy amidst the agrarian crisis and its ecological concerns. Findings from a primary survey reveal that operational challenges, market uncertainties, and gaps in institutional support make it a risky venture, prompting continued preference for stable paddy cultivation. To unshackle the chains of wheat-paddy mono-cropping, policies should prioritise the development of an effective institutional marketing system and public

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investment in post-harvest infrastructure, such as secondary processing units and effective supply chains

Improving Farmers' Income through Price Forecast: A Case of Potato Prices in Uttar Pradesh

D. Abinayarajam [1], Jasmeet Kaur[2] and Rakesh Singh[2]

This study uses ARIMA models to forecast potato prices in the key markets of Uttar Pradesh, covering Agra, Aligarh, Mathura, Etah, Mainpuri, and Firozabad. Monthly wholesale price data from January 2013 to December 2023 was analyzed, and normality and stationarity tests were applied to ensure the data's suitability for ARIMA modelling. The best-performing models were identified using Mean Absolute Percent Error (MAPE) and Root Mean Square Error (RMSE). The ARIMA {(2,0,0) (2,0,0) [12]} model was found to be the most suitable for Agra, with variations for other markets. The forecasted prices show an increasing trend across all markets, especially during the latter part of the year. These findings underscore the importance of predictive models in agricultural price forecasting. By utilizing these models, farmers can make informed decisions on when to sell their produce, maximizing profits. Additionally, the results can aid policymakers in crafting price stabilization policies, ultimately benefiting the agricultural sector and farmers' livelihoods.

Univariate Long Short-Term Memory for Vegetable Price Forecasting in Varanasi

M. Manjubala, Abhishek Singh and Sunil Jhade[3]

The paper explores using Long Short-Term Memory (LSTM) models to forecast the prices of perishable crops like vegetables, focusing specifically on potatoes and tomatoes in Varanasi, Uttar Pradesh. The study involved collecting weekly wholesale price data for potatoes and tomatoes from 2016 to 2022 and evaluating the performance of LSTM against traditional models. The findings revealed that the LSTM model outperformed other models, showing lower Root Mean Square Error (RMSE), Mean Absolute Error (MAE), and Mean Absolute Percentage Error (MAPE). The Diebold-Mariano test further confirmed the superiority of LSTM, indicating significant differences in performance compared to other models. It concludes that LSTM offers a more accurate and reliable method for forecasting vegetable prices, which is critical for farmers, policymakers, and agribusiness. Accurate price predictions can help farmers make informed decisions about planting and selling crops, ultimately leading to better income stability and market efficiency. The study also emphasizes the need

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for proper tuning of hyperparameters and a large dataset to fully leverage the capabilities of LSTM models in agricultural forecasting.

Socio-Economic Impact of Rural Tourism on Livelihood of Local Horticulture Growers: A Case Study from East-Khasi Hills District of Meghalaya

Bhaskar J. Bhuyan and Ram Singh[1]

The paper explores the relationship between rural tourism and the income distribution and food security of horticulture growers in the region. Rural tourism, particularly in Mawlynnong (a tourism village), has been found to diversify income sources and improve livelihoods for horticultural growers. This study compares income levels and food security between Mawlynnong, which has embraced rural tourism, and Nongsohphan, a non-tourism village. Data were collected from 100 respondents across both villages. Key findings indicate that although income inequality is higher in the tourism village, average household income and per capita income are significantly greater compared to the non-tourism village. Tourism fosters markets for local produce and helps enhance nutrition through improved access to fruits and vegetables. The study further reveals gaps in food and nutrient consumption, noting that both villages face deficits in critical areas like protein and fat intake, with tourism slightly improving overall nutrition levels.

Fennel Growth Story in India

Reshmi Ganguly[2], Mohini Aggarwal[3] and Anjana Singh[2]

The paper explores India's prominent role as a leading producer and exporter of fennel. As awareness of fennel's medicinal and culinary benefits grows, its demand is rising globally. This study analyzes the production trends of fennel in India, focusing on the growth in cultivated area, production volume, and export revenue from 2006-07 to 2022-23. Using empirical models, the paper calculates the growth rates and instability indexes for these variables, highlighting medium instability in cultivation and production but significant instability in export revenue. The research also discusses challenges, such as fluctuating prices and competition, while showcasing successful case studies that illustrate improvements in fennel quality and yield through research and innovation. The authors propose initiatives to stabilize export prices and encourage sustainable cultivation practices, such as organic farming and better irrigation techniques. The study concludes with suggestions to enhance fennel production and export potential, which could boost India's economy and meet the rising global demand for this versatile crop.

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Study on Forecasting of Indian Onion Export Price Using Machine Learning Techniques Based Hybrid Models

Sunil Jhade, Abhishek Singh and M. Manjubala[1]

The study explores onion price volatility and forecasting in India, the largest producer and second-largest exporter of onions globally. Onion prices in India are highly unstable due to supply shocks, leading to financial losses for farmers and affecting exports. The paper proposes hybrid models to improve forecasting accuracy, comparing traditional models like ARIMA, TDNN, and SVR with hybrid machine learning models (EMD-ARIMA, EMD-TDNN, EMD-SVR, and their ensemble versions). Using monthly onion price data from 2008 to 2021, the authors decompose the data into intrinsic mode functions (IMFs) using Empirical Mode Decomposition (EMD) and Ensemble EMD (EEMD) to address non-linearity and non-stationarity. The models are evaluated using metrics such as RMSE and MAPE, with the EEMD-SVR model outperforming other models, yielding the lowest error rates. The study concludes that hybrid models significantly enhance price forecasting accuracy, aiding policymakers and farmers in minimizing market risks and improving export strategies.

Market Dynamics of Walnut in Jammu and Kashmir

Faheem Jabbar Bhat[2], Anil Bhat[2], Pawan Kumar Sharma[2], Manish Kumar Sharma[2], Sajad Abdullah Saraf[3], Malika Sharma[2] and Eva Sharma[2]

The paper investigates the seasonality, pricing, and marketing patterns of walnuts in the region, which accounts for over 80 per cent of India's walnut production. Walnuts are a significant economic resource in Jammu and Kashmir, contributing to foreign exchange and regional livelihoods. The study analyzes the seasonal fluctuations in walnut arrivals and prices from 2012 to 2022, highlighting that the peak arrival months are October and November, with price variations depending on market dynamics. Two major marketing channels are examined: Channel I involves direct sales to local retailers, while Channel II includes sales through forwarding and commission agents. The producer's share in consumer prices ranges from 52.70 per cent to 67.41 per cent for Channel I and 60 per cent to 62 per cent for Channel II. The marketing efficiency is higher in Channel II, particularly in the Kashmir region, which reaches 5.79. The paper concludes that despite the region's dominance in walnut production, improvements in marketing strategies and government support are crucial for enhancing profitability and sustainability in the walnut industry.

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Impact of National Horticulture Mission on the Status of Beneficiary Farmers in Tiruchirappalli District of Tamil Nadu

K. Gokulpriya, A. Pouchepparadjou, N. Swaminathan, S. Parthasarthy and M. Umamageswari[1]

The study evaluates the National Horticulture Mission's (NHM) socio-economic impact on farmers in the Tiruchirappalli district. Initiated by the Government of India in 2005-06, NHM aims to promote comprehensive horticultural growth through forward and backward linkages, with active participation from farmers and private entrepreneurs. The program provides credit-linked back-ended subsidies for infrastructure development, improving farmers' livelihoods. The study used a multi-stage random sampling technique to collect primary data from 60 beneficiaries and 60 non-beneficiaries, focusing on costs, returns, income, employment, and infrastructure. The findings reveal that NHM significantly expanded land use for horticulture and led to a notable increase in income for beneficiaries due to technological support and resources provided by the mission. Beneficiaries experienced improvements in occupation, income, savings, material possessions, social development, and employment generation. The technological interventions under NHM boosted horticultural production and enhanced the overall socio-economic status of the participants. The study concludes that NHM has positively impacted rural development and the livelihoods of farmers in the district.

Is Cashewnut a Hard Nut to Crack: Insights from the Production Scenario of Raw Cashewnuts in India

Chandrakumar Aswathy[2], C. Thamban[3], S. Jayasekhar[3], Priyanka Singh[4], M. Hema[5], E. Eradasappa[2], V. Thondaiman[2], Nishad Jyoti [2], T. N. Raviprasad[2] and J. Dinakara Adiga[2]

The paper analyzes the trends, instability, and growth patterns in raw cashewnut production across India’s major cashew-growing states over the last five decades. The study uses Hazell's decomposition analysis to assess the effects of changes in area, yield, and variability on production growth. Findings reveal that cashew production has increased at a decelerating rate with a compound annual growth rate (CAGR) of 4.01 per cent from 1971-72 to 2020-21, driven primarily by an expansion in the area under cultivation. Maharashtra leads in production but exhibits the highest instability, while Kerala shows a negative growth rate in both area (-1.02 per cent) and production (-0.93 per cent), signalling a need for intervention. The study emphasizes a multi-pronged approach to increase domestic cashew production and

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sustain the Indian cashew industry, including better research, genetic improvements, and enhanced extension services for farmers. Reviving cashew cultivation in underperforming states like Kerala is crucial for the overall growth and sustainability of the sector.

Economic Analysis of Ornamental Plant Nurseries in Kangra District of Himachal Pradesh

Dev Shaynee Vashisath[1]

The study attempts to analyze the economics of ornamental plant nurseries in the Kangra district of Himachal Pradesh. A sample of 40 nurseries was selected by simple random sampling. Annuals, perennials, houseplants and bulb plants were the main ornamental plants in the sample nurseries. On average, the total number of all pot plants per sample nursery stood at 34510 in the study area, of which annuals accounted for the maximum proportion of total ornamentals, followed by house plants and perennials. The total cost of raising ornamental plants, which includes fixed and variable costs, was estimated to be Rs. 958339 per nursery. Expenses on human labour and planting material/seed formed the major component of the total cost. The NPV of the ornamental plants at a 10 per cent discount rate was Rs 30.15 lakh and the BC ratio for all pot plants at 1.49. The internal rate of return was 255 per cent for ornamental plants. Low level of awareness, lack of skilled labour and lack of technical know-how and trainings emerged as the major problems in the production/raising of ornamental plants. The study emphasized improving the awareness level of nursery owners through concerted extension education efforts, including demonstration trials.

Total Factor Productivity and Returns to Investment in Acid Lime Research in Maharashtra

Rohini Ashok Vilhekar[2], V. G. Pokharkar[2] and V. K. Garande[3]

In the study, the Total Factor Productivity (TFP) indices for acid lime were calculated using the Tornqvist-Theil Index pertaining to the period 1994-95 to 2018-19. The factors contributing to TFP growth were also assessed for this time frame. A stagnating but positive TFP growth rate was observed, indicating inefficient allocation of inputs in acid lime cultivation. During the first period (1994-95 to 2005-06), TFP grew at an annual rate of 2.17 per cent. This improvement in TFP is likely due to non-input factors such as investment in research, increased cropping intensity, and balanced fertilizer use. Research investment, cropping intensity and balanced fertilizer use were the key contributors to TFP growth in acid lime. One rupee invested in acid lime research generated an additional ₹ 17.49, demonstrating high returns on research investment in Maharashtra. Thus, it is recommended that the government allocate more funds to public research on acid lime to enhance productivity.

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