32nd Annual Conference of
Agricultural Economics Research Association (India)
on

Digitalization of Agriculture for Higher, Sustainable, and Inclusive Growth

11-13 December 2024

Abstracts

Organized by

Agricultural Economics Research Association (India), New Delhi

in collaboration with

Indira Gandhi Krishi Vishwavidyalaya, Raipur

ICAR-NIBSM, Raipur

32nd Annual Conference of
Agricultural Economics Research Association (India)
on
Digitalization of Agriculture for Higher, Sustainable, and Inclusive Growth

11-13 December 2024

Abstracts

Organized by

Agricultural Economics Research Association (India), New Delhi

in collaboration with

Indira Gandhi Krishi Vishwavidyalaya, Raipur
ICAR-NIBSM, Raipur

Abstracts: 32nd Annual Conference of Agricultural Economics Research Association (India)

Published by:
Anjani Kumar
Secretary, AERA
on behalf of
Agricultural Economics Research Association (India)

Digitalization of Agriculture and Adoption of Improved Technologies

Why digitalization matters? challenges ahead in the context of India agriculture

K K Datta[1*] and U K Bhattacharya[2]
[1]Manipur University
[2]Institute of Development Studies Kolkata (IDSK)
Email: kkdatta2007@gmail.com; uttam.bhattacharya@gmail.com

Innovative farmer centric digital services will increase economic efficiency and competitiveness through its transparency by creating businesses and new products for enlarging the scope of business. The policy focus is by nurturing the processes and frameworks in digital technology greatly helped by solving the irreversible and transformational change. It's added the value of connectivity through accepting the challenges relating to increasing financial inclusion, improving governance, empowered society and a knowledge-based economy. It also helps to bridge the gap between farmers and consumers by reducing its dependency on intermediaries for fair pricing. Improved connectivity not only boosts farmer income but also promotes economic inclusivity by enabling smallholders to participate actively in the market. Growth has been inclusive with a reduction in unemployment and multi-dimensional poverty and an increase in labour force participation. Overall, the Indian economy looks forward by anticipating broad-based and inclusive growth embedded with *Atmanirbhar Bharat i*n terms of targeted relief to different sectors of the economy and sections of the population, and structural reforms that assisted a firm recovery and increased the medium-term growth potential. Despite increase in per capita food production, some sections of the population still suffer from under nutrition and malnutrition. This situation necessitates a paradigm shift in agriculture through digitalization, which opens up opportunities. New sphere of science and technology, information, communication technology (ICT) and agri business have built a potential to transform agriculture production and post-harvest activities. Significant changes have been found on the demand side, with consumer preferences shifting towards healthy, safe, trait-based and quality food and biosphere. These changes indicate that the future of agriculture (and those engaged with these sectors) might enjoy profound transformation in the coming decades through digitalization by tapping its unexplored potential for gainful employment generation. New jobs might emerge near and outside the farms. Grading, processing, packaging, transporting, warehousing g and retailing of produce or the supply of inputs and services to farmers can found a new world. It requires re-imagining agriculture and a vision of the "farm as a factory" producing crops that are raw material for further value addition. There is a need to create an enabling environment for this transition. Appropriate policies and institutions an enabling regulatory environment, development of frontier technologies, as well as public and private investments in agriculture and agri-business are the emerging needs of the present decade. This will enable agriculture to play a key role in achieving the goal of *Viksit Bharat*, inclusive development, green growth and gainful employment during *Amrit Kaal*.

Keywords Agriculture, digitalization, employment, inclusive growth, informal sector, sustainable development

Agri-retailers' preference for mobile-based payment system: breaking the digital divide across the rural and urban India

SM Feroze[1*], Akash Priyadarshi[2], Shiv Raj Singh[3], Sanjiv Kumar[1], PC Meena[1] and S Yuvraj[4]
[1]ICAR-National Academy of Agricultural Research Management, Hyderabad
[2]Central Agricultural University, Imphal
[3]Bihar Animal Sciences University, Patna.
[4]Karur Vysya Bank Pvt. Ltd., Villupuram District, Tamil Nadu
Email: feroze@naarm.org.in

The acceptance and adoption of mobile-based payment systems (MBPS) among agricultural retailers of India are of critical importance in the evolving digital landscape of the country. This study aims to identify the key demographic and socioeconomic factors influencing the acceptance of MBPS by agricultural product retailers/sellers. Primary data were collected from 1,472 agriculture retailers through offline surveys, employing a structured questionnaire with two set of schedules. The findings of this research highlight the pivotal role of education and age in shaping the acceptance and utilization of mobile-based payment systems among agricultural retailers and reveal that users exhibit a high level of trust and satisfaction with mobile payments, although usage frequency varies. Non-users demonstrate a readiness to embrace mobile payment systems, but barriers such as limited digital literacy and concerns about trust hinder adoption. Both users and non-users express a continued preference for cash payments. To encourage broader adoption, efforts should focus on raising awareness, addressing security concerns, and improving accessibility and trust in mobile payment systems. The study recommends that further in-depth exploration of barriers and motivations, and the digital literacy among the non-users which can contribute to the development of effective strategies for promoting MBPS adoption.

Keywords Mobile payment, UPI, agricultural retailers, digital, logit

Analysis of ascertain information provided by KMAS and usefulness of the messages as perceived by the beneficiaries

Akash Tiwari[1*], Hulas Pathak[1], V. K. Choudhary[1] and Chandra Kumar Verma[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: akashtiwari7321@gmail.com

The study on Kisan Mobile Advisory Services (KMAS) reveals that this innovative agricultural extension initiative has been successful in delivering valuable information to farmers in India. Many beneficiaries, who were predominantly middle-aged, educated, and engaged in agriculture as their main occupation, found messages on crop protection, particularly insect and disease management, to be most useful. However, despite the usefulness of KMAS, several constraints were identified, including the use of technical terminology, limited access to relevant information, risk aversion, poor connectivity, and difficulties in operating mobile devices. To overcome these challenges, beneficiaries suggested a range of improvements, including receiving messages in local languages, simple and understandable content, regular message delivery, consideration of local needs and preferences, and the provision of voice message facilities. By addressing these concerns and refining the service, KMAS can further enhance its impact on agricultural productivity, farmers' decision-making abilities, and ultimately, their livelihoods.

Driving sustainable agricultural growth: the role of digitalization in enhancing farmers' decision-making and promoting inclusive socio-economic upliftment

Akshita Vashishth[1*] and Sanjay Kumar Joshi[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: akshita.vashishth.9@gmail.com

This study investigates the impact of information-seeking behaviour, willingness to adopt digital technologies, and decision-making behaviour on the socio-economic upliftment of farmers. Using Structural Equation Modeling (SEM), the research analyzes the relationships among these factors, focusing on 300 farmers from Durg district in Chhattisgarh. The findings reveal that the relationship between information-seeking behaviour and willingness to adopt digital technologies is positive but moderate. This suggests that while actively seeking and processing information can influence a farmer's openness to new technologies, the effect is not particularly strong. However, farmers who are more open to adopting digital tools exhibit a moderate to strong positive impact on their decision-making behaviour, indicating that these technologies play a significant role in enhancing decision-making. The most substantial relationship identified is between decision-making behaviour and socio-economic upliftment, demonstrating that farmers with strong decision-making skills are more likely to achieve significant improvements in their socio-economic status. The results highlight the critical importance of decision-making behaviour in driving socio-economic advancement. The study highlights the importance of creating a positive outlook among farmers regarding digital technologies, ensuring they have access to these tools and the necessary support to utilize them effectively. By improving farmers' interaction with information, encouraging proactive information-seeking behaviour, and integrating digital technologies, better decision-making can be achieved. This holistic approach not only promotes their socio-economic upliftment but also contributes to sustainable and inclusive growth in the agricultural sector.

Keywords Information-seeking behaviour, willingness to adopt, digital technologies, digitalization, big data, ICT, innovation, sustainable agriculture, structural equation modeling

Agricultural information access in India: analyzing farmers' preferences, determinants, and disparities

Amit Thakur[1], Prakash G. Athare[2], Priyanka Lal[3], Kamlesh Kumar Acharya[4] and Shweta Bijla[5*]
[1]ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora, Uttarakhand- 263601, India
[2]Institute of Economic Growth, Delhi-110007, India
[3]Lovely Professional University, Phagwara, Punjab- 144411, India
[4]ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi-110012, India
[5]ICAR-Directorate of Mushroom Research, Solan, Himachal Pradesh-173213, India
Email: shwetabijla00@gmail.com

The study explores farmers' access to agricultural information, analyzing their determinants of selecting different information access modes *viz.* digital, physical, and hybrid mode. The data is taken from the NSSO 77th round dataset. The multinomial logistic regression model identifies the key determinants; age, education, landholding size, etc. influencing the choice of information modes. The findings reveal that physical mode of information access is dominant, while digital platforms are utilized predominantly by educated large landholders and hilly region farmers. Results highlight regional and socio-economic disparities in accessing information and calls for policy interventions to improve digital infrastructure, thus, promoting a hybrid approach to ensure equitable access to agricultural information in the country.

Keywords Agricultural information, digital platforms, hybrid mode, determinants, socio-economic disparities

Innovation in agribusiness startups and its impact on farm economy

Siddharth Kumar[1*], A K Gauraha[1], Hulas Pathak[1] and S K Joshi[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: siddharthpisda@gmail.com

The Gross Value Added (GVA) of the agriculture and related industries is projected to reach approximately US$ 275 billion in FY23, making up 15% of the country's overall GVA. The industry has grown at an about 4% CAGR over the last five years, which ends in FY23. Agri-tech is predicted to reach a US$ 13.5 billion valuation by 2023, and the agribusiness sector expects a spike in digital usage. Initiatives from the government, such as the National Agriculture Market (e-NAM) Scheme, Digital Agriculture Mission, and Digital Public Agriculture Infrastructure, are designed to encourage agri-entrepreneurs and promote farmer-centric solutions, hence accelerating the growth of agri-tech. To increase farmer productivity and profitability, the government should work to promote the use of agri-tech solutions including drone-based agriculture, IoT-based real-time data collecting systems, and AI-based precision agriculture. This study, which is exploratory and descriptive in nature, uses a quantitative and descriptive technique to primarily gather secondary data. Revenue was Rs 16.42 lakhs, expenses were Rs 16.17 lakhs, and net income was Rs 0.18 lakh for the fiscal year 2021–2022. Likewise, for the fiscal year 2022–2023, revenue was Rs 30.15 lakhs, expenses were Rs 29.70 lakhs, and net income was Rs 0.21 lakh. On average, however, revenue was Rs 23.29 lakhs, expenses were Rs 22.94 lakhs, and net income was Rs 0.20 lakh. Following an evaluation of their rankings using the average score, it was systematically discovered that quality/quantity (during packaging) was seen as the most significant efficacy, with an average score of 81.30 ranking it first. This was succeeded by raw material, which came in second place with 78.72.

Keywords Innovation, agri- startups, agribusiness, ecosystem, global food demand

Does digital connectivity enhance land productivity? a micro-analysis from Bundelkhand, central India

Bishwa Bhaskar Choudhary[1*], Priyanka Singh[2], Sadhna Pandey[1], Purushottam Sharma[1], Samir Barman[1], Pawan Kumar Gautam[1] and Sachendra[1]
[1]ICAR-Indian Grassland and Fodder Research Institute, Jhansi
[2]ICAR-Central Agroforestry Research Institute, Jhansi
Email: bishwa606@gmail.com

India is increasingly prioritizing agricultural digitalization to foster growth, improve resource management, and promote sustainable development within the sector, however little is known about the causal impact of digitalization on productivity performance within the sector. This study, utilizing cross-sectional data from 633 farmers in the Bundelkhand region and applying endogenous switching regression model, examines the impact of the fundamental digital technology—internet access—on farmers' land productivity. The findings reveal that losing internet access would reduce crop income per acre by approximately INR 5,524.78 for farmers who currently have it, while gaining internet access would boost productivity by about INR 9,328.88 for those who do not presently having the access. However, results from quantile regression also show heterogeneous effects of internet access, with the highest impact in the lowest percentile (10th) group. Therefore, prioritizing disadvantaged groups in expanding internet access can substantially enhance land productivity. Additionally, the study recommends prioritizing increased internet access for marginalized communities, including Scheduled Castes and Tribes. Improving access to primary markets and offering extension and training services would also be imperative for enhancing land productivity in the Bundelkhand region and other areas with similar agro-ecological challenges.

Keywords Internet access, land productivity, endogenous switching regression, Bundelkhand

Digital transformation of agriculture marketing in India-current scenario and opportunities ahead

P Archana[1*] and R Vijayakumari[1]
[1]Professor Jayashankar Telangana State Agricultural University, Hyderabad-500030, India
Email: archanapalamur27@gmail.com

The digital transformation of agriculture marketing in India presents a vital opportunity to address longstanding challenges such as inefficiencies, limited market access, and low farmer incomes, particularly among smallholders. This paper explores the impact of digital innovations—including mobile connectivity, IoT, big data, and AI—on agricultural marketing practices. By facilitating direct connections between farmers and consumers, digital platforms can eliminate intermediaries, enhance price transparency, and provide real-time market information. The analysis highlights key government initiatives, such as the e-NAM platform, alongside private sector contributions that aim to streamline supply chains and empower farmers. However, significant barriers remain, including inadequate digital infrastructure, limited digital literacy, and cultural resistance to change. This paper underscores the need for a holistic approach to digital transformation that prioritizes inclusivity, sustainability, and capacity building within the agricultural sector, ultimately aiming to foster a more resilient and equitable agrifood system in India.

Keywords Digital transformation, agriculture marketing, supply chains, digital literacy

Dashboard for smart monitoring CIFT solar hybrid fish dryer efficiency

Chandrasekar V[1*], Murali S[1], Geethalakshmi[1] and Nikita Gopal[1]
[1]ICAR-Central Institute of Fisheries Technique, CIFT Jn., Matsyapuri P.O., Willingdon Island, Cochin – 682 029
Email: vcsecon@gmail.com

This manuscript presents the development of an Excel-based dashboard designed to visualize the operational efficiency of ICAR-CIFT solar hybrid fish dryers. The dashboard incorporated key metrics such as adoption rates, energy consumption, cost-benefit analysis, and scenario analysis to assess the performance of the dryers under varying conditions. Data were collected from operational records, field surveys, energy consumption logs, and scientific literature on traditional fish drying methods. The dashboard provided real-time visual tools to assist decision-makers and stakeholders in evaluating the economic viability of the dryers. Adoption rates were displayed through regional variations, while energy savings were assessed by comparing solar and electric energy consumption. A cost-benefit analysis broke down revenue from dried fish sales and operational costs for both solar and electric systems, with environmental impact measured by reductions in greenhouse gas emissions. Scenario analysis was also conducted, comparing best- and worst-case scenarios based on solar availability, energy costs, and adoption rates. By highlighting the economic and environmental benefits of solar-powered fish drying technology, the dashboard supported sustainable development goals, including reducing greenhouse gas emissions and promoting clean energy use. The findings offered a comprehensive tool for improving decision-making in fish drying operations, encouraging wider adoption of solar hybrid dryers, and fostering a cleaner, more efficient post-harvest process in fishing communities.

Keywords Solar hybrid fish dryers, excel dashboard, operational efficiency, adoption rates, energy savings, cost-benefit analysis & scenario analysis

A comprehensive study on ICT-based adaptation strategies to cope with climatic shocks among the agrarian community in Chhattisgarh

Devendra Kumar Kurrey[1*], Hulas Pathak[1], VK Choudhary[1], OP Sonvanee[4] and MK Seth[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: drdevendrakurrey95@gmail.com

Climatic risks such as flood, drought, frost, hailstorms, heat and cold wave, causes significant losses of fam income which affect the livelihood of agrarian community. Chhattisgarh is one of the vulnerable state in India. High Temperature reduce the yield while encouraging diseases and pests' proliferation. Changes in rainfall pattern affect farming causing crop failure. Timely availability of weather information and reliable agro-advisories can help to minimize losses in agriculture. ICT based approaches such as applications, websites, email and WhatsApp, text messages, Radio etc. help to carry out to proper management of resources for agricultural practices by minimizing the risks and facilitate optimum crop yield. This study presents the present status while an integrated and scientific approach to identify effective and free available ICT services information. Simple and Average excel tools were used for analysing available data. This study suggests to improve the accuracy and quality of weather information. Timely, local lingual and Location based agro-advisories are much helpful to farming communities.

Keywords Digital agriculture, agro-advisory, climate change, weather information, ICT, climate adaptation

Digital agriculture and ICT: paving the way for sustainable development

Saghir Ahmad Ansari[1] and Alfishan Rehmat[1*]
[1]Aligarh Muslim University, Aligarh
Email: rehmatalfishan@gmail.com

The role of information and communication technology (ICT) in advancing agriculture has become even more necessary. It assists farmers with timely information related to environmental conditions, soil health, and crop management and beyond it, where it has the potential to stimulate growth in agricultural productivity and promote sustainable farming through informed decision-making and resource management. It can stimulate economic development through improved access to markets and knowledge sharing with ICT playing an important role in supporting rural communities. However, challenges concerning to limited connectivity and low computer literacy, these challenges must be addressed to facilitate widespread adoption of ICTs. This paper reviews the relevance of ICTs in farming for rural development, food security, and resilience. Newer technologies such as 5G, AI, and cloud computing provide exciting new possibilities to explore for a robust vision for Indian agriculture that is organized, data-oriented, and productive. ICT in agriculture draws parallels to the "Third Green Revolution," where we have to strive towards more affirmative inclusion of small farm households and women, especially amongst developing countries.

Keywords Information communication technologies, sustainable farming, agriculture, rural development, artificial intelligence

Farmers perception on drone technology application in hill agriculture of Arunachal Pradesh

Miranda Thaimei[1], L. D. Hatai[1] and B. R. Phukan[1*]
[1]Central Agricultural University (Imphal), Pasighat, Arunachal Pradesh -791102
Email: phukan.br@gmail.com

Drones in agriculture give farmers access to real-time data, enabling them to make informed choices on the use of agricultural inputs in hilly regions of Arunachal Pradesh. An attempt has been made in this study to analyse the importance of drone application in agriculture in East-Siang district of Arunachal Pradesh. To study the applications of drone technology related information among the farmers, 60 farmers were selected for the study based on random sampling technique. From the findings of the study, it was revealed that large category of sample farmers, the extent of awareness on drone technology and its application in crop health monitoring, seed planting, crop spraying, weed controlling and disease monitoring was found to be higher than small and medium sized farmers. It was observed that about 42.4 percent large farmers were aware of drone technology application in agriculture of Arunachal Pradesh. However, medium and small farmers were aware of drone technology and its application in agriculture about 30.6 percent and 27.7 percent respectively. Moreover, farmers may use advanced drone technology to help address issues facing agriculture. Data on crop yields, livestock health, soil quality, nutrient assessments, weather and rainfall patterns, and other topics can be gathered using drones. Farms and agribusiness companies in Arunachal Pradesh can increase crop yields, save time, and make better land management decisions that will lead to long-term success by utilizing drone technology. Drones have become an important instruments for gathering sensor data and real-time pictures from agricultural areas, enabling farmers to make educated decisions about the use of agricultural inputs. Research and development are essential to the development of drone technology because they have the ability to mitigate the risks and vulnerabilities related to their application in agriculture. The diverse uses of drones in agriculture need for an all-encompassing strategy that includes integration into current systems, legal frameworks, and research and development. Drone technology's full potential can be realized through increase in its efficacy, efficiency, and acceptability towards sustainable development of agriculture in Arunachal Pradesh.

Keywords Drone technology, supply chain, hill agriculture, Arunachal Pradesh

Financial solutions for farmers: the rise of agri-fintech in India's agricultural landscape

Swati Singh[1*], Pawan Kumawat[1], Subhasis Mandal[1] and Akriti Sharma[1]
[1]ICAR-National Dairy Research Institute, Karnal – 132001 (Haryana)
Email: swatisingh8840@gmail.com

The Indian agriculture sector employs 45.76% of the workforce and contributes 15% to GVA (PLFS, 2023). Despite its significance, accessible, affordable, customized credit remains a challenge. Agri-fintech emerges as a plausible solution, integrating agriculture with financial technology to enhance financing and logistics. This study landscapes global and Indian agri-fintech trends using Tracxn Technologies' database. The results depict that the USA leads with 40 agri-fintech, followed by India with 23, with Maharashtra as an epicenter. Financial and marketing platforms are prevalent business models in agrifintech companies. However, early-stage funding for agri-fintech companies remains inadequate due to risk associated with their establishment

Keywords Agricultural credit, agri-fintech, digital infrastructure, bussiness models

Artificial intelligence for sustainable agribusiness: evidence from emerging economies

Tribhuvan Nath[1*] and Jasmeet Kaur[1]
[1]Banaras Hindu University, Varanasi
Email: tribhwan@gmail.com

This paper aims to examine the transformative role of Artificial Intelligence (AI) in agribusiness particularly from an emerging economy perspective. The existing literatures have extensively discussed the potential of AI in improving agricultural productivity, optimizing farming practices and profitability for all stakeholders. However, there have been limited evidences on ongoing experiments and practices involving AI in agribusiness operations such as increasing efficiency of agri-food supply chain, achieving operational excellence in food industry and sustainability. This study analyse the some selected cases on AI application in agribusiness particularly from some emerging economies where agricultural development is key for country's socio-economic development and food security including poverty reduction. The study has also discussed the potential future applications of AI in agribusiness.

Keywords Artificial intelligence (AI), agribusiness, emerging economies

SaaS-based agri solutions and their impact on farmers' price realization in India- a case study of potato growers of Haryana

Sagar U Kolkur[1], Akriti Sharma[1*], Praveen K.V[1], Alka Singh[1], Girish Kumar Jha[1] and Sitaram Bishnoi[1]
[1]Indian Agricultural Research Institute, New Delhi- 110012, India
Email: aakritinankur@gmail.com

Agriculture in India has evolved significantly beyond the mere cultivation of essential food grains, transitioning from import dependency to self-sufficiency. Startups have introduced innovative solutions and disruptive technologies, transforming the agricultural landscape by connecting producers and consumers while addressing supply chain inefficiencies. Specifically, Software as a Service (SaaS)-based agriculture emerges as a viable solution to meet increasing demands and tackle pressing issues such as resource depletion and environmental concerns. The focus of the study is to evaluate the impact of SaaS-based agricultural startups on price realization for farmers in India and to provide a comprehensive overview of these innovations in the global and Indian agricultural landscape. By analyzing both primary data of potato farmers in Haryana region and secondary data obtained from Tracxn Technologies database, this research provides a comprehensive overview of global and Indian SaaS-based agricultural startups, utilizing descriptive statistical tools and the difference-in-differences technique to assess their impact on price realization for farmers. Key findings outline the geographical, incorporation, funding and business landscape in the global and Indian scenario. The results reveal that the USA leads in SaaS agriculture startups, with Karnataka at the forefront in India. It also highlighted the dominance of croptech sector in terms of funding and number of companies working in it. E-market place was also found as an important sub sector of the whole SaaS based spectrum where, the study indicates that farmers using these platforms achieve higher prices—approximately Rs 1.87/kg above traditional mandi rates. This highlights the transformative potential of SaaS technologies in redefining India's agrarian economy and enhancing the economic welfare of farmers.

Economics of digital technology in production of dragon fruit in Solapur district of Maharashtra

Snehal Sathe[1*], M. S. Jadhav[1], Aniruddha Barve[1] and P. N. Ayare[1]
[1]College of Agriculture, Kolhapur, Maharashtra
Email: sathesnehal33@gmail.com

Maharashtra leads in dragon fruit cultivation in India, thanks to its varied climate that spans coastal areas to hilly regions, creating an ideal environment for the fruit. Key cultivation areas include Solapur, Sangli, Ahmednagar, Pune, Nashik, and Satara. The state government supports dragon fruit farming through subsidies and various assistance programs, making it an attractive option for farmers. In particular, Solapur district has emerged as a significant hub for dragon fruit farming. The district's farmers have embraced this crop due to its high profitability and suitability to the local climate. The region has seen a rise in the adoption of advanced farming techniques and drip irrigation, further enhancing productivity and quality.In this view this study provides a detailed economic analysis of the costs and returns of dragon fruit cultivation through digital technology in the Solapur district of Maharashtra. Solapur district was purposively selected for study because of highest area under dragon fruit. Multistage simple random sampling was adopted, to arrive at 90 farmers which were further distributed equally into three categories based on growing area. For this study, primary data was gathered during the year 2022-23.Input costs across different farm sizes revealed that cement poles and plates constitute the largest expenditure, accounting for about (49%) of total costs across all farm sizes. Seedlings also form a considerable portion of the budget, contributing roughly (17.88%). The total working capital constitutes approximately (74.36%) of the total costs, with little variation across farm sizes. Family labour, both male and female, contributes modestly, with male labour accounting for about (1.32%) and female labour for (0.47%). Overall, the cost structure is consistent across small, medium, and large farms, with only minor variations in the percentage allocation to different inputs. The overall cost (Cost C) across all farm sizes is highest on large farms, ₹ 1086300.25, with medium farms at ₹ 1081931.94, and small farms at ₹ 927125.14. Large farms have the highest output (298.65 quintals), followed by medium (253.69 quintals) and small farms (223.2 quintals). This indicates that while large farms incur higher costs, they also achieve greater output, with significant investments in machine power, manure, and irrigation, alongside higher amortization costs. Large farms have the highest gross returns ¹ 2986500, followed by medium farms ¹ 2536900 and small farms ¹ 2236000. The overall average gross return is ¹ 2586400. Large farms have the highest returns per rupee of investment (3.54), followed by medium farms (3.37) and small farms (3.32). The overall average return per rupee of investment is 3.42. The R^2 value of 0.70 indicates that 70 per cent of the variation in dragon fruit production can be explained by the included variables, suggesting a fairly strong fit for the model.Manure and potassium have a significant positive impact on dragon fruit production. By using digital technologythe increase in the return of dragon fruit growers was 22 percent and reduced cost by 20 percent at overall level. Also, the benefit cost ratio will be increased to 5.35.

Keywords Dragon fruit, establishment cost, return, profit, Solapur

IoT based agriculture: timeline, current landscape, impact and challenges

M.J.S.L. Naga Durga [1]*, V K Choudhary[1], Lalenpuii[1] and Manoj Kumar Dara[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: jaanumoturi@gmail.com

The Internet of Things (IoT) integrates various advanced technologies, such as wireless sensor networks, cloud computing, and big data analytics, to address critical challenges in agriculture. With global population growth, resource depletion, and climate variability increasingly threatening food security, the transition to smart agriculture is imperative. IoT and big data solutions offer significant potential to enhance operational efficiency and productivity. However, challenges remain, including high implementation costs, data privacy concerns, and the need for technical expertise, which must be addressed to fully realize the benefits of smart agriculture (Akkaya et al., 2021). This research paper explores current IoT applications in agriculture, their impacts on productivity and sustainability, and identifies key challenges and future directions in this rapidly evolving field.

Keywords Smart farming, IoT devices, sensors, data management, challenges

The global discovery of knowledge on digital agriculture: current status and future research directions

Jabir Ali[1]*
[1]Indian Institute of Management Jammu, Jagti, Jammu – 181221, Jammu and Kashmir, India
Email: jabirali@live.in

This paper analyses the current status of research productivity and the discovery of knowledge on digital agriculture. It also suggests future research directions based on a literature review and bibliometric analysis. The study is based on comprehensive data of 5617 articles from the Scopus database published from 1980 to 2024. The data was analysed to map the research productivity, knowledge discovery, and future research themes using R-Studio and VOS Viewer software. The scientific research on digital agriculture has significantly increased at an annual growth rate of 14.8 percent during 1980 to 2024. The evolution of thematic keywords indicates that the use of remote sensing, geographical information systems (GIS), and image processing were major themes during the first phase, i.e. 1980-2009, which emerged remote sensing, precision agriculture and digital agriculture during 2010-22 and machine learning, deep learning, internet of things (IoT), Smart farming, and digital economy in the recent years. This research provides interesting insights on how scientific understanding of digital agriculture has migrated from basic digital technologies to advanced applications and provides a way forward for future research to strengthen the digital technologies adoption in agriculture.

Keywords Remote sensing, precision agriculture, internet of things, smart farming, digital agriculture

Digitalization of agriculture for higher, sustainable, and inclusive growth; an Indian case study

Badri Narayan Gopalkrishnan[1], Emil Thomas Johny[2] and Athul Chandran Nambiar[3*]
[1]Boston College
[2]Gokhale Institute of Politics and Economics, Pune
[3]Dr. B R Ambedkar School of Economics University, Bengaluru
Email: athulcnambiar@gmail.com

Agriculture used to be a pure labour-intensive sector in its early period before mechanisation took over which brought about several technological changes, increased productivity, cost efficiency and thereby better returns. India being one of the major agricultural powerhouses around the globe with over 2/3rds of its population involved in the agricultural sector, it's necessary that we focus on achieving maximum penetration levels to the small-scale farmers to foster growth and development.

Keywords Artificial intelligence (AI), internet of things (IoT), digitalisation, precision farming

Adoption of digital services and its impact on per capita farm income: a case study of eastern India

Kriti Sharma[1], Sonali Katoch[2*], Soumya Mohapatra[3], Manpreet Kaur and Anjani Kumar[1]
[1]International Food Policy Research Institute, South Asia Regional Office, New Delhi
[2]CCS- National Institute of Agricultural Marketing, Jaipur, Rajasthan
[3]ICAR- Central Institute of Post-Harvest Engineering and Technology, Ludhiana, Punjab
[4]ICAR- Central Institute for Arid Horticulture, Bikaner, Rajasthan
Email: katoch.sonali@gmail.com

Digitalization in the agriculture sector of developing nations acts as a stepping stone to improve efficiency, productivity and profitability of this sector by enabling the farmers' access to crucial information on prices, weather-based agro-advisory and extension services. The current study concentrated on the access of digital technologies to the farmers of Eastern India and their impact on the income level. Primary data was collected from 3375 farmers from thirty-four districts of five states *viz.* Bihar, Uttar Pradesh (East), Jharkhand, Odisha and West Bengal. The findings from the discrete-choice probit model highlighted the importance of UPI/Net banking and agriculture-related platforms in providing better access to education, participation in Krishi Mela, and access to credit through the government's Kisan Credit Card schemes. These services have a significant positive effect on per-capita agricultural income. However, there is a disparity in the adoption of these technologies across farm sizes and marginal farmers lag in the digitalization process. Policies promoting education, particularly digital literacy in schools, could foster greater adoption. Additionally, easier access to credit could help farmers invest in smart devices once they understand their benefits. Furthermore, the availability of agro-advisory services in local languages could enhance the familiarity and accessibility of these digital services among the farmers. There should be a strengthened policy framework to improve capacity-building for Indian farmers to adopt and utilize these digital services to boost the performance of the agriculture sector.

Keywords Adoption, agri related apps, digital services, farm income, impact, eastern India

Solutions for lacunae in AI solutions for boosting agricultural yields

Rajeev Johari[1*]
[1]I.T.S School of Management, Ghaziabad
Email: rajeevjohari@its.edu.in

The future of agricultural research promises a more resilient, efficient, and sustainable food system, driven by scientific innovation and a commitment to addressing global food security and environmental challenges, shaped by a convergence of AI technologies, sustainability concerns, and the need for climate resilience. Sustainable practices like regenerative agriculture and vertical farming aim to restore soil health, improve biodiversity, and reduce reliance on traditional, resource intensive farming techniques. There is growing interest in reducing agriculture's carbon footprint, with initiatives to lower greenhouse gas emissions, develop low emission fertilizers and increase carbon sequestration. This paper suggests solutions to overcoming of gaps in prevailing AI and UAV techniques employed to decrease dependency on traditional agricultural practices towards enhancing productivity of crops.

Keywords Convergence, commitment, challenge, climate, carbon, sustainable, AI and innovation

From farm to future: the impact of smart technology in agriculture

Shubh Laxmi[1*], Dhananjay Kumar[1] and Dilip Kumar Mehto[1]
[1]Bihar Agricultural University, Sabour
Email: shubhlaxmi15@gmail.com

Farming is highly dependent on resources such as soil quality and texture, water resources, seeds, market demands, and most importantly weather conditions. Up to 70% of the water we take from rivers and groundwater is consumed in the food and agriculture sector which is three times more than 50 years ago. Whereas, the demand for water in agriculture is estimated to be increased further by 19% by the year 2050 due to irrigation needs. The increasing demands for irrigation are threatening to dry up the ecosystem. In today's world of combating challenges like climate change and global warming, natural resources are shrinking and seasons are becoming unpredictable. The 500 million smallholder farming households worldwide produce about 33% of the world's food. These farmers face multiple challenges during cultivation from procuring quality seeds to selling harvest at a reasonable price. Often, they lack the required skill set and knowledge to improve productivity and cut financial losses. Farm digitalization is making inroads into the agricultural sector and has gained pace to meet the demands of a growing population. Digitalization of agriculture has become integral to enabling collaboration among various stakeholders and farmers to ensure a successful cultivation cycle.

Keywords Farm, farm digitalization, natural resources, opportunities

Pioneering autonomous greenhouses: Towards AI-driven climate control and energy optimization

Semal Johari[1*]
[1]Gautam Buddha University, Gautam Budh Nagar, Opp. Yamuna Expressway Greater Noida (U.P.)-201312, India
Email: semaljohari80@gmail.com

Greenhouses play a vital role in the Agriculture sector by providing controlled environments that facilitate year-round crop production, protection against extreme weather, and increased crop yields. However, maintaining optimal conditions for plant growth requires constant monitoring and precise control of the temperature, humidity, and carbon dioxide (CO_2) levels, which can be energy-intensive and expensive. With the advancements in Artificial Intelligence, AI-driven solutions are progressively being applied in agriculture to optimize resource usage and improve productivity. This paper aims to explore and evaluate Machine Learning models for autonomous climate control in greenhouses, with a comprehensive focus on enhancing energy efficiency while simultaneously meeting specific crop requirements.

Keywords Greenhouses, agriculture, machine learning, artificial intelligence, temperature, humidity, energy

The equity and sustainability risks of digitalization in agriculture

Lalenpuii [1*], Chintawar Shraddha [1] and M.J.S.L. Naga Durga[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: enic129@gmail.com

The digitalization of agriculture in India offers transformative potential to address long-standing challenges such as low productivity, inefficient resource use, and climate variability. Through various government initiatives, farmers are gaining improved access to markets, better decision-making tools and enhanced resource management capabilities. However, alongside these benefits, significant equity and sustainability risks arise. The digital divide marked by unequal access to technology between smallholder farmers and large agribusinesses threatens to deepen social inequalities, with women and marginalized groups often disproportionately affected. Additionally, digital agriculture poses environmental risks through increased energy consumption and the generation of e-waste, raising concerns about its long-term sustainability. To ensure that the benefits of digitalization are widely shared and environmentally sustainable, policy interventions focusing on rural infrastructure, digital literacy, gender inclusivity, data governance and sustainable technological practices are essential. This paper explores both the potential and the risks associated with the digital transformation of Indian agriculture, offering recommendations for achieving an inclusive and sustainable future.

Keywords Digitalization, digital India, risk, digital divide

Transforming Indian agriculture: digital pathways for growth and inclusivity

M. Srinivasa Reddy [1*] and Sanjit Kumar Rout[2]
[1]Nizamiah Observatory Campus, Begumpet, Hyderabad – 500016, India
[2]Prananath College (Autonomous), Mukundaprasad, Khordha-752057, Odisha, India
Email: msrinivasareddy@cess.ac.in; ms.srinivasa@gmail.com

India's agricultural sector, a vital component of its economy, is experiencing a profound transformation driven by digitalization. As technology revolutionizes agricultural practices worldwide, India's approach to digital agriculture—utilizing innovations such as precision farming, data analytics, mobile platforms, and digitized supply chains—has the potential to enhance productivity, promote sustainable farming practices, and foster inclusive growth for millions of farmers. Given the sector's significant contributions to both employment and Gross Domestic Product (GDP), these digital tools and platforms can effectively address various challenges, including inefficient supply chains, limited market access, and financial exclusion. This review paper discusses the key drivers behind India's agricultural digitalization, the impact of digital tools on productivity, sustainability, and inclusion, as well as the challenges and policy recommendations necessary for an equitable digital transition. By analyzing government initiatives, technological innovations, and farmer adoption trends, this paper aims to provide a comprehensive overview of how digital agriculture can secure the future of farming in India. The paper concludes with a discussion on policies and future strategies needed to maximize the benefits of digital agriculture for India's economic and social prosperity.

Harnessing AI for a sustainable future: a systematic review of innovations in Indian agriculture

Parminder Singh[1], Balaji Parasuraman[2*] Vidhyavathi Arumugam[2] and Satish Chandra Pant[3]
[1]Krishi Vigyan Kendra, Sonipat
[2]Tamil Nadu Agricultural University, Coimbatore
[3]DBS Global University, Dehradun, Uttrakhand
Email: pbalaji@tnau.ac.in

This systematic literature review investigates the role of artificial intelligence (AI) in agriculture within emerging economies, with a focus on India. By analyzing 211 SCOPUS articles through the PRISMA protocol, the study explores how AI integrates with technologies like sensors, the Internet of Things (IoT), and big data analytics to drive sustainable agricultural development. Key themes identified include climate change resilience, precision farming, crop and yield management, natural resource conservation, and digital agriculture. The study highlights four priority areas essential for adaptive agricultural strategies: climate-resilient crops, precision farming, sustainable practices (such as AI-driven irrigation and reduced agrochemical usage), and agricultural policy improvements. This research provides valuable insights for policymakers, researchers, and practitioners, emphasizing AI's potential to transform Indian agriculture into a more efficient and sustainable system.

Keywords Artificial intelligence, Indian agriculture, emerging economies, precision farming, agri policy

Drones vs. tradition: economic efficiency and challenges in modern agriculture

Gowri Shankar R[1] and Malaisamy, A[1*]
[1]Agricultural College and Research Institute, Madurai, Tamil Nadu-625104, India
Email: malaisamy@tnau.ac.in

Indian agriculture, vital to the nation's GDP, employment, and food security, is often limited by labor-intensive, traditional methods. Drones, a promising new technology, can transform this landscape by offering real-time data on crop health, soil conditions, and pest management. This study, focusing on paddy cultivation in Tamil Nadu, compares the impact of drones (UAVs) to conventional methods. Results show that drones can improve economic efficiency by 90%, reduce cultivation costs by 30%, and increase income by 41%. With AI integration, drones are positioned to play a key role in making Indian agriculture more sustainable and profitable.

Keywords Drone technology; paddy cultivation; constraints

Integrating artificial intelligence, deep learning, and robotics in recent agriculture technology

Nirjharnee Nandeha[1*] and Ayushi Trivedi[2]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
[2]Mahatma Gandhi University of Horticulture and Forestry, Sankara, Patan, Durg, Chhattisgarh
Email: aieeeagriculture2024@gmail.com

Agriculture is seen as an important sector of the economy in many countries including India. The fast population growth has made it necessary to satisfy people's nutritional demands. Adoption of smart agriculture is necessary to achieve these food security goals. Convolutional neural networks (CNN) and recurrent neural networks (RNN), two deep learning techniques, have been extensively studied lately and applied in a range of sectors, including agriculture. Artificial intelligence (AI) techniques used in agriculture include fuzzy logic (FL), artificial neural networks (ANN), genetic algorithms (GA), particle swarm optimisation (PSO), artificial potential fields (APF), simulated annealing (SA), artificial bee colony algorithms (ABC), harmony search algorithms (HS), bat algorithms (BA), cell decomposition algorithms (CD), and firefly algorithms (FA). Expert systems, agriculturally designed robots, and data collection sensors are among the topics covered. Nothing in the literature emphasizes the use of deep learning methods and robots in cultivation, monitoring, and harvesting to understand their respective contributions to the agricultural industry and to compare each in terms of popularity and usefulness at the same time. By understanding the extent of AI engaged and the robots used, this work analyses the comparative comparison of three crucial stages of agriculture: cultivation, monitoring, and harvesting.

Keywords Robotics, cultivation, monitoring, harvesting, modern agriculture

Digital innovations in the agriculture sector: improving access to markets through public-private partnerships

Mandas Banjare[1*] and Tanuja Ekka[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: maanbanjare6226@gmail.com

Public Private Partnership (PPP) mode has emerged as an important enabler for the digital transformation of agricultural marketing which is playing a key role in increasing the efficiency, transparency and outreach of agri-markets. By fostering collaboration between government entities, private enterprises and new technological innovators PPPs are bridging the gap between traditional agricultural practices and modern digital tools. These partnerships enable the development and availability of digital platforms for market access, transparency in pricing and supply chain management, benefitting farmers and stakeholders alike. The government's initiatives in association with private sector experts have created e-marketplaces, mobile applications and data-driven solutions that empower smallholder farmers, reduce market inefficiencies and increase their bargaining power. This summary explores key digital attributes driven by public private partnerships (PPP) that demonstrate agricultural market linkages, farmers' incomes and their impacts on the overall agricultural ecosystem Indicates the transformatory potential of PPP in liberalizing access to agricultural markets through digital innovations, paving the way for perennial and conventional development in the agriculture sector.

Keywords Public–private partnerships, digital transformation, technological innovators, stakeholders, smallholder, e-marketplaces

Digital technology in agricultural marketing: global practices, challenges, and opportunities for India

Vinita Kanwal[1], Bitan Mondal [2*] and Arti[2]
[1]Punjab Agricultural University, Ludhiana
[2]Visva-Bharati, Sriniketan, Birbhum, West Bengal
Email: bitan.mondal@visva-bharati.ac.in

Digital technologies are transforming agricultural marketing worldwide, offering significant improvements in market efficiency, transparency, and farmer inclusivity. Technologies such as blockchain, the Internet of Things (IoT), and artificial intelligence (AI) are revolutionizing how agricultural products are marketed, distributed, and consumed by enhancing traceability, reducing transaction costs, and promoting data-driven decision-making. The adoption of these innovations has shown promising results globally, particularly in regions with smallholder farming systems. However, in India, despite the potential for digital tools to bridge critical gaps in agricultural marketing, challenges such as infrastructural limitations, digital illiteracy, and a persistent urban-rural digital divide hinder widespread adoption. Drawing on international experiences, this paper identifies key obstacles and offers strategic insights for integrating digital technologies into India's agricultural sector. It underscores the importance of policy reforms, infrastructural investments, and capacity-building programs to enable smallholder farmers to fully benefit from the digital transformation of agricultural markets, fostering a more inclusive and efficient system.

Keywords Digital agriculture, agricultural marketing, blockchain technology, iot in agriculture, smallholder farmers

Navigating the digital frontier: insights into e-governance and digital agriculture in India- a review

M.J.S.L. Naga Durga [1]*, V.K. Choudhary[1], Lalenpuii[1] and Manoj Kumar Dara[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: jaanumoturi@gmail.com

The digitalization of India's agricultural sector presents numerous complexities. Recent e-governance initiatives, particularly through the National E-Governance Plan for Agriculture (NeGP-A), are fostering significant advancements within this domain. Central to this digital transformation is the India Digital Ecosystem of Agriculture (IDEA) framework, which incorporates Digital AgriStack—integrating various technologies and databases focused on farmers. Despite limited exploratory research on administrative e-governance efforts in agriculture, this review aims to comprehensively examine the evolution, current status, advancements and challenges within this evolving landscape.

Mobile-based agricultural information services: farmers' willingness to pay and efficiency in rice cultivation

Biswajit Mondal[1*], GAK Kumar[1], NN Jambhulkar[1], JP Bisen[2], S.K. Mishra[3], Sudipta Paul[1] and Asit Kumar Pradhan[1]
[1]ICAR-National Rice Research Institute, Cuttack, Odisha, India
[2]ICAR-Indian Agricultural Statistics Research Institute, New Delhi, India
[3]ICAR-Indian Institute of Water Management, Bhubaneswar, India
Email: bisumondal@rediffmail.com

Information is essential for agricultural growth, with ICTs offering valuable support to farmers by enhancing market access and productivity, yet a National Sample Survey reveals that over half of surveyed farmers lack access to modern farming techniques related to rice cultivation, limiting their adoption. This study seeks to map agricultural information sources, evaluate farmers' willingness to pay for rice-specific agricultural data, identify influencing factors, and assess the impact of this information on rice production efficiency. To achieve this, a survey was conducted across eight states - Assam, Bihar, Jharkhand, Chhattisgarh, Madhya Pradesh, Maharashtra, Odisha, and West Bengal - where the ICAR-National Rice Research Institute, Cuttack, has implemented paddy variety demonstrations over the past five years. While traditionally, farmers accessed free agricultural information from various sources, recent years have seen increased popularity of mobile-based services, which provide SMS and voice updates on key topics, including crop cultivation, fertilizer use, pest control, market trends, weather, and government schemes. The study employs the Contingent Valuation Method (CVM) to gauge farmers' willingness to pay (WTP) for rice-related information. A probit model identifies socioeconomic factors influencing this willingness, and a stochastic frontier production function assesses the technical efficiency of farms utilizing mobile phones for agricultural information versus those that do not. Findings indicate that farmers primarily rely on input dealers, extension officers, societies, television, and newspapers for agricultural updates. While 96% of farm families own mobile phones, only 70% actively use them for agricultural information, and of these, 21% are willing to pay an average of Rs. 30.65 monthly. Factors such as education, family size, landholding, social status, and income significantly affect this willingness, as shown in the probit model analysis. Additionally, the stochastic frontier model reveals that rice-producing households using mobile phones for information access have an efficiency rate of 82.93%, compared to 63.66% for non-users, with the lowest efficiency (59.36%) among those without mobile access, which are further influenced by education, land holding size and social position. Using mobile phones for agricultural information greatly improves rice farming efficiency, making expanded mobile-based access a promising avenue for boosting productivity, income, and rural livelihoods.

Key words ICT, SMS, Contingent Valuation Method, Probit Model

The evolution and effectiveness of direct benefit transfers: a systematic review

Chintawar Shraddha[1*], Lalenpuii[1], Rayirala Rakesh[2] and Chikkulapally Shekhar[2]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
[2]Professor Jayashankar Telangana State Agricultural University, Hyderabad, Telangana
Email: Shraddhachintawar909@gmail.com

Direct benefit transfers (DBT) have become an essential tool for the implementation of welfare schemes, aiming to minimize inefficiencies and ensure direct delivery of benefits to beneficiaries. The systematic review traces the evolution of DBT systems, with a focus on their implementation in developing economies such as India. By reviewing data from existing research, it highlights the impact of DBT on reducing corruption, improving transparency, and enhancing the efficacy of welfare programs. The review also evaluates the technological and policy innovations that have supported DBT systems and assesses their effectiveness through various indicators such as leakage reduction, beneficiary coverage, and user satisfaction. Finally, it examines the challenges and limitations of DBT, such as digital exclusion, poor infrastructure, and grievance redressal mechanisms, while offering suggestions for future improvements.

Keywords Direct benefit transfer, developing economies, digital payments, financial inclusion, leakage reduction, transparency, welfare schemes

The economic implications of drone use in paddy fields in Chhattisgarh: a pilot study

A. K. Gauraha[1*], S. K. Joshi[1], V. K. Choudhary[1] and H. Pathak[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: ajaygauraha15@gmail.com

Drones provide notable benefits in precision agriculture by facilitating the effective application of various inputs such as fertilizers, pesticides, and other chemicals. The study investigates the economic implications of drone technology in paddy farming. The analysis evaluates the costs, returns, and resource utilization efficiency of paddy farmers who employ drones versus those who do not. A multi-stage stratified random sampling method was utilized in the Raipur and Bilaspur districts of Chhattisgarh, encompassing 120 respondents. The findings indicate that paddy farmers utilizing drones saw a 16.04 percent decrease in per acre cultivation costs and achieved greater net income compared to those who do not use drones. The reduction in both the quantity and cost of fertilizer and pesticide usage may be attributed to the consistent application of inputs through drone technology. However, the shortage of human labor was also an unavoidable constraint in paddy cultivation. This new technology appears to be a viable option for promoting sustainable growth in agriculture. To effectively leverage the influence of drone technology in agriculture, it is essential to thoughtfully examine the associated policy implications. Implementing such policies would enhance the advantages of drone technology while promoting its sustainable and socially responsible use as a transformative tool. There is a growing necessity for demonstrations of drone technology at agricultural universities, the department of agriculture, and KVK to investigate the advantages of this innovative technology. It plays a crucial role in improving productivity, promoting sustainability, cutting costs, saving time, and reducing environmental impact.

Keywords Drones Productivity Technology

Smart agri-tech for sustainable farming

Shana Srivalli[1*], Chintawar Shraddha[2] and Pydi Anuhya[3]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: shanasrivalli@gmail.com

The digitalization of agriculture enhanced by smart agri-tech innovations and it is transforming farming by enhancing productivity, sustainability and inclusivity. Leveraging advanced technologies such as IoT, AI, precision farming and data analytics, smart farming optimizes resource utilization, minimizes environmental impacts and improves crop yields. These technologies provide real-time insights into soil health, weather, and crop performance, enabling data-driven decisions that reduce waste and increase efficiency. Additionally, digital platforms offer small-scale farmers access to markets, financial services, and expert advice, promoting equity within the sector. This shift supports food security while aligning with global sustainability goals, fostering climate-resilient practices, and reducing farming's carbon footprint.

Keywords digitalization of agriculture, food security

Role of smart phone applications on empowering Indian farmers and modernizing agriculture

Sadhana Swastika[1] and Madhu Chhanda Kishan[1*]
[1]Odisha University of Agriculture and Technology, Bhubaneswar, Odisha
Email: Madhuchhandakishan@gmail.com

Indian agriculture has shown impressive growth over last few decades. Over 60 per cent of rural households rely on agriculture for their livelihood, making it a critical pillar of Indian economy. Agriculture and it's allied sectors contributes around one third of the nation's GDP, making it one of the largest contributors. Timely access to information is necessary for decision-making in agriculture and allied sectors along with accessibility and cost-effectiveness. Keeping these needs in view, the introduction of apps through mobile phones has transformed agricultural communication. The advantages of mobile phones include: affordability, wide ownership, voice communication, and instant and convenient service delivery. Due to these, there is explosion across the world in the number of mobile apps, facilitated by the evolution of mobile networks and by the increasing functions and falling prices of mobile handsets (World Bank,2012). Various applications regarding crop management, weather information, educational resources, crop health, and fertilizer calculations through multimodal and multimedia delivery using smart phones have been introduced in the field of agriculture. Apps like Pusa Krishi, Kisan Suvidha, IFFCO app, Meghdoot, SHC mobile app play important roles in addressing a diverse array of agricultural challenges. These applications portray the amalgamation of technology into agriculture, sustainability, elevated productivity, and the well-being of India's farming community. The future of agriculture relies on these digital solutions.

Keywords Mobile apps, digital solutions, GDP, SHC mobile app

Enhancing agricultural supply chain management through agri tech and digital marketing integration

Tanuja Ekka [1*] and Mandas Banjare [1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: tanuekka18@gmail.com

Agri-tech and digital marketing together streamline agricultural supply chain management. Traditional supply networks of agriculture faced major problems such as inefficiencies, information gap and lack in transparency (Kumar et al., 2022). With the integration of technology like artificial intelligence, blockchain and (IoT) Internet of Things (Vern et al., 2022) and digital marketing is definitely a solutions to agriculture supply chain management. Social media, e-commerce, and data analytics play an important role in reducing the cost and providing direct access to farmers through consumer. The incorporation of various technologies and digital marketing supports the development of effective, transparent and sustainable agricultural supply chains for all involved parties.

Keywords Agricultural supply chain, IoT (internet of things), digital marketing

Enhancing agricultural efficiency and sustainability with drone technology

Aashi Sarva[1*], Avan Das Sahu[1], Arti Dhruw[1] and Dharni Sahu[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: sarva.aashi@gmail.com

Drones, or unmanned aerial vehicles (UAVs), are transforming agriculture by offering precise crop monitoring, soil analysis, and resource management capabilities. Equipped with multispectral and thermal cameras, drones enable real-time assessment of crop health, soil moisture, and pest detection, allowing data-driven decisions that improve yield and reduce resource use (*Zhang & Kovacs, 2012*). This technology benefits both large and small farms, increasing efficiency while reducing labor costs and environmental impact (*Hunt et al., 2018*). Challenges include regulatory issues and technical requirements. This paper explores the potential of drones to drive sustainable, productive farming (*Tsouros et al., 2019*).

Keywords Drones, UAVs, precision agriculture, crop monitoring, sustainable farming, agricultural technology

AI applications in agriculture: enhancing productivity and sustainability

Arti Dhruw[1*] and Aashi Sarva[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: artidhruw6154@gmail.com

Artificial intelligence (AI) is revolutionizing agriculture by improving crop yield, optimizing resource use, and enhancing sustainability. AI techniques such as machine learning, remote sensing and computer vision enable precision farming, pest detection, and soil health monitoring. These innovations help farmers make data-driven decisions, reduce waste, and minimize environmental impact (*Liakos, K. G. et al., 2018)*. Despite challenges like data accessibility and implementation costs, AI offers significant potential for addressing global food security and climate change. Ongoing research aims to refine these technologies for broader, equitable adoption in agriculture (*Wolfert, S., et al., 2017*).

Keywords AI, agriculture, precision farming, sustainability, machine learning

IoT (internet of things) in smart farming

Yogeshwari Sahu[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: yogitasahu071994@gmail.com

IoT is driving the transformation of traditional agriculture into "smart" agriculture, allowing farmers to leverage real-time data, automation, and advanced analytics to improve efficiency, sustainability, and profitability. The integration of IoT into agriculture is revolutionizing farming practices by enabling smarter, data-driven decisions, improving efficiency, and ensuring sustainability. By embedding sensors, devices, and communication networks into farming systems, IoT enables farmers to gather real-time data and make data-driven decisions and connecting agricultural devices and sensors to the internet, IoT provides real-time data on various environmental factors, crop health, and livestock well-being. This data can be used to automate processes, monitor conditions remotely, and optimize resource usage, leading to improved productivity and sustainability. The future of IoT in agriculture is bright, with advances in AI, machine learning, and 5G networks further enhancing the capabilities of IoT systems.

Keywords Internet, agriculture, efficiency, sustainability

Sowing the seeds of change – cloud revolution in agriculture

Pydi Anuhya[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: anuhyapydi@gmail.com

As there are many emerging technologies in agriculture, among them one of the most prominent technology is Cloud Computing. It's promising role in improving yield, input and irrigation efficiency and promote resilience and sustainability. It help out the farmers with smart agriculture by using cloud data and Internet of Things to make data driven decisions. This computing collect data from satellites, sensors and drones to optimize the usage of resources and helps in crop management effectively. It forms a platform that fosters the collaboration and knowledge exchange among the farmers, researchers and policy makers. By accessing real time data and predictive analysis helps in minimizing risk and enhancing the efficiency. Thus promotes sustainability by reducing adverse environmental effect and ensuring long term agriculture viability.

Keywords Cloud computing, sensors, drones, sustainability

Internet of things and precision agriculture

Anuja Mariya Wilson[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: anujamariya98@gmail.com

To meet the global food demand, modifying the traditional methods with precision agriculture and internet of things (IoT) creates a greater surge in agricultural production. IoT facilitates the connection of a number of devices over internet transmitting the information related to crop conditions, soil nutrient status, irrigation, weather and other environmental aspects even without human interaction. With the use of sensors and optimized resource usage, farmers can make better decisions thereby increasing the profit and reducing the risks. An explorative study to develop cost effective IoT technologies reaching to small scale farmers and rural areas will be a promising tool in agriculture sector.

Keywords Internet of things, precision agriculture, optimum resources, profit, reduced risks

The role of GPS technology in precision agriculture

Avan Das Sahu[1*] and Aashi Sarva[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: avandas119@gmail.com

Global positioning system (GPS) technology is transforming agriculture by enabling precise mapping, field monitoring, and machinery guidance, thus improving farm efficiency. GPS-based systems support site-specific applications of resources like seeds, water, and fertilizers, reducing waste and enhancing crop yields (Swinton & Lowenberg-DeBoer, 1998). This technology also aids in tracking livestock and automating farming operations, making agriculture more sustainable (Zarco-Tejada et al., 2014). This paper explores the applications, advantages, and challenges of GPS in precision agriculture.

Keywords GPS, precision agriculture, site-specific management, farm automation, sustainable farming

Innovation towards digitalization of agriculture in Andhra Pradesh-case of RBKs

A. Boopathi Raja [1*], G. Raghunadha Reddy[1] and Govindhraj[1]
[1]Acharya N. G. Ranga Agricultural University, Guntur, Andhra Pradesh
Email: acboopathi@gmail.com

This study examines the digitalization of agricultural services through Rythu Bharosa Kendras (RBKs) in Andhra Pradesh, established to enhance service accessibility and support farmers. By leveraging digital tools like kiosks, Smart TVs, and the e-Karshak app, RBKs provide essential agricultural information, e-crop booking, and registration for schemes such as crop insurance and Rythu Bharosa. Using a sample of 400 farmers, the study assesses factors influencing participation in these digital services. Results from pooled logistic regression reveal that access to digital infrastructure, gender, age, education, landholding size, and occupation significantly impact participation. The study highlights increased adoption of digital services over time, emphasizing the importance of tailored outreach and streamlined digital infrastructure to strengthen agricultural support for farmers in Andhra Pradesh.

Keywords Participation, pooled logistic regression, rythu bharosa kendras

Short communication: internet of things (IoT) integration in smart farming and its effects on agricultural marketing

Dushyant Kumar[1*], Avan Das Sahu[1] and Dronak Kumar Sahu[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: dushyant98agri@gmail.com

Smart farming is fast becoming adopted in agriculture through the IoT that has facilitated efficient performances, precision, and accuracy. Thanks to the blinks of the IoT technologies wherein sensors, devices and analytics are all inter connected, has enabled precision agriculture, monitoring, and decision-making solutions. Consumer marketing is among the areas in smart agriculture that has been enhanced by integration of IoT as this paper will address. Through the IoT elements currently in place, farmers are now able to obtain more detailed market information on consumers and diversified means of supply chain management and crop production to feed demand. Some of these challenges include connectivity, high initial investment and security of data are highlighted as are some of ways through which IoT adoption in agriculture can be enhanced.

Key words Smart Farming, connectivity, marketing

Short communication: the impact of digital transformation on agricultural cooperatives and farmer organizations

Dushyant Kumar[1*], Avan Das Sahu[1] and Dronak Kumar Sahu[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: dushyant98agri@gmail.com

As a result of digital transformation agricultural cooperatives and farmer organizations are finding a new way of improving its operations, access to market and members. These organizations are enabling efficiencies, such as sourcing products more transparently, supply chain management, and enabling farmers to make informed decisions underpinning digital technology. This paper aims at identifying major effects of digital transformations on agricultural cooperatives, discuss literature, reveal the problem, the option to develop further and the analysis of all innovations. Farming is the principal occupation of about 40% of the world's farmers and due to the advancement in information technology, the application of the same in agriculture is expected to enhance its performance, sustainability, and competitiveness of the small holder farmers**.**

Keywords Digital transformation, cooperatives, efficiency

Role and application of blockchain analysis in distributing agricultural products

K. Muthuvel[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: kmuthuvel215@gmail.com

Blockchain technology has emerged as a transformative solution in various industries, including agriculture. In the distribution of agricultural products, blockchain enables the creation of immutable and transparent records that provide real-time tracking and traceability across the entire supply chain. This paper explores the role and applications of blockchain analysis in distributing agricultural products, emphasizing how it can optimize supply chain management, reduce fraud, ensure product quality, and empower stakeholders such as farmers, distributors, and consumers. The study highlights real-world examples of blockchain applications in agriculture, examines challenges in adoption, and proposes future avenues for integrating blockchain technology to achieve a more efficient, equitable, and transparent agricultural distribution system.

Keywords Application, supply chain management, fair price, challenges

Digital marketing of agricultural produces through social media in Tamilnadu

Muthuvel K[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: kmuthuvel215@gmail.com

The research on social media is a good instrument in agriculture marketing and for farmers. It saves farmers time and money. The study was analysed how farmers used the social media in agriculture. The villages selected randomly in Tamilnadu. The study was based on the primary data of 161 farmers for the year 2022-2023. Farmers are interviewed with the structured questionnaire. The details collected were General characteristics of the sample farmers, Use of mobile phone, Accounts on social media, Aware of government plan through social media, Purposes of social media, Problems faced in social media, Use of social media in agricultural marketing. Facebook, Whatsapp, Youtube are the most likely used social media for pages and profiles. Peoples are less trusted on e-buying, e-selling agricultural commodity on social media.

Keywords Farmers, mobile phone, social media, problems, agricultural marketing

Digitalization of agricultural in Dhamtari district of Chhattisgarh- the case for doubling farmer's income

Narrottam Kumar Sahu[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: sahu.nero03@gmail.com

COVID-19 Pandemics has highlighted the need for more resilient, efficient, productive, remunerative and sustainable agricultural. according ,the govt. of Chhattisgarh It highlight the application of different digital technologies to increase farm yield, improve farm level decision-making ,maximum use efficiency ,and ultimately enhance the income of marginal and small farmers . It is based on analytic ales paper biased on a survey of literature that utilities secondary sources such as book, research article, policy documents, reports published by various govt. and non govt. organization, online database, and discussion papers. The paper suggests that policymakers focus on doubling the farmer's income through different stages of food production and supply chain

Keywords COVID-19, agricultural digitalization, digital, technologies, doubling farmers, public policy

Transforming agriculture: the role of digital systems in marketing of farm produce in Chhattisgarh

O.P. Sonvanee[1]* and Devendra Kumar Kurrey[2]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
[2]LM College of Agriculture & Research Station, Narayanpur (Kerlapal)-494661
Email: omprakashsonvanee@gmail.com

It is known that invention is the mother of development, one of these inventions is information and broadcasting equipment. In India, the National Information Center (NIC) has been responsible for e-governess services and various initiatives of digital India with a national wide advanced, and robust ICT infrastructure. NIC has developed several digital platforms for the country's socio-economic development. Chhattisgarh state is famous for its forest wealth and mineral resources and there is abundant production of crops. According to total area of crops, Paddy (77.47 percent) and Chickpea (5.43 percent) are major crops of Chhattisgarh state. Concerning the state income of Chhattisgarh (Year 2018-19 to advance estimate 2023-24), it was found that the regression coefficient of communication & broadcasting services on agriculture is estimated to be 14.83 and the correlation coefficient was estimated to be 0.97 (Source: Economic Survey 2023-24, DES, Chhattisgarh). The government has also established e-NAM schemes in the country's markets with the help of NIC, which is helping increase farmers' incomes through digital means. To see the impact of this scheme in Chhattisgarh, we have included the income, expenditure, and arrival-related data for 7 years before the scheme was launched and for the next 7 years. The study found that the Compound Growth Rate of arrival (4.42%), income (9.22%), and expenditure (6.56%) more increased significantly before and after the implementation of the scheme (Source: Statistics, Chhattisgarh Mandi Board). The trend that is being seen is going to increase further if the number of farmers registered under this scheme is increased, farmers and traders are encouraged, unregistered traders are controlled and an effective policy is established.

Keywords Digital systems, marketing, income

Krishi bazaar: revolutionizing agricultural market access for farmers in India

Neelam Sunil Tigga[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: neelamsuniltigga@gmail.com

Krishi Bazaar is an online market place that has the potential to bring farmers closer to the customers, suppliers, and service providers. This makes it possible to buy outputs from farmers and sell agricultural inputs directly to them and organizers and at improved prices. It also avails the latest market information to farmers to make a better decision in their selling processes. Launched with the objectives of minimizing cost, increasing efficiency and subsequently ensuring appropriate price that could help farmers, Krishi Bazaar is aimed at enhancing farmers' capabilities to foster the agriculture business.

Keywords Krishi bazaar, agricultural market, supply chain, digital platforms, e-commerce

Digital transforming in agri-marketing

Sahil Naik[1]*, Jyoti Kachroo[1] and Rohit Kumar[1]
[1]Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu - Jammu
Email: sahilnaik226@gmail.com

Agri-marketing's digital revolution transforms the agricultural environment by improving farmers' access to markets, productivity, and profitability. This shift makes use of cutting-edge technology such as blockchain, mobile applications, the Internet of Things (IoT), and artificial intelligence (AI) to optimize procedures throughout the agricultural value chain. Predictive analytics for crop forecasting, real-time monitoring systems, digital platforms that link farmers with customers and markets directly, and precision farming equipment are some of the breakthroughs. These solutions provide fair pricing and quick information access while improving crop planning, cutting waste, and increasing market openness. Additionally, direct farmer-to-consumer transactions are made possible by e-commerce in agri-marketing, which removes middlemen and boosts farmer profitability. Blockchain technology increases accountability and supply chain traceability while fostering stakeholder confidence. Notwithstanding these developments, obstacles still exist, such as farmers' low level of digital literacy, inadequacies in infrastructure, and worries about data protection. To effectively reach small and marginal farmers, digital agri-marketing solutions must be scaled by addressing these difficulties. By combining these digital technologies, agribusinesses may become more resilient, sustainable, and responsive to shifting market needs, which is the way of the future for agriculture.

Keywords Digital revolution, block chain, artificial intelligence, value chain, crop forecasting, digital platforms, e-commerce

Revolutionizing agriculture: agri-tech startups' impact on price and market efficiency

Rahul Sahu[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: sahu27061999@gmail.com

Agri-tech startups are transforming agricultural markets through digital innovation. This study examines their impact on market efficiency and pricing, leveraging data from over 100 startups. The findings reveal significant benefits: digital innovations improve price discovery, reduce information asymmetry, and enhance market transparency. Notably, agri-tech startups achieve a 15% reduction in price volatility, 20% increase in market efficiency, and 30% improvement in farmer revenue. These results underscore the transformative potential of agri-tech startups in optimizing agricultural markets, ultimately benefiting farmers, consumers, and the economy.

Keywords Agri-tech, startups, market efficiency, price discovery, agricultural innovation, digital agriculture

Empowering agri-startups: digitalization of agriculture through virtual mentoring

Sandipamu Raahalya[1*] **and Saravanan Raj**
[1]National Institute of Agricultural Extension Management (MANAGE), Hyderabad, Telangana
Email: sandipamuraahalya@gmail.com

Digital transformation in agriculture presents unprecedented opportunities for achieving sustainable and inclusive growth in the farming sector. This study examines MANAGE's innovative digital mentoring initiatives through three key programs: Agri Startup Saturday Webinars, Digital Marketing Skills Training and Pre-incubation Mentoring Programs. The research analyses comprehensive data from 240 participants (80 participants from each program) to evaluate the effectiveness of virtual mentoring in fostering agri-entrepreneurship. Through structured online learning modules, expert-led webinars, and personalized digital mentoring sessions, MANAGE has created a virtual ecosystem for aspiring entrepreneurs. The analysis focuses on three critical dimensions: awareness creation, knowledge management, and promotion of best practices in the agri-startup ecosystem. The findings demonstrate how virtual mentoring has democratized access to entrepreneurial resources by reducing geographical barriers. The study provides insights into scaling digital mentoring models for fostering innovation and entrepreneurship in agriculture while addressing critical challenges in the agri-startup ecosystem.

Keywords Digital agriculture, virtual mentoring, agri-startups, knowledge management, entrepreneurship development

Bridging the gap: digital platforms connecting farmers to markets

Sanat Kumar Sahu[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: sanatkumarsahu1998@gmail.com

This study explores how digital platforms, notably e-NAM and AGMARKNET, revolutionize farmer-market connectivity in India. By leveraging these platforms, farmers gain enhanced access to markets (50% increase), reduced intermediaries (30% decrease), improved price discovery (15-20% increase), and increased transparency and traceability. Consequently, farmers experience significant benefits, including a 20-25% income boost and 40% improvement in market information. This research provides valuable insights for policymakers and stakeholders seeking to harness digital platforms for inclusive agricultural market development, ultimately empowering farmers and transforming India's agricultural landscape.

Keywords Digital agriculture, e-NAM, AGMARKNET, farmer-market connectivity

Digital marketing in the agricultural sector and strategies for promoting sustainability in agro-based industries: opportunities and challenges

Satyanarayan Soni[1*]
[1]College of Agriculture and Research Station, Raigarh, 496001
Email: zsatyay@gmail.com

Digital marketing represents a contemporary aspect of marketing that utilizes internet-based technologies, including computers, Smartphone's, and other digital tools and platforms, to advertise products and services. Originating in the 1990s, the concept of digital marketing has gained significant traction in the global business landscape, particularly around the mid-2010s. This approach to marketing presents distinct opportunities for the agricultural sector to reach consumers. The marketing mix used to introduce agricultural products to the market must consider the specific characteristics of the agricultural industry. Digital marketing can offer benefits to farmers, such as enhancing the promotion of agricultural products and boosting desirability and sales through various digital marketing strategies. Agricultural businesses are continuing to operate by utilizing a mix of traditional and digital marketing strategies to achieve customer satisfaction. This research examines the various elements that contribute to this and the advantages that can be realized if farmers effectively adopt digital marketing within the agricultural industry. The research encompasses articles sourced from multiple literature platforms using validated keywords. A review of these articles is conducted to explore digital marketing within the agricultural sector and the factors that drive the digital transition of agricultural marketing. The research indicates that for digital marketing techniques to be effectively executed within the agricultural sector, businesses need to concentrate on digital transformation. The research highlights the importance of digital marketing and digital transformation in agriculture. It provides an overview of the benefits and potential of digital marketing strategies in the agricultural field; this primarily serves as a resource for farmers, agriculture researchers, and various stakeholders. By utilizing digital marketing strategies, farmers can enhance their ability to determine prices and lower both production and marketing expenses for their agricultural goods. To achieve this, it is essential to encourage farmers to adopt digital marketing tools in their agricultural practices, and policymakers should formulate strategies to promote the growth of digital marketing in agriculture. The results highlight the role that digital marketing plays in promoting agricultural sustainability and indicate that it is critical to make strategic investments in digital infrastructure, improve data security, and embrace new technologies. Furthermore, to maximize the impact of digital marketing strategies in furthering sustainability goals, joint learning and ongoing review are crucial.

Keywords Farming promotion, online marketing, farming industry, digital tools, approach, digital marketing, sustainability, artificial intelligence (AI), consumer behaviour, environmental conservation, data security

Empowering agri-startups: digitalization of agriculture through virtual mentoring

Sandipamu Raahalya[1*] and Saravanan Raj[1]
[1]National Institute of Agricultural Extension Management (MANAGE), Hyderabad, Telangana
Email: sandipamuraahalya@gmail.com

Digital transformation in agriculture presents unprecedented opportunities for achieving sustainable and inclusive growth in the farming sector. This study examines MANAGE's innovative digital mentoring initiatives through three key programs: Agri Startup Saturday Webinars, Digital Marketing Skills Training and Pre-incubation Mentoring Programs. The research analyzes comprehensive data from 240 participants (80 participants from each program) to evaluate the effectiveness of virtual mentoring in fostering agri-entrepreneurship. Through structured online learning modules, expert-led webinars, and personalized digital mentoring sessions, MANAGE has created a virtual ecosystem for aspiring entrepreneurs. The analysis focuses on three critical dimensions: awareness creation, knowledge management, and promotion of best practices in the agri-startup ecosystem. The findings demonstrate how virtual mentoring has democratized access to entrepreneurial resources by reducing geographical barriers. The study provides insights into scaling digital mentoring models for fostering innovation and entrepreneurship in agriculture while addressing critical challenges in the agri-startup ecosystem.

Keywords Digital agriculture, virtual mentoring, agri-startups, knowledge management, entrepreneurship development

Assessment of digital marketing of inputs to the horticulture sector: a case study of the eastern Uttar Pradesh

Sarvesh Kumar[1]*, Amarjeet Prajapati[1] and Jitendra Kumar Yadav[1]
[1]Shri Durga Ji P.G.College, Chandeshwar, Azamgarh, U. P.
Email: sarvesh6126@gmail.com

This case study investigates the digital marketing strategies used to promote agricultural inputs in Eastern Uttar Pradesh, an area essential to India's horticulture output. The study examines how digital platforms, including social media, e-commerce, and mobile applications, can improve the accessibility and uptake of horticulture inputs, including equipment, seeds/seedlings, fertilizer, and pesticides. The research determines the main factors influencing acceptance, obstacles to overcome, and the efficiency of online marketing in raising sustainability and productivity by examining how local farmers use these digital technologies. The results show that although digital marketing offers a lot of chances for outreach and information sharing, obstacles like internet connectivity, digital literacy, and trust in online platforms still exist. It was further observed that digital credit facilities were offered by preharvest contractors-cum-input suppliers to the growers on pre-sale contracts. Findings indicate that digital marketing significantly enhances visibility and accessibility for horticultural businesses, fostering direct communication with consumers and promoting sustainable practices. The study examines the impact of these challenges on market reach, customer engagement, and overall business growth. In addition to highlighting the potential for scaling digital marketing initiatives to support the growth of the horticultural sector in Eastern Uttar Pradesh, the study recommends improving accessibility, training, and content relevance for local farmers.

Keywords digital, online, marketing, inputs, horticulture

Agri startups in India- a way ahead to success

Siddharth Kumar[1*] and Hulas Pathak[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: siddharthpisda@gmail.com

The basis of study, it is very clear that the government is very serious about the overall development of start-ups in India by creating a full-fledged start-up-ecosystem. India is making progress toward its goal of creating a robust start-up-ecosystem. The government has dedicated ministry (department) committed to assisting start-ups in order to promote and support them. Furthermore, the Indian government has introduced a slew of initiatives aimed at boosting entrepreneurship in the country and providing financial assistance to start-ups. Even in COVID-19 restrictions, Government of India is facilitating start-ups by operating its numerous program (viz., RKVY-RAFTAAR) in virtual mode. India has the 3rd largest startup ecosystem in the world; expected to witness YoY growth of a consistent annual growth of 12-15%, India had about 50,000 startups in India in 2018; Out of these, around 8,900 - 9,300 were technology-based startups which is increasing year by year 1300 new tech startups were born in 2019 alone implying there are 2-3 tech startups born every day. Indian startup ecosystem could see 370 growth-stage startup funding deals in 2023, up only 4.5% from 354 such deals in 2022. Further, the growth-stage funding could touch 740 Cr in 2023, approximately 3.9% less than the 770 Cr raised in 2022. Start-ups are critical for fostering creativity in a society. These entrepreneurs are challenging the dominance of huge corporations not simply via innovation, but also by giving simpler answers to the problems they address. Start-ups have unique ideas. They are always understaffed, never have enough hours in the day, and nonetheless have a pragmatic mindset that drives them to find new solutions to problems. These firms, via their unique approaches, have aided stressed farmers (especially small and marginal farmers) and provide solutions to Indian agriculture's difficulties.

Keywords Startups, RKVY- RAFTAAR, year to year growth

Digitalisation in agriculture: a review of technologies in practice, challenges, and opportunities for farmers in India

Upashna Chandravanshi[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: upashnachandravanshi78@gmail.com

Digital transformation in agriculture is enhancing production, enabling farmers to increase yield, data collection, supply chain management, and automate manual tasks. It facilitates seamless communication and transactions by connecting farmers to dealers, and distributors on a centralized platform. Digital technologies address challenges like unpredictable weather conditions and labour availability by collecting data on weather patterns, market demand and supply, and enabling production approaches. Sustainable agricultural practices like smart irrigation and soil health monitoring using drones and AI are also promoted. Precision farming techniques are adopted, and supply chain management is enhanced with using modern techniques. Digital transformation has enabled key domains of change, including crop management, automatic irrigation systems, livestock management, farm automation, produce monitoring, drone farming, indoor vertical farming, and supply monitoring. This digitalization strengthens communication between stakeholders and enhances visibility along the supply chain, making the process more transparent and efficient.

Key words Digital transformation, supply chain management, efficiency

Navigating the shadows of digitalization: equity and sustainability risks

Upasana Chandravanshi[1]*
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: upashnachandravanshi78@gmail.com

Digitalization's rapid ascent raises critical concerns regarding equity and sustainability. This study investigates the unintended consequences of digitalization, including: exacerbated income inequality (20-30%); Unequal access to digital resources (40-50%); Environmental impacts (e-waste, energy consumption); Job displacement and skill obsolescence. Findings underscore the need for inclusive digital strategies addressing equity and sustainability. Policymakers, corporations, and stakeholders must prioritize targeted interventions to mitigate risks and ensure digitalization benefits all.

Keywords Digitalization, equity, sustainability, inequality, environmental impact

Exploring barriers and enablers to farmers' adoption of digital technologies: evidence from Maharashtra

Sneha Kumari[1], Varun Miglani[1]* and Nisha Bharti[2]
[1]Symbiosis School of Economics, Symbiosis International (Deemed University), Pune
[2]National Institute of Bank Management, Pune
Email: varun.miglani@sse.ac.in

Digitalization is changing agriculture and food systems with technology, including mobile technologies, applications, data analytics, artificial intelligence, services delivered through digital delivery and apps, and the internet. The article explores the factors that affect farmers' adoption of digital transformation. Using observations, surveys, demonstrations and an extensive literature review. We carried out surveys with 35 farmers to understand the perception and adoption of agricultural technologies (including digital technology). Mass media and digital platforms such as Television (news channel), youtube, whatsapp are a key source of information dissemination. Technical demonstration session by Governmnet extension departments or private firms were also important source for farmers to get aware about new technology. Most of the farmers complained of unstable internet access and preferred offline modes of technology demonstration. High prices and lack of understanding about how to use new technology became the major barriers in adopting technology. Half of the respondents perceived that the new technologies may have a small impact on the farm performance. This highlights knowledge gaps and mistrust among farmers. Willingness for digital technology adoption significantly differs across the farmer groups—the attitude toward adopting digital technology change based on the training. The results confirm that once exposed to the knowledge, farmers revealed improved orientation. Therefore, mentoring and training the farmers in the use of technology is essential before implementation.

Keywords Digital transformation, progressive farming, precision agriculture, mobile application

Use of ICTs in agriculture: an overview

Y S Dhruw[1*], Piyush Pradhan[1], V K Markam[1] and Deepak Thakur[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: yuvrajdhruw.igkv@gmail.com

Agriculture is facing continuously new and important problems and challenges. Use of Information and Communication Technologies (ICTs) can be a major intervention for more efficient agriculture. It is in this arena that ICTs can play a very crucial role by disseminating information to farmers to help them make better well informed decisions. ICT services provide critical access to the knowledge, information and technology that farmers require to improve the productivity and thus improve the quality of their lives and livelihoods. ICT helps in growing demand for new approaches. It also helps in empowering the rural people by providing better access to natural resources, improved agricultural technologies, effective production strategies, markets, banking and financial services etc. ICT can help us meet the demand for food, by collecting and sharing timely and accurate information on weather, inputs, markets, and prices, by feeding information into research and development initiatives, by disseminating knowledge to farmers, by connecting producers and consumers, and through many other avenues. The main phases of the agriculture industry are: Crop Cultivation, Water Management, Fertilizer Application, Fustigation, Pest Management, Harvesting, Post Harvest Handling, Transporting of Food/Food Products, Packaging, Food Preservation, Food Processing/Value Addition, Food Quality Management, Food Safety, Food Storage, Food marketing. Technologies composed of ICTs are the blessing to agriculture as they provide the farmers with data, information and knowledge with which they can empower themselves with modern agricultural technology and act accordingly for increasing the production of higher value crops, reduction in expenses of production, increase in selling price, less use of pesticides for vegetables on their farms. This article explores the role of ICT in agricultural sector.

Keywords Information and communication technologies (ICTs), e-agriculture, agricultural production and market information

Impact of agro-meteorological advisory services (AAS) in Haryana

Nisha[1*] and D.P. Malik[2]
[1]ICAR- National Institute of Agricultural Economics and Policy Research, New Delhi
[2]Chaudhary Charan Singh Haryana Agricultural University, Hisar
Email: nishasharma890481@gmail.com

The present study was conducted in Kurukshetra, Sonipat, Kaithal and Karnal districts selected from eastern zone and Hisar, Sirsa, Fatehabad and Bhiwani districts selected from western zone based on maximum number of farmers registered in the m-Kisan portal. A purposive multistage sampling technique was used to select Agro-meteorological Advisory Service (AAS) farmers and non-AAS farmers. In the eastern zone, the increase in net return of paddy and wheat of AAS farmers estimated through propensity score matching was found to be Rs11044.76 ha^{-1} and Rs3596.88 ha^{-1}, respectively. While, in the western zone, the increment in net return estimated through propensity score matching was found to be Rs 7319.28 ha^{-1} and Rs 3494.52 ha^{-1} in case of paddy and wheat, respectively.

Keywords Weather, agro-meteorology, advisory services, impact, net return

Leveraging digital transformation to enhance agri-marketing channels for aloevera producers

Shubham Kumar Thakur[1]*, Shubhi Singh[2], Vaibhav Laxmi Tiwari[3] and Vivek Kumar Singhal[4]
[1]Mahant Bisahu Das College of Horticulture and Research Station, GPM, Chhattisgarh 495117, India
[2]College of Horticulture and Research Station, Kunkuri, Chhattisgarh 496225, India
[3]ICAR-National Institute of Biotic Stress Management, Baronda, Chhattisgarh 493225, India
[4]College of Agriculture and Research Station Mahasamund, Chhattisgarh 493445, India
Email: shubhamcks@gmail.com

The study explores marketing channels used by Aloe vera growers and analyzes related marketing costs and intermediary margins across different pathways. Three primary channels were identified: Channel A (direct sale to processors/industries), Channel B (sales via Self-Help Groups (SHGs) or societies to processors), and Channel D (sales through local traders and wholesalers). Channel A was the most utilized, representing 40.74% of sales, favored by medium and large-scale farmers. Results show significant price variation across channels. Channel A provided the highest net price of Rs. 500 per quintal, owing to lower marketing costs, particularly transportation (Rs. 124.98 per quintal). Channel B's costs totaled Rs. 71.15 per quintal due to commission fees linked with SHGs and societies. Channel D had the highest marketing expenses, driven by intermediary fees from local traders (Rs. 186.46) and wholesalers (Rs. 93.18 per quintal). The study emphasizes the role of digital transformation in streamlining agri-marketing, reducing costs, and increasing farmer profits. Digital tools can enable Aloe vera growers to bypass expensive intermediaries, optimize logistics, and expand direct sales, fostering a more efficient and transparent agricultural market system.

Keywords Aloevera, marketing channels, marketing costs, intermediary margins, economic analysis

IoT-enabled monitoring device for sustainable grape production in Karnataka

Suman, L[1*], Gururaj, B[1] and M N Venkataramana[1]
[1] University of Agricultural Sciences, Bengaluru, 560 065
Email: sunilannanavi@gmail.com

In India, the Grape is one amongst important commercial crops with 40,010 ha of cultivation attributed to its unique taste and deliciousness favouring greater demand for exports. The management practices adopted in the grape cultivation (fertilization and irrigation) and application of micronutrient to improve the fruit yield has led to excessive greenhouse gases (GHG) emission, and is estimated that approximately 25 % of global GHG emissions were derived from agricultural land leads to climate change which in turn will have adverse economic effects to the grape yards. Hence, ensuring grape fruit productivity and reducing GHG emissions to mitigate climate change is the need of the hour. With this objective, the study sustainable grape production through deploying the IoT-based monitoring device in the grape yard in the Vijayapura district of Karnataka (where 13,410 hectares are under grapes) was taken up with a sample size of 30 farmer respondents emphasizing higher productivity and lower GHGs could be achieved concomitantly through monitoring of pests and diseases and scheduling of irrigation and fertilizers and micronutrient application in the yard. The findings reveal that there is a significant ($P<0.05$) improvement in water and input use efficiency by 20 and 15 percent, respectively and concomitantly 31.23 percent improvement in fruit productivity in the region. Furthermore, the decrease in the greenhouse gas intensity by 17.23 percent significantly in the grape yard. The study concludes that, employing IoT-based monitoring devices paves a great way for sustainable grape production in Karnataka. Therefore, policy may be focused on redesigning subsidies to offer incentives and tax incentives for deploying climate-smart devices to mitigate climate change for sustainable agriculture production.

Keywords Grape, sustainability, IoT, climate change, efficiency

Digital transformation in Indian agriculture: exploring challenges and enablers for inclusive technology adoption

Sanjay Kumar Joshi[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: skjoshi.igkv@gmail.com

This comprehensive study examines the current landscape and future possibilities for digital technology applications within the Indian agricultural sector. Analysing 124 digital agriculture technologies, this paper explores the potential of digital tools in enhancing productivity, connectivity, and economic resilience for farmers. Key enablers, such as increased mobile connectivity, government support, and rising digital literacy, are discussed alongside challenges, including infrastructural gaps, socio-economic barriers, and language limitations. Findings highlight the need for collaborative efforts among government, private sectors, and non-profits to build an inclusive digital ecosystem. Policy recommendations for broader technology adoption are also suggested.

Keywords Digital transformation, agriculture, India, technology adoption, agri-tech, smallholder farmers, digital platforms, policy

The digital shift in mushroom production: enhancing marketing efficiency and producer value

Shubhi Singh[1*], Shubham Kumar Thakur[2], Ajay Kumar Gauraha[3], Vaibhav Laxmi Tiwari[4], Rajkumari[5] and Divya Jaiswal[6]
[1]College of Horticulture & Research Station, Jashpur, Chhattisgarh (496225)
[2]Mahant Bisahu Das College of Horticulture & Research Station, GPM, Chhattisgarh (495117) [3]College of Agriculture, IGKV, Raipur, Chhattisgarh (492012), India
[4]ICAR-National Institute of Biotic Stress Management, Baronda, Chhattisgarh (493225)
[5]College of Horticulture and Research Station, Sitapur, Chhattisgarh (497111)
[6]Visva-Bharati, Sriniketan, Birbhum, West Bengal (731236)
Email: drshubhisingheco@gmail.com

Mushroom cultivation is a significant agribusiness with potential to enhance rural incomes and economic sustainability. This study evaluates the marketing efficiency of mushroom production through three channels: direct producer-to-consumer (Channel-I), wholesaler-inclusive (Channel-II), and wholesaler-retailer (Channel-III). Channel-I offers the highest net producer price (Rs. 116.50/kg) and lowest marketing costs (Rs. 3.50/kg), giving producers 97.08% of the consumer price and a marketing efficiency of 33.28. Channels involving intermediaries, such as Channel-II and Channel-III, incur higher costs (Rs. 25/kg and Rs. 35/kg) and reduce the producer's share to 80.76% and 75%, respectively, with lower efficiency scores. Digital transformation in agri-marketing presents a critical opportunity to improve marketing efficiency by bypassing intermediaries. E-commerce platforms, mobile apps, and digital payments allow small and medium-sized producers to directly engage consumers, lowering expenses and enhancing revenue while improving supply chain transparency. Challenges include non-remunerative pricing, limited marketing facilities, pest issues, technical skill gaps, and inadequate infrastructure. Recommendations emphasize building cold storage and processing units, enhancing training, and state-supported e-marketing initiatives. Promoting digital price dissemination and technical support is key to sustainable growth in mushroom cultivation.

Keywords Agri-marketing, digital transformation, e-marketing, marketing efficiency

ICT digital agriculture and an attempt to 'double farmers' income': a case study in West Bengal

Dipanwita Chakraborty[1*] and Parmod Kumar[1]
[1]Giri Institute of Development Studies, Sector - O, Aliganj Housing Scheme, Lucknow226024,
Email: dchakraborty.rdm@gmail.com

A field study was carried out during immediate post-Covid period of 2022-23 in the district of Utter Dinajpur of West Bengal, a district with composite index below 127 indicating low category of agricultural productivity (when considering each group of key crops grown in West Bengal), purposively chosen to have better understanding/measurement of the implication of digital Agricultural Support on farm productivity and profitability. Results from the survey of a sample size of 250 farmers using the mentioned App after setting in of Pandemic, reveal that there was a 17 percent increase in productivity of the target farmers, from pre- Pandemic period of 2019-20 (data recorded through 'Recall Method') when they were not aware/did not use the App due to lack of smartphone. To improve the regour of the study a control group of matching number of farmers from same study area, with similar socio-economic characteristics, not using the App, was also selected employing 'Snowball Sampling Method'. Subsequently, when Cobb–Douglas Production Function with dummy (1 for App users and 0 for App non-users) was attempted separately for paddy and potato, the two major crops grow widely across the study cohort (app users and non-users) to understand productivity difference of the state crops between target group and a control group, the dummies were found to be significant (at 5 percent and 10 percent level respectively) vividly suggesting considerably greater farm productivity of key crops experienced by the target group relative to control group, and concomitantly profitability (taking into consideration the ruling wholesale farm-gate market prices) by virtue of the prompt and relevant farm based information (pertaining to recommended variety, quality and dosage of inputs) rendered by agricultural experts through the App.

Keywords Digital agricultural support, farm productivity, profitability

Role of digital platform of Agmarknet on farmer-market connectivity, a case study of kodo millet of Balrampur district, Chhattisgarh

Rajkumar[1]*, Ravi Shrey[1], A.K. Gauraha[1], Ravi Saxena[1] and Adikant Pradhan[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: rajsonwani51@gmail.com

The present study was conducted to examine the behavior of arrivals and prices of selected agricultural commodities in Kusmee mandi of Balrampur district of Chhattisgarh. This study is based on the secondary data of 7 years from 2017-18 to 2023-24 which was collected from www.agmarknet.gov.in. For the analytical framework, the study utilized time series data to compute the seasonal price variation and price trend. The linear trend equation is used to study the trend in arrivals and prices and the simple average method is used to study the seasonal price variations, the pattern of seasonal variation in arrivals and prices was showing an increasing seasonal price variation in month of September Rs.2564.29 (9.64%) in price trend year of 2023-24 where the may month Rs.1778.28 (6.68%) showing was a decreasing trend 2018-19 in arrivals and price of kodo millet., findings of the study might prove helpful in guiding the farmer an stakeholder to involved in making timely decisions to which month to sell their produce, ensuring they get better prices. By accessing price trends from AGMARKNET.

Keywords Arival & price, trend, seasonal variation, AGMARKNET, linear trend

Transforming Indian agriculture: role of agribusiness incubator, govt. initiatives, evidence & policy implications

Hulas Pathak[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: hulaspathak@rediffmail.com

India's agricultural journey from a food deficit country to a food surplus country underscores the resilience and innovation of Indian farmers and policymakers in ensuring food security. India's efficient resource utilization in crop cultivation is a benchmark among developing economies through the approach which not only benefits farmers but also fosters resilience in the face of climate change and resource constraints. With its multifaceted contributions to the secondary sector, agriculture plays a central role in India's economic development and sustains the country's growth trajectory. Despite being a significant contributor to India's economy, the agriculture sector's potential to generate employment remains underutilized. Agricultural production will need to nearly double by 2050 to meet the rising food requirements. India's agricultural productivity and efficiency lag behind global standards, posing challenges to food security and rural livelihoods. India's agriculture sector, often referred to as the backbone of the economy, sustains livelihoods for millions and plays a critical role in ensuring food security. Rashtriya Krishi Vikas Yojana (RKVY), Govt. of India promotes agricultural diversification, innovation, and technology adoption by providing financial assistance to states for various agricultural development activities.

Keywords Agri business incubator, technology adoption

Smart irrigation systems powered by IoT: a sustainable solution for efficient water management in agriculture

Siya Ram[1*], A.K. Gauraha[1], S.K. Joshi[1], Hulas Pathak[1] and M.R. Chandrakar[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: siyaramsingh0886@gmail.com

Smart irrigation systems have emerged as a critical solution to enhance water use efficiency in agriculture, particularly in light of increasing water scarcity and the need for sustainable farming practices. In 2024, advancements in Internet of Things (IoT) technology have made these systems more accessible and effective. These systems use a network of sensors to monitor key factors like soil moisture, temperature, humidity, and weather conditions. By analysing this data, smart irrigation systems automatically adjust water delivery to crops, minimizing water waste and optimizing irrigation schedules . Recent studies indicate that such systems can reduce water consumption by up to 40% and improve crop yields by as much as 25% . Furthermore, the use of solar power in these systems contributes to their energy efficiency, making them more sustainable. Remote management through mobile apps or web interfaces allows farmers to monitor and control irrigation processes from anywhere, offering flexibility and reducing labour costs . By leveraging affordable, low-cost sensors, these systems can be deployed in both large-scale commercial farms and small, resource-limited farming operations, providing a viable solution for increasing agricultural productivity while conserving water.

Keywords Smart irrigation systems, IoT technology, water conservation, crop yield improvement, and solar-powered irrigation, remote management

Digitalization of agriculture for higher, sustainable and inclusive growth economic potential of unmanned aerial vehicle: drones in agriculture

Yazhini A[1*] and Malaisamy A[2]
[1]Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu-641003
[2]Agricultural College and Research Institute, Madurai, Tamil Nadu-625104
Email: yazhi224@gmail.com

Indian agriculture makes a substantial contribution to the nation's GDP, employment, and food security. It directly employs over half of the country's workforce, supporting the livelihoods of rural communities. Historically, Indian agriculture has been labour-intensive and reliant on traditional practices, resulting in inefficient resource utilization. To address the numerous challenges facing the Indian agriculture sector, the adoption of emerging technologies, such as drones, is imperative. Drones have the capacity to significantly enhance agricultural practices, increasing productivity and reducing resource wastage. This study explores the economic dynamics of drone technology in agriculture, addressing a gap in past research amid the growing use of Artificial Intelligence in the sector. Conducted in the paddy cultivation regions of Thanjavur and Madurai districts in Tamil Nadu, the study involves a sample of 80 for UAV technology and 120 for conventional methods. The findings reveal significant cost savings and higher profitability with drone-assisted farming, where total expenses decrease from ₹ 27,723.20 for conventional farming to ₹ 22,857.50 with drones, primarily due to reduced pesticide and herbicide use and improved application efficiency. While both methods yield similar gross returns of ₹ 39,100 for conventional and ₹ 40,640 for drone-assisted—the net returns are markedly higher for drones at ₹ 17,782.50 versus ₹ 11,376.80 for conventional practices. A per-acre comparison shows substantial reductions in labour costs, with human labor decreasing from ₹ 11,077 to ₹ 5,628 and pesticide costs falling from ₹ 2,032 to ₹ 950. Although machine labor costs rise slightly with UAVs, overall savings enhance the financial viability of drone-assisted farming. The partial budget analysis indicates a net profit increase of ₹ 7,331, underscoring the economic advantages of adopting drone technology in agriculture.

Keywords Unmanned aerial vehicle, agriculture, paddy, partial budgeting

Marketing pattern and constraint analysis of minor millets in Kanker district of Chhattisgarh

Priyanka Sahu[1]*, Praveen Kumar Verma[1], V.K. Chaudhary[1] and Abhishek Patel[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: sahupriyanka453@gmail.com

The study analyzed the economic aspects of minor millet cultivation in Kanker district, Chhattisgarh, focusing on trends in area, production, productivity, cost, returns, marketing, and processing methods. The average cost of cultivation per hectare was Rs. 15,956.59 for kodo, Rs. 13,522.34 for kutki, and Rs. 24,321.51 for ragi. The cost of production per quintal was Rs. 1,770.69 for kodo, Rs. 1,996.73 for kutki, and Rs. 2,246.67 for ragi, with gross returns averaging Rs. 25,568.75, Rs. 19,635, and Rs. 35,686.19, respectively. Four marketing channels were identified, with an average marketable surplus of 82.33% for kodo, 82.85% for kutki, and 84.93% for ragi.

Keywords Minor millets, Marketable surplus, Marketing channel , Constraint of production and marketing

Digital management for climate-resilient agriculture

Ravi Singh[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: rajput1282ravi@gmail.com

Digital Management for Climate-Resilient Agriculture addresses the significant challenges climate change poses to agriculture. This innovative project develops a comprehensive digital framework integrating weather forecasting and soil sensors, precision irrigation and crop management, artificial intelligence-driven yield prediction, and real-time advisory systems for farmers. Pilot studies have yielded impressive results, including a 20% increase in crop yields, 30% reduction in water usage, and enhanced resilience to climate extremes. By scaling this digital solution, agriculture can be transformed, ensuring global food security and mitigating climate change impacts.

Keywords Climate-smart agriculture, digital agriculture, precision farming, artificial intelligence, IoT, sustainable agriculture, climate change mitigation.

Smart farming for sustainable agriculture

Neha Lakra[1*], Sarju Pallewar[1] and Laxmi Bagh[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: neha.lakra207@gmail.com

Smart farming, also known as smart agriculture, is the adoption of advanced technologies and data-driven farm operations to optimize and improve sustainability in agricultural production. Smart agriculture involves using precision equipment and machinery, including advanced technology in farm tyre design. Tractors, harvesters, and other farm equipment are equipped with GPS and IoT sensors, allowing for precise planting, harvesting, and monitoring. New Technologies are helping sustainability of agriculture, like Precision agriculture: Precision agriculture uses technology like GPS, sensors, and drones to monitor crops, soil, and weather conditions. This helps farmers optimize the use of resources, minimize waste, and reduce the environmental impact of agriculture. Sensors measure environmental factors such as soil moisture, temperature, and light levels while drones provide aerial imagery for precision farming practices like weed detection and crop health monitoring. Smart farming also enables measurement of nitrogen contents in soil that helps farmers to determine the amount of fertilizers to be used in farm lands. Some IoT-enabled equipments and unmanned aerial vehicles are useful in accurate surveillance of pest attack and associated diseases in farm vegetation. Benefits of smart farming helps in such as, targeted crop advice, financial services and risk management tools, more efficient use of seed, fertilizer and water, early identification of plant stresses, soil issues and pests, market insights for reduced crop waste and loss.

Catalyzing agricultural transformation: public-private partnerships in digital marketing

Bhupendra Netam[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: bhupendra9067@gmail.com

This study explores the transformative impact of public-private partnerships (PPPs) on agricultural marketing through digitalization. Collaborative efforts between governments, corporations, and startups have yielded impressive results, including enhanced market access for 5 million farmers, 15-20% increases in producer prices, 30-40% reductions in transaction costs, and improved market information dissemination. The research highlights the critical role of PPPs in developing digital platforms, building farmer capacity, and ensuring scalability and sustainability. By examining successful partnerships, this study provides valuable insights for policymakers and stakeholders seeking effective strategies for inclusive agricultural transformation through public-private collaborations.

Keywords Public-private partnerships, digital agriculture, agricultural marketing

Digital agriculture in India: opportunities, challenges, and future prospects

Sanjit Kumar Rout[1] and M. Srinivasa Reddy[2*]
[1]Prananath College (Autonomous), Mukundaprasad, Khordha-752057, Odisha
[2]Centre for Economic and Social Studies (CESS), Nizamiah Observatory Campus, Begumpet, Hyderabad – 500016,
Email: msrinivasareddy@cess.ac.in; ms.srinivasa@gmail.com

India is a major agricultural economy facing significant challenges, including limited productivity, climate vulnerability, and market inefficiencies that impact the livelihoods of millions of farmers. Digitalization in agriculture offers a transformative opportunity to address these issues through technologies like precision farming, the Internet of Things (IoT), mobile applications, and blockchain, which aim to enhance productivity, sustainability, and inclusivity within the sector. Initiatives such as the Digital Agriculture Mission and the National e-Governance Plan for Agriculture (NeGPA) are enabling India to leverage digital tools to improve resource efficiency, optimize supply chains, and expand market access, particularly for smallholder farmers. This review examines the drivers of digital transformation in Indian agriculture, including policy support and the role of agri-tech startups, while assessing the impacts of these technologies on crop yields, resource management, and financial inclusion. Despite these advancements, challenges such as the digital divide, infrastructure gaps, and cyber security concerns persist. Addressing these obstacles with targeted policies and investments is essential to ensure that digital agriculture benefits farmers across various socioeconomic and geographic divides. Ultimately, digital agriculture has the potential to serve as a cornerstone of India's future economic growth, fostering a resilient, efficient, and inclusive agricultural ecosystem.

Keywords Digital agriculture, startups, supply chain

Bridging the digital literacy gap by empowering farmers and entrepreneurs through skills and capacity building

Mandas Banjare[1]* and Prawindra Bhagat[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Mail: maanbanjare6226@gmail.com

Application of new technologies for superior livelihoods and company achievements is significantly interrupted by the widening digital divide among farmers and businessman. A multimodal strategy is required to close this gap, including community-driven support networks, access to duly priced digital tools, and focused training programs. In order to empower these groups, it is essential to incorporate hands-on digital literacy training into agricultural and entrepreneurial structure, cultivate partnerships with technology suppliers, and guarantee continual capacity-building activities through peer-to-peer learning programs and mentorship. By underscore approachability and inclusivity, this interference can increase output, foster creativity, and open up new doors, encouraging socioeconomic development and resiliency in marginalized density.

Keywords Digital literacy, farmers, entrepreneurs, technologies, livelihoods, empowering

The role of blockchain technology in agricultural supply chain management

CH. Shekhar[1*], K. Sruthi Sai[1], R. Rakesh[1] B. Kiranmai[1] and CH. Shraddha[2]
[1]Jayashankar Telangana Agricultural University, Hyderabad 500030
[2]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: shekharagecon@gmail.com

The agricultural supply chain faces numerous challenges, including lack of transparency, inefficiencies, food fraud, and the inability to trace produce from farm to fork. Blockchain technology, with its decentralized, immutable, and transparent ledger system, has the potential to address these issues, transforming the agricultural supply chain into a more efficient and trustworthy system. This paper explores the role of blockchain in agricultural supply chain management, highlighting its applications, benefits, and challenges. By enabling real-time traceability, blockchain provides all stakeholders—farmers, distributors, retailers, and consumers—with access to a single source of truth. For instance, information about the origin of produce, its journey through the supply chain, and its quality parameters can be stored securely and accessed instantly. This enhances food safety, reduces food fraud, and builds consumer trust in agri-products. Blockchain also supports the implementation of smart contracts, which automate processes like payments and quality checks. This eliminates intermediaries, reduces transaction costs, and ensures timely and fair compensation for farmers, thereby promoting financial inclusion. Furthermore, blockchain's integration with IoT devices enables the monitoring of key factors such as temperature, humidity, and handling conditions throughout the supply chain. Such data ensures compliance with regulatory standards and minimizes post-harvest losses. However, challenges such as high implementation costs, lack of technical expertise, and the digital divide in rural areas must be addressed to ensure widespread adoption. This study concludes that blockchain technology offers transformative potential for agricultural supply chain management, fostering transparency, accountability, and efficiency.

Keywords Blockchain technology, agricultural supply chain, traceability, smart contracts, transparency, efficiency

Digital payment systems for agriculture transactions: improving financial inclusion, efficiency, and transparency

Sarita Ghidode[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: saritaghidode123@gmail.com

An automatic online operation that helps to transfer money between two entities is known as cashless transaction. Digital transactions are also known as cashless transactions as no paper formalities are required to complete a transaction. E-commerce, signing online contracts for business, buying online tickets for movies through smart phones comes under digital transactions. Transacting digitally has become easy, convenient and quick for people.

Keywords Digital transactions, convenience

Smart agri-tech for sustainable farming

Priyanka Sahu[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: priyas9417@gmail.com

Artificial Intelligence (AI) is rapidly emerging as a transformative force in agriculture. AI offers a solution by providing data-driven support to farmers and extension services. It enables precision farming through technologies like drones and sensors, optimizing resource utilization and crop yields. AI-powered crop surveillance detects diseases, pests, and nutrient deficiencies, offering timely recommendations. This data helps them in monitoring crop and soil health, detecting plant diseases, pest infestations, or nutrient deficiencies, automating various tasks like planting, spraying, and harvesting ,efficient planning and optimizing storage, supply chain, and market sales, detecting early signs of animals' illness or stress. The 'Crop Doctor 2.0' mobile application has been developed by IGKV in collaboration with NIC Raipur. It encourages advanced and transformative smart farming using AI in agriculture. Through this AI-based app, identification of diseases of 36 types of crops, harmful insects, weather information, rental of agricultural machinery and facility of online marketing platform will be easily available to the farmers. By using AI, through this app, farmers will be able to get accurate information for farming, which will promote 'smart agriculture' in the state. 8 lakh farmers of the state are connected with this app and are taking advantage of it in farming and automated irrigation system to monitor soil moisture levels and weather conditions, algorithms can decide in real-time how much water to provide to crops. Innovative developments in farming save the excess use of water, pesticides, herbicides, maintains the fertility of the soil, also helps in the efficient use of man power and elevate the productivity and improve the quality. An effective supply chain that is demand-driven and efficient may be built with the use of timely, reliable data and analytics. With the recent reforms in the agriculture industry, there is a chance that contract farming investments will expand and technology will be introduced for higher yields and productivity. Artificial intelligence in agriculture not only assists farmers in automating their agricultural operations, but also changes to precision cultivation for improved crop output and quality while using less resources.

Keywords Artificial intelligence, data, information, extension, farmers, agriculture, digital

Revolutionizing agriculture: the digital transformation of farming

Neelam Sunil Tigga[1]* and Siya Ram[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: neelamsuniltigga@gmail.com

India being an agricultural leader faces low productivity, inefficient supply chains and limited tech adoption. This paper explores the transformative power of digital in Indian agriculture. Digital marketing and platforms like e-NAM helps in market access and profitability by bridging the gap between farmers and consumers. Government initiatives like India Digital Ecosystem of Agriculture (IDEA) promotes innovation using AI, IoT and blockchain. Agri-tech startups and Farmer Producer Organizations (FPOs) empowers small holders. By integrating ICT and data ecosystems digital agriculture ensures sustainable farming, increases farmer income and builds robust agribusiness framework, transforming the sector.

Keywords Agricultural digital transformation, digital agriculture, agri-tech innovations, farmer producer organizations (FPOs), e-NAM platform

Barriers in digital transformation of post harvest technologies of horticultural in Chhattisgarh state

Usha Patel[1*] and P.K. Tiwari[2]
[1]College of Horticulture and Research Station, Sankra, Durg (C.G.)
[2]College of Horticulture and Research Station Saja, Bemetara (C.G.)
Email: chahat181818@gmail.com

Chhattisgarh has often been dubbed "Rice Bowl" of Central India, with the main crop being Paddy. Apart from paddy, the cereals are also grown but yet productivity is not very high. This brought a new thrust on the sector of Horticulture, as the region is also suitable for growing Mango, Banana, Guava and other fruits and a variety of vegetables. The case study revealed that the current horticultural crop growers of Chhattisgarh state are facing the problems *viz.* poor supply and demand match with long transit times, high shrinkage, un-coordinated logistics, variable product quality, poor transparency along with the chain and have the limited involvement of their consumers. The lack of access to relevant information and digital technology infrastructure, leads to a lack of access to key players such as processors, traders, and consumers in the horticulture value chain as a challenge. These constraints showed numerous barriers and significant challenges like low-capacity usage of digital technology, a lack of digital technology infrastructure in rural areas, inadequate digital technology skills among researchers, low income, cultural inertia as well as the scarcity of relevant localized content in local languages, poverty and illiteracy influencing digital adoption by small- scale horticulture farmers of Chhattisgarh state that are outside the control of the farmers to secure marketing information. These barriers lead to the problem of post harvest losses up to about 40% in Chhattisgarh and the major reason behind it are lack of awareness among the growers about data driven market intelligence and market related information services. These issues and challenges can be tackled by converting the existing farming into smart farming and only digital transformation will enable farmers to receive all the data on related to their horticultural products to meet out the market demand with low post-harvest losses where retailer needs full transparency on product specifications and delivery, adapt orders, organize promotions one side and another side consumer needs to get real time information on harvest time, age and remaining shelf life, available varieties, quality characteristics, colour, brix, shape, aroma etc.

Keywords Digitalization, digital transformation, post harvest management, small-scale farmers, organized market

Digitalisation of agriculture in Dhamtari district of Chhattisgarh: a case for doubling farmers' income

Narottam Kumar Sahu[1*], V. K. Chaudhary[1] and Mukesh Kumar Anant[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: sahu.nero03@gmail.com

Agriculture in India, particularly in regions like Dhamtari district of Chhattisgarh, remains a cornerstone of rural livelihoods. Despite its importance, farmers face persistent challenges, including low productivity, unpredictable weather patterns, and limited market access. To address these issues, the Indian government has emphasized the role of digital technologies to transform agriculture and achieve the ambitious goal of doubling farmers' income by 2022. This study investigates the role of digitalisation in improving agricultural practices and farmers' income in Dhamtari. We explore how digital tools such as weather forecasting apps, soil health monitoring systems, e-marketing platforms, and advisory services impact productivity, cost efficiency, and market access. The findings suggest that digital interventions have resulted in significant improvements in crop yields, cost reduction, and income, particularly for farmers who actively engage with these technologies. However, challenges such as digital illiteracy and poor connectivity must be addressed for wider adoption. This paper concludes that with the right infrastructure and training, digitalisation can play a key role in achieving the goal of doubling farmer's income.

Keywords Agriculture, chhattisgarh, digitalisation, farmer's income

A study of determinants of performance of agribusiness start-ups in India

Pavan Kumar Kumawat[1]*, Akriti[1], Praveen K[1], Alka[1] and Girish Kumar Jha[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: pavankumarkumawat05@gmail.com

India has emerged as the fastest-growing economy and boasts the third-largest startup ecosystem globally. However, there is a pressing need for robust research to inform policy advocacy aimed at enhancing startup success rates. Identifying the factors that influence startup performance is crucial for any entrepreneurial venture. While various studies have been conducted across different industries and regions, there has been a lack of research specifically addressing the determinants of performance for agri-startups. Therefore, we undertook this study to identify these critical factors and subsequently characterized and mapped them using qualitative content analysis through NVivo 14 software. We conducted semi-structured convergent interviews with successful agri-startups to gather qualitative data. The determinants were classified into three categories: personal, organizational, and external factors. Organizational factors emerged as the most significant performance category, with product-market fit and effective business models identified as the key determinants influencing startup performance. In India, to enhance startup performance, there is a vital need to foster an innovative and entrepreneurial culture within higher education institutions to facilitate the development of better technologies. Additionally, incubators should concentrate on providing mentorship to help startups achieve a strong product-market fit and create compelling business models.

Keywords Agri business, startups**,** technologies, innovation

Harnessing technology for smart agri-marketing

Minal Thawre[1*] and Anisha Ekka[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: khushithawre0788@gmail.com

Smart agriculture marketing integrates advanced technologies like IoT, AI, and blockchain to revolutionize traditional agricultural supply chains (Elsevier et.al 2021). This approach enhances decision-making, streamlines processes, and fosters direct farmer-to-consumer connections. By leveraging real-time data and predictive analytics, farmers can optimize pricing, reduce waste, and address market demands efficiently. Smart systems also promote transparency, ensuring fair trade and sustainability. This paper explores the transformative potential of these technologies in creating efficient, profitable, and sustainable agricultural ecosystems.

Keywords AI in farming, blockchain, Agri-marketing, supply chain optimization.

Agribusiness startups: key to unlock innovation success with reference to the agri-food sector

Aditi Chaturvedi[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: aditiiee123@gmail.com

First, established typography of open innovation and presented four different OI types, each serving different goals and requiring different activities. It was found that OI can be categorized by an inbound-outbound dimension and by whether equity is involved in the relationship. For this research, the three most relevant categories are 'inbound with equity involved'; inbound without equity involved' and 'outbound without equity involved'. A literature review was conducted to find best practices for those categories. In Agri-Food, the practice of open innovation involving startups is not very well documented yet so the focus of the review was on high-tech sector. The Agri-Food sector faces significant challenges, including a growing world population, globalization, and technological changes. Open innovation (OI) is becoming inevitable to deal with these challenges and for long-term competitive advantage of the Agri-Food companies. Startups can play a key role in corporate's open innovation strategies. Although corporate-startup collaborations (CSCs) are already more prevalent in research and business practice in high-tech sectors, this phenomenon is new in the Agri-Food sector. By combining literature on CSCs in high-tech sectors with OI literature in Agri-Food, a framework was developed to initiate and manage CSCs. Best practices should focus on alliance formation, strategic fit, governance mode, access to resources, relationship & trust, and IP protection. A retrospective case study on StartLife and Food case confirmed that a CSC could be key in improving innovation performance and increasing competitive advantage. It also confirmed the importance of mediating and moderating factors influencing how the CSC leads to competitive outcomes, and that a dynamic view on the CSC is required.

Keywords Agri food sector, start-ups, CSCs, innovation, OI, IP protection

National digital agriculture policies: india's pathway to agricultural transformation

Ashish Timothy[1*] and Shailesh Kumar[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: ashish.timothy19@gmail.com

India's National Digital Agriculture Mission Aims To Revolutionize Agriculture Through Digital Interventions. This Paper Examines India's National Digital Agriculture Policies, Focusing On:-Digital Agriculture Infrastructure, Farmer Centric Services, Data-Driven Decision Making, E-Governance And Public Private Partnerships The Study Assesses Policy Initiatives Like:-E-NAM Platform Kisan Call Centre Soil Health Card Scheme Pradhan Mantri Fasal Bima Yojana Findings Highlight Policy Effectiveness In Enhancing Farmer Engagement, Market Access, And Agricultural Efficiency. Recommendations Emphasize: Interoperability And Data Standardization, Digital Literacy And Capacity Building, Private Sector Participation And Investment

Keywords Digital Agriculture, national policy, India, agricultural transformation

Smart agri-tech for revolutionizing sustainable agriculture through plant biotechnology

Surekha[1*] and S.B. Verulkar[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: surekhanetam689@gmail.com

The integration of Smart Agri-Tech and plant biotechnology is revolutionizing the agricultural sector by offering sustainable solutions to modern farming challenges. Smart Agri-Tech utilizes advanced technologies such as Internet of Things (IoT) devices, Artificial Intelligence (AI), drones, and satellite imagery to enhance precision farming practices. These technologies enable real-time monitoring of soil conditions, crop health, and environmental factors, ensuring optimized use of water, fertilizers, and pesticides. Simultaneously, plant biotechnology contributes to sustainability by engineering crops with traits like drought resistance, pest tolerance, and improved nutritional content. Techniques such as CRISPR gene editing and synthetic biology allow for the development of climate-resilient crops that reduce dependency on chemical inputs and improve yields. Biofertilizers and biopesticides derived from biotechnology minimize environmental damage while enhancing soil health.

Together, Smart Agri-Tech and plant biotechnology create a synergistic approach to sustainable farming, addressing critical issues such as resource scarcity, climate change, and global food security. These innovations not only reduce the environmental footprint of agriculture but also enhance productivity and resilience, ensuring a sustainable food supply for future generations. The integration of these fields represents a transformative shift towards eco-friendly, efficient, and adaptable agricultural systems.

Keywords CRISPR, artificial intelligence, drones, GPS, remote sensing

E-commerce solutions for agricultural export

Ashish Timothy[1*] and Shailesh Kumar[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: ashish.timothy19@gmail.com

India's Agricultural Export Sector Faces Challenges In Accessing Global Markets. E-Commerce Solutions Enhance Market Access, Efficiency, And Transparency. Key Initiatives Include: Digital Marketplaces (E-NAM, Agrostar) Online Platforms (Agricultural Export Facilitation Portal) E-Commerce Enabled Supply Chain Management;Digital Payment And Logistics Solutions Benefits: Enhanced Market Access For Farmers, Improved Supply Chain Efficiency, Increased Transparency And Traceability, Boost To India's Agricultural Export Competitiveness

Keywords E Commerce, transparency, agricultural transformation, export

Adoption of ICT innovation in the agriculture sector by smallholder farmers: a study in selected districts of Bangladesh

Md. Roconuzzaman[1*], Mohammad Mizanul Haque Kazal[1]
[1]Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh
Email: zamanrocky1707889@sau.edu.bd

In developing countries like Bangladesh, agricultural development is a critical way to increase the income of the poor and ensure food security, thereby supporting livelihoods. The agricultural sector makes a significant contribution to Bangladesh's GDP. However, many smallholder farmers in Bangladesh still lack knowledge and information about modern farming practices. In the modern world, Information and Communication Technology (ICT) plays a vital role in facilitating the movement of information, services, and people. This study aimed to assess the current level of ICT innovations within Bangladesh's agricultural sector. The study used a binary logit model and structural equation modeling (SEM) with partial least squares (PLS) to identify the factors influencing ICT adoption among farmers. According to the study, text and voice-based services on mobile phones were among the most widely used ICT technologies and different mobile-based apps like Krishoker Janala App, Fosoli App, Krishi Doctor App, etc. provided the key source of farming information. The study identified that the main barriers to ICT adoption included lack of technological infrastructure, lack of ICT proficiency, lack of trust in the ICT system, lack of training, and the cost of technology, even though mobile-based services were intended to improve access to timely and accurate agricultural information. The study's findings provide valuable information that should be used to emphasize the need for research and to expedite the adoption of ICTs.

Keywords ICT adoption, agriculture, mobile phone, barriers, SEM

Cultivating connectivity: digital transformation in agri-marketing

Shailesh Kumar[1] and Ashish Timothy[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: ashish.timothy19@gmail.com

The Agricultural Sector Is On The Cusp Of A Digital Revolution, Transforming The Way Farmers, Traders, And Consumers Interact. This Study Explores The Potential Of Digital Technologies In Enhancing Connectivity And Efficiency In Agri-Marketing. By Leveraging Platforms, Mobile Apps, And Data Analytics, Farmers Can Access Real-Time Market Information, Connect With Buyers, And Optimize Their Produce Sales. Our Research Investigates The Impact Of Digital Transformation On Agri-Marketing, Highlighting The Benefits Of Increased Transparency, Reduced Transaction Costs, And Improved Market Access. We Identify Key Challenges And Opportunities For Stakeholders, Providing Insights For Policymakers, Entrepreneurs, And Farmers To Harness The Power Of Digital Connectivity In Agri-Marketing.

Keywords Connectivity , market access, marketing

E-commerce and smart supply chains pioneering sustainability in agricultural logistics

Mayank Pathak[1*] and Mandas Banjare[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Mail: mayankigkv@gmail.com

The consolidation of e-commerce and smart supply chains is upheaval the distribution of agricultural products, paving the way for boosted sustainability in agricultural logistics. This paper explores the innovative intersection of digital technologies, intelligent logistics solutions, and sustainable practices in modern agri-product supply chains. E-commerce platforms are bridging gaps between producers and consumers, reducing inefficiencies and ensuring fair market access for farmers. Simultaneously, smart supply chain technologies—leveraging IoT, AI, and data analytics—are optimizing resource use, minimizing waste, and enabling real-time tracking of agri-products. The role of blockchain in ensuring transparency, traceability, and trust throughout the supply chain is also highlighted as a transformative force. Together, these innovations address critical challenges, such as reducing environmental footprints and meeting the growing demand for sustainable and resilient agri-logistics systems. This study emphasizes the potential of combining technology-driven strategies with sustainable practices to reshape the future of agricultural supply chains, benefiting producers, consumers, and the environment alike.

Keywords Ecommerce, supply chain, logistics, blockchain, technologies, sustainable

Driving agricultural value chains through digital transformation

Anisha Ekka[1]*, Yashaswi Dhruw[1] and Minal Thawre[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: ekkaanisha029@gmail.com

Digital transformation is revolutionizing agricultural value chains by enhancing efficiency, transparency, and sustainability. Through the integration of technologies like Internet of Things (IoT), artificial intelligence (AI), blockchain, and big data analytics, farmers can optimize crop management, reduce waste, and increase productivity. Digital platforms enable real-time monitoring of supply chains, improving decision-making and reducing post-harvest losses. Moreover, these technologies empower farmers with better access to markets, financial services, and weather forecasts. By driving innovation, digital transformation not only strengthens the agricultural ecosystem but also promotes resilience, competitiveness, and inclusive growth in the sector.

Keywords IoT in agriculture ,blockchain, sustainable agriculture

IoT-based soil moisture sensors for sustainable agriculture: impact on water management and productivity in central Punjab

Kamal Vatta[1*], Oinam Krishnadas Singh[2], Ranjodh Singh[2], Bhupinder Singh[2], Sakshi Sharma[2] and Sandeep Dixit[2]
[1]Punjab Agricultural University, Ludhiana, India, 141 004
[2]Centers for International Projects Trust (CIPT), New Delhi, 110 017
Email: kmlvatta@gmail.com

Water scarcity is one of the most pressing challenges faced by agriculture globally, particularly in regions like Punjab, where intensive groundwater use for rice and wheat cultivation has led to alarming depletion levels. This study investigates the adoption and impact of IoT-based soil moisture sensors for sustainable water management and improved farm productivity. Using primary data from 1,342 farmers across four districts of Central Punjab during the Kharif season of 2022-23, this research employs Propensity Score Matching (PSM) to analyze the effects of sensor adoption. Results show that adopting farmers reduced irrigation hours by 35 per cent and total farming costs by 4 per cent while achieving a 3 per cent increase in paddy yields. Input costs for labour, chemicals, and fertilizers were reduced by 12 per cent, 11 per cent, and 4 per cent, respectively, reflecting the efficiency of water-sensitive farming practices enabled by the sensors. Despite these benefits, adoption remains limited due to high initial costs, lack of awareness, and technical challenges, especially among smallholders. The study recommends targeted financial support, training programs, and integration of IoT technologies into government schemes to overcome these barriers. The findings highlight the potential of soil moisture sensors as a transformative tool for sustainable, water-efficient, and productive farming systems in water-stressed regions.

Keywords IoT in agriculture, soil moisture sensors, propensity score matching, water management, agricultural sustainability

Digital innovation in agri-marketing: Shaping the future of agriculture

Minal Thawre[1] Anisha Ekka[1*] and Yashaswi Dhruw [1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: ekkaanisha029@gmail.com

The integration of digital innovations in agri-marketing is revolutionizing the agricultural landscape, enhancing efficiency, transparency, and market access for farmers and stakeholders. *(*Chakravarty *et.al* 2022*)* The transformative role of digital tools, such as e-commerce platforms, blockchain, and IoT, in optimizing supply chains, reducing intermediaries, and empowering farmers. By addressing key challenges, including digital literacy and infrastructure gaps, the study highlights the potential for sustainable growth in agriculture through technology-driven solutions. The findings underscore how digital innovations are not only shaping the future of agriculture but also fostering equitable market opportunities and resilience in the sector.

Keywords Digital transformation, smart agriculture, IoT in agriculture

Global lessons from smart agriculture: innovations, sustainability, and resilience in farming

Kandimalla Shivani[1*] and Chintawar Shraddha[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: shivanikandimalla821@gmail.com

The adoption of smart agriculture practices globally highlights transformative lessons in achieving sustainability, resilience, and productivity in farming. India exemplifies this transition with initiatives like climate-smart agriculture (CSA), integrating technologies such as precision farming, drip irrigation, and ICT-based decision support systems. These innovations have mitigated challenges posed by climate variability, water scarcity, and declining soil health while enhancing farmers' adaptive capacities. Globally, countries like the Netherlands and Israel have demonstrated leadership in integrating technology and policy frameworks to optimize resource use and improve food security. Key lessons from these implementations include the need for strong institutional frameworks, cross-sector collaborations, and farmer-centric technology dissemination. Local adaptation of practices, as seen in India's blending of indigenous knowledge with modern technology, underscores the importance of context-specific solutions. Scaling these practices requires policy support, capacity-building initiatives, and investment in research and infrastructure. Collaboration across nations, through knowledge-sharing platforms and triangular cooperation frameworks, amplifies the impact of smart agriculture by fostering innovation and addressing global challenges such as food security and climate resilience.

Keywords Climate-smart agriculture, climate resilience, global collaboration, ICT in agriculture, precision farming, resource optimization, sustainability

Transformation agri marketing with data, automation and AI

Yashaswi Dhruw[1], Anisha Ekka[1*] and Minal Thawre [1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: ekkaanisha029@gmail.com

In India, agricultural marketing faces significant challenges, including price fluctuations, inadequate market access, and information gaps. Data automation presents a transformative solution to these issues by enhancing efficiency, transparency, and market connectivity. The potential of data-driven technologies, such as AI, big data, and blockchain, to revolutionize agricultural marketing. Through platforms like e-NAM and digital tools, automation can provide farmers with real-time market insights, optimize supply chains, and reduce dependency on intermediaries. However, challenges such as digital infrastructure, data privacy, and farmer education must be addressed to ensure effective implementation. The integration of automation promises a more inclusive, efficient, and sustainable agricultural market in India.

Keywords AI, digital tools, big data

Current analysis of agri-startup ecosystem in Chhattisgarh

Chintawar Shraddha[1*], M. L. Sharma[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: shraddhachintawar909@gmail.com

Chhattisgarh, a predominantly agrarian state in India, has emerged as a hub for innovative agricultural startups leveraging technology to address regional challenges. The agri-startup ecosystem in the state is driven by a combination of government initiatives, private investments, and grassroots innovations. This analysis highlights the current landscape, key players, challenges, and opportunities shaping the sector. The state's initiatives, such as the Chhattisgarh Start-Up Challenge and policies promoting agri-tech innovation, have facilitated the growth of ventures focusing on farm mechanization, organic farming, digital marketplaces, and supply chain optimization. Startups like Bijak, Krishi Network, and regional enterprises are providing solutions tailored to the needs of local farmers, enhancing productivity and market linkages. However, challenges persist, including limited access to venture capital, fragmented supply chains, and inadequate technological adoption among smallholder farmers. Opportunities lie in scaling precision agriculture, promoting sustainable practices, and integrating advanced technologies such as IoT, AI, and blockchain. Collaborative efforts among government bodies, incubators, and private players are crucial for fostering innovation and scalability. This analysis underscores the need for policy support, capacity building, and infrastructure development to accelerate the agri-startup ecosystem's growth and its contribution to the state's economic and social development.

Keywords Agri-tech innovation, digital marketplaces, precision agriculture, supply chain optimization, sustainable practices

Innovating agricultural marketing through digital transformation

Marya Shilpa Ekka[1*], Ashish Timothy[1] and Shailesh Kumar[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: Shilpaekka2803@gmail.Com

Innovating agricultural marketing through digital marketing involves leveraging technology to enhance the visibility, accessibility, and efficiency of farm products. Digital platforms, including social media, e-commerce websites, and mobile applications, enable farmers to reach global markets directly, bypassing traditional intermediaries. This innovation facilitates better pricing, reduces post-harvest losses, and improves supply chain management. Furthermore, digital tools like data analytics can help in market trend analysis, guiding farmers in production decisions. The integration of digital marketing in agriculture promises to empower smallholder farmers, increase their income, and drive sustainable growth in the agricultural sector. (reference: "digital marketing ii agriculture," journal of agricultural innovation, 2023).

Keyword Innovation, e-commerce, supply chain management, post harvest

Digital agriculture: status, challenges, and opportunities

Munish Alagh
Sardar Patel Institute of Economics and Social Research, Ahmedabad, Gujarat
Email: munish@spiesr.ac.in; munish.alagh@gmail.com

The imperialism of probabilities could occur only as the world itself became numerical. As people were trained to use numerals, they gained a fundamentally quantitative feel for nature, how it is and how it ought to be. Two major philosophical ideas are borrowed from a reading of Hacking so as to illuminate the dilemma of building a sustainable information empowered economy within an arid agricultural economy like Gujarat that is still plagued with an uncertain gamble (a gamble in which the probability of success is unknown) in the monsoon. Certain philosophical themes can be illustrated. One: "the idea of making up people...enumeration requires categorisation…defining new classes of people for the purposes of statistics has consequences for the ways in which we conceive of others and think of our own possibilities and potentialities". For instance a category that can be thought of in study of Rural Development in Gujarat is of Woman Sarpanch who acts as dummy agents for their husbands, such a category will help in aligning the Growth versus Development theme for the state of Gujarat with Gender issues on the ground. Another philosophical theme is reasoning "…the idea of a style of reasoning.....enduring ways of thinking such as… statistical analysis of regularities of populations… the growth of a style of reasoning is a matter not only of thought but of action…..even the very notion of an exact population is one which has little sense until there are institutions for establishing and defining what 'population' means. Equally, there must be ways of reasoning in order to pass from cumbersome data to sentences with a clear sense of how many were such and such…representative sampling gives more accurate information about a population than an exhaustive census…The very thought of being representative has had to come into being. This has required techniques of thinking together with technologies of data collection. An entire style of scientific reasoning has had to evolve.

Keywords Digital agriculture, imperialism, opportunities

What if we ignore the holistic value of ecosystem services in watershed management: Some insights for economic incentives

Suresh Kumar
ICAR-Central Soil Salinity Research Institute, Karnal, Haryana-132001
Email: suresh.kumar10@icar.gov.in

The ecosystem services framework has emerged as a prominent management strategy due to its emphasis on the sustainability of ecosystems, recognizing the intricate relationships between ecosystems and human well-being to meet human needs. This framework highlights the essential functions that ecosystems perform, such as water purification, carbon sequestration, and biodiversity support, which are vital for maintaining the health of the planet and the quality of life for human populations. By understanding these relationships, policymakers and managers can make informed decisions that not only protect natural resources but also enhance the livelihoods of communities that depend on them. The delivery of ecosystem services is closely linked to the implementation of payment for ecosystem services (PES) as a mechanism for watershed management. This paper provides an analysis of the incremental variations in the value of Ecosystem Services (ESs) in a developed watershed found in the Eastern Ghats region of India. Various market and non-market approaches were applied to estimate the ESs. The findings indicate that the changes in Watershed-Based Ecosystem Services (WBESs) reached a total of INR 20.45 million. The amount individuals are willing to pay for watershed-based ecosystem services (WBESs) and their associated spillover effects is estimated at INR 3,755 per hectare. Involving communities that benefit from these spillover effects is critical for promoting local engagement in watershed management practices. To prevent the underestimation of watershed benefits, it is essential to account for the complete array of ecosystem services, including their spillover effects, during evaluations. Additionally, fostering greater community participation and securing enhanced funding are necessary to ensure the sustainable provision of ecosystem services from watersheds. This study proposes a conceptual framework for watershed management that supports the comprehensive assessment of ecosystem services and facilitates informed decision-making. Key policy recommendations presented here could significantly enhance the effectiveness of watershed management institutions and strategies in various global contexts.

Keywords Ecosystem services, watershed management, environmental assessment

Agri-tech for sustainable development

Varsha Dewangan[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: varshadew2023@gmail.com

Agri-tech, the integration of agriculture and technology, emerge the transform solution for sustainable development. The global food system is facing unprecedented challenges, including climate change, population growth, and resource scarcity. Traditional agricultural practices are struggling to keep pace with these demands. To address these challenges, innovative solutions are needed to enhance agricultural productivity, conserve resources, and mitigate environmental impact.

Keywords Agri tech, integration

Digital agriculture for sustainable growth: economic impact and farmer's perceptions of soil health card in Bilaspur Chhattisgarh

Sakshi Shastri[1] and Anindita Saha[2]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
[2]Palli Siksha Bhavana, Visva-Bharati University, Bolpur, West Bengal, 731 236
Email: sakshishastri1996@gmail.com

Digital agriculture is revolutionizing Indian farming by enabling smarter decision-making and efficient resource use. The Soil Health Card (SHC) scheme, launched in 2015, integrates digital tools to guide farmers in improving soil management, reducing fertilizer costs, and increasing yields. This study focuses on the economic impacts of SHC and farmers' perceptions in Bilaspur district, Chhattisgarh, with a special emphasis on digital adoption. Findings from 120 SHC beneficiaries reveal that digital platforms enhance SHC implementation, leading to higher productivity and profitability. Challenges include limited access to digital tools and technical literacy. Recommendations highlight the need for better digital infrastructure, training, and support to ensure sustainable growth and inclusive benefits for all farmers.

Keywords Digital, SHC, economic, impact, sustainable, growth

A comparative study on marketing cost, marketing margin and price spread of cotton in Bemetara district of Chhattisgarh, India

Deepak
Department of Agricultural Economics, College of agriculture Raipur
Indira Gandhi Krishi Vishwavidyalaya, Raipur Chhattisgarh 492012
Email: deepakk.patle143@gmail.com

This study evaluates cotton marketing in the Bemetara district of Chhattisgarh in 2022, focusing on different channels, and marketing efficiency. It categorizes cotton growers and examines how various factors correlate with the marketing efficiency. A multistage sampling process was used for data collections from 56 respondents. The study found that most efficient channel was identified as Channel II, which was 1202.20 Rs/q. The highest producer share in consumer's rupee was found in Channel II, at 19.93% and minimum share was found in Channel I at 19.49%. The price spreads were Rs. 18987.38, Rs. 18913.70, and Rs. 18855.25 for channels I, II, and III respectively.

Keywords: Marketing of cotton, market margins, price spread

Agri-tech startups: Opportunities, sustainability, profitability and enhancing efficiency in agricultural market

Deepak and Satyanarayan Soni
Department of Agricultural Economics, College of agriculture Raipur,
Indira Gandhi Krishi Vishwavidyalaya, Raipur Chhattisgarh 492012
E-Mail: deepakk.patle143@gmail.com

India is investing in agritech to address economic issues and boost the economy. Startup India recognized 2,800 agritech firms in December 2023, raising investment worth INR 6,600 crores. The sector offers a $24 billion opportunity, potentially increasing farmers' incomes by 25-35% and contributing $95 billion to the GDP. Opportunities include financial assistance, infrastructure support, regulatory ease, and innovation through Research Parks and Clusters. Agritech startups focus on supply chain technology, sustainability, precision farming, online marketplaces, machine-based quality management, and storage facilities.

Keywords: Agritech startups, entrepreneurs, Agri hub

e-NAM: Way ahead in agricultural market efficiency- A longitudinal approach

Adrita Dam, Harbir Singh, Nithyashree ML, M Balasubramanian, Pramod Kumar, P.Venkatesh, Sumit Sutradhar and Shubho Paul
Division of Agricultural Economics, ICAR-Indian Agricultural Research Institute, New Delhi 110012
Email:adritacob@gmail.com ; bala.sbrmnn@gmail.com

India has achieved several milestones in agricultural production, yet challenges in agricultural marketing pertaining to small and marginal farmers. The government of India launched Electronic National Agricultural Market (e-NAM) to improve market efficiency and price discovery. This study evaluates the impact of e-NAM on trade concentration and price realization for last three financial years. The evidence indicates that trade concentration is high in specific commodities like flowers and oilseeds with substantial growth in share of total trade in terms of both volumes and values during the period 2022-23 as compared to 2021-22, but faced a decline in 2023-24. Farmers even failed to realize the Minimum Support Price (MSP) under e-NAM platform and prices on e-NAM generally fall below AGMARKNET prices. Further, e-NAM has expanded market access and trade volume, not uniform price realization for the farmers. Thus, e-NAM needs further refinement, such as better infrastructure, enhanced technology, and increased farmer participation, to realize its potential and ensure fair pricing outcomes for all stakeholders.

Keywords: Electronic National Agricultural Market (e-NAM), trade concentration, price realization, AGMARKNET

Digitalization of Agriculture and Implications for Prices

Agri-tech startups: Driving price transparency and market efficiency in agriculture

Neelam Sinha
Indira Gandhi Krishi Vishwavidhyalaya, Raipur
Email: itsneel12@gmail.com

Agri-tech startups are transforming agricultural markets by improving price transparency and market efficiency. These startups leverage digital platforms, AI, and blockchain to streamline supply chains, reduce transaction costs, and connect farmers directly with buyers. By providing real-time price information, demand forecasting, and logistics solutions, agri-tech startups minimize the role of intermediaries, leading to fairer pricing for farmers and consumers. Enhanced data analytics and predictive tools help optimize production and distribution, reducing wastage and improving supply-demand matching. Overall, agri-tech startups contribute to more efficient, transparent, and competitive agricultural markets, ultimately benefiting both producers and consumers.

Keywords Agri-tech startups, price transparency, market efficiency, AI

Can natural farming practices get certification, fetching premium price and stabilized market to farmers – Insights from coffee, a high value crop of Andhra Pradesh: A success story from India

Mahantesh Meliwinki1[1], Yash Srivastava[1], Saikumar C. Bharamappanavara[1*], Biswaranjan Baraj[1], Aniruddha Brahmachari[2], Bhavit Pant[2] and Vinuthna Patibandla[2]
[1] Sambodhi Research and Communications Pvt. Ltd
[2]Rainforest Alliance team (India)
Email: saikumar@sambodhi.co.in

Coffee is an export-oriented commodity for producing countries, and it is actively traded at international commodity exchange platforms, such as the International Exchange (ICE) New York and (ICE) London. Commissioned by Rainforest Alliance and funded by GEF7, Sambodhi Research and Communications Pvt Ltd conducted this study to comprehensively assess Andhra Pradesh's coffee production, certification practices, market structures, financial institutions, and value chains. A sample of 160 respondents cultivating coffee as their major crop was collected from Allu Seetarama Raju (ASR) in Andhra Pradesh. The study reveals that Arabica coffee yields more and commands a higher price than Robusta coffee. Pepper yields similarly for both varieties when intercropped. The most popular SAPs such as mulching and crop rotation which enhance soil fertility are widely adopted in the study area. Local markets are the most favored channel due to price competitiveness, but challenges such as monopoly commission agents and lack of transparency persist. However, MNCs like Tata Coffee have market ties in the region. Although awareness of crop certification is low due to financial and procedural barriers, farmers recognize that certified crops offer better prices, signalling potential for growth in this area. The study also suggests strategies to enhance certification and market linkages, including expanding education on sustainable agriculture and market awareness, promoting village-level processing techniques, training farmers in value addition, simplifying certification processes, fostering fair trade practices, and improving banking infrastructure and financial literacy, especially in tribal areas.

Keywords Coffee Production, Arabica and Robusta Coffee, Sustainable Agriculture Practices, Market Channels, Crop Certification

An assessment of the efficiency of groundnut marketing channels in Karnataka

Bhoomika, Jainuddin S M, Amrutha T Joshi, Satishkumar M and Vijaya B Wali
College of Agriculture, UAS Raichur, Karnataka
Email: bhoomikasangolage@gmail.com

Groundnut is a major oilseed crop contributing around 25.14 per cent of the total oilseeds production in the country during 2021-22. The present study examined the efficiency of existing groundnut marketing channels in the study area. The top two districts; Ballari and Chitradurga were selected from Karnataka based on area under groundnut crop. The results showed that most of the farmers were selling their produce through Channel –III in both Ballari (56.66 %) and Chitradurga (60.00 %) districts as majority of the oilseeds move towards processing for oil preparation. Price spread of groundnut growers was the lowest for channel I (2516 for Ballari and 2414 for Chitradurga) followed by channel-II and channel III. It is evident from the study that producer's share in consumer's rupees was higher for channel I in both Ballari (74.84 %) and Chitradurga (76.43 %) districts. Channel I was the most efficient as per the results of Shepherd's method and Acharya and Agarwal method in both Ballari and Chitradurga districts representing an important means for raising the income level of farmers.

Keywords Market efficiency, Marketing channels, Methods

Time for establishing the National Livestock Exchange (NLE)

S Rajeshwaran[1*] and Amrita Dhiman[2]
1 Dr Waran's Livestock Management Consultancy, Bangalore
2 Development Management Institute, Patna
Email: dr.waran@gmail.com

Considering the immense untapped opportunity to segregate the "above-average" females and males for considering them as "parent stock" for producing the next generation of young stock for producing milk or meat, it is imperative that an online platform is developed as a public good on the lines of the National Stock Exchange by the Government of India. This would enable individual farmers through their own associations to identify such animals belonging to them using RFID tags with 128 bit IPv6 addresses and enter their pedigree details and techno-economic parameters for each individual. Such information can be verified using PGS certification system and blockchain technology and ensure veracity and reliability. Once such foolproof identification an information system with zero information asymmetry in place, the top 20% can put up for trading on the auction platform while the rest can be put up on the sales platform. In the former, the buyer bids for a price and the seller will have the option of accepting / not accepting the offer. On the sales platform, near perfect free market works with since all data about the individual is available, duly verified and certified and enable the seller to get the best price for the breeding stock and the buyer to get the best animal for breeding within a specific price range, in a transparent manner. This will also pave way for financial credit institutions to provide long and short-term credit to entrepreneurs to debt leverage their purchase and rearing costs and insurance agencies can also offer designer risk cover products for 100% of the animals traded through the exchange covered for various eventualities. Only then can livestock rearing can be said to be truly inclusive and give a fillip to the entire livestock and agriculture sector.

Keywords Livestock Exchange RFID, IPv6, blockchain, market, inclusive

Role of e-NAM and ITC in enhancing market access for major pulses in C.G. Plains

Mukesh K Seth[1], V K Choudhary[1], Anurag[2], H Siwana[1], Subodh K Pradhan[1] and D K Kurrey[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur
[2]College of Agriculture and Research Station, Mahasamund, IGKV, Raipur
Email: drsethmk@gmail.com

The agricultural sector in India, especially in states like Chhattisgarh, faces significant challenges in the marketing of pulses, due to issues related to price volatility, limited market access and inefficient supply chain management. Over the past few years, digital platforms such as e-National Agriculture Market (e-NAM) and the involvement of private sectors like ITC Limited have emerged as transformative solutions to these challenges. Study explores the role of e-NAM and ITC in enhancing the marketing of pulses in Chhattisgarh plains, focusing on their impact on farmers' market access, price realization, and overall market efficiency. e-NAM facilitates direct online trading between farmers and buyers, promoting transparency, competition, and better price discovery. ITC, one of India's largest agribusiness companies, has also played a significant role in improving the marketing of agricultural produce, including pulses, through its supply chain initiatives, partnerships with farmers, and its 'e-Choupal' platform. This study employs both qualitative and quantitative data, including well prepared interview schedule with 150 farmers, 12 traders, and 40 stakeholders, as well as an analysis of market data from selected "mandis" (markets) in Balodabajar- Bhatapara, Mahasamund, Durg and Raipur district of Chhattisgarh. The research assesses the adoption of e-NAM by farmers, the challenges they face in using digital platforms, and the role of ITC in strengthening market linkages for pulses. Additionally, the study examines the impact of these platforms on farmers' income, market access, and their ability to secure better prices for their pulses. The major findings of the study suggest that e-NAM has improved market transparency and reduced the role of middlemen, enabling farmers to sell pulses at competitive prices. ITC's initiatives, including its direct procurement system, have further facilitated better price realization and ensured a steady market for pulses. However, the research also highlights certain barriers, such as limited digital literacy among farmers, infrastructural challenges, and the need for better awareness and training to fully capitalize on these platforms. This research concludes by providing the focus among the key area like effectiveness of e-NAM and private sector involvement, particularly through collaborations like ITC, to strengthen the marketing of pulses in Chhattisgarh and highlights policy recommendations and strategies to enhance the income and sustainability of pulse farmers in the region.

Keywords e-NAM, ITC, Pulses, marketing, Chhattisgarh, Agricultural markets, digital platforms

Assessing the effectiveness of digital platforms in connecting small-scale farmers to markets and reducing intermediaries

Avan Das Sahu, Aashi Sarva, Dushyant Kumar and Ankur Jaiswal
Indira Gandhi Krishi Vishwavidhyalaya, Raipur
Email: avandas119@gmail.com

Digital platforms offer small-scale farmers direct access to markets, aiming to reduce intermediary costs and enhance profitability. Studies show these platforms improve price transparency, reduce supply chain layers, and potentially increase farmers' incomes. However, barriers such as limited digital literacy and internet access in rural areas can hinder full adoption. Digital literacy programs and infrastructure improvements are recommended to maximize platform efficacy. Overall, while promising, digital solutions require supportive policies to foster equitable access and long-term success in linking farmers directly to markets.

Keywords Digital platforms, small- scale farmers, digital literacy, infrastructure

e-Platforms in agricultural marketing

B. Kiranmai[1], K. Sruthi Sai[1], G. Swetha[2], Ch. Shekhar[1]
1 Professor Jayashankar Telangana Agricultural University, Hyderabad
2 Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar
Email: kiranmai3500@gmail.com

The agricultural marketing system traditionally faced inefficiencies due to high costs, asymmetric information, and excessive middlemen, limiting farmer's profits. To address these, the Government of India launched the e-NAM platform in 2016, creating a unified online marketplace that provides competitive pricing, real-time information and secure payment processing. Private initiatives are e-Choupal, NCDEX, Ninjacart and AgriBazaar led digital agriculture marketing before government intervention. Apps such as Napanta, Uzhavan, and Bijak enhance digital engagement in agricultural marketing following e-NAM implementation. The study found that e-platforms reduce marketing costs, enhance price transparency, enable quick digital payments and eliminate middlemen, allowing farmers to reach larger buyers and improve their incomes. However, the constraints faced by the farmers were limited digital literacy, poor internet access and low awareness still restrict adoption. Increasing awareness and implementing digital literacy programs are suggested to make these platforms more accessible and beneficial for farmers.

Keywords e-NAM, marketing, e-platform

Effects of Indian government price support programs on farmer income and market stability

Renuka Tirsuniya
Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur
Email: renukatirsuniya84@gmail.com

Government of India support Minimum Support Prices (MSPs) which play a crucial role in ensuring the income stability of farmers and the overall stability of agricultural markets. This study investigates the effects of these price support mechanisms on farmer income and market stability, focusing on the economic outcomes for Indian farmers across various agricultural sectors. The research employs both quantitative and qualitative methods, analyzing data from government sources, agricultural price trends, and interviews with farmers and policymakers. The findings reveal that government price support programs, such as MSPs, have a significant impact on farmer income, particularly during periods of low market prices. These programs act as a safety net for farmers, offering guaranteed prices for certain crops and reducing the risk of income loss due to market fluctuations. However, the study also identifies several challenges associated with these price support schemes. While MSPs help stabilize income in the short term, they have led to overproduction of certain crops, resulting in market distortions and inefficiencies. Additionally, the benefits of MSPs are not uniformly distributed; smallholder farmers often face barriers in accessing these price guarantees due to inadequate procurement infrastructure, leading to disparities in the effectiveness of support programs. The study further highlights the broader impact of price support on market stability. While MSPs may provide temporary price stability, they can create imbalances in supply and demand, contributing to stockpiling issues and market inefficiencies. Additionally, the continued reliance on MSPs raises concerns about the long-term sustainability of such support programs, especially given the increasing fiscal burden on the government and the need for agricultural diversification.

Keywords Minimum Support Price, farmer income, market stability, agricultural policy, procurement, agricultural market distortions, crop diversification

Transforming agricultural markets: The impact of digitalization in Chhattisgarh's APMCs on transparency, efficiency, and farmer income

Devendra Kumar Kurrey[1] and Hulas Pathak[2]
[1]LM College of Agriculture and Research Station, Kerlapal, Narayanpur
[2]College of Agriculture, Raipur
Email: drdevendrakurrey95@gmail.com

The digitization of Agricultural Produce Market Committees (APMCs) in Chhattisgarh has revolutionized traditional agricultural marketing, fostering transparency, efficiency, and enhanced farmer income. Through the adoption of digital tools, including the Electronic National Agriculture Market (e-NAM) platform, Chhattisgarh's APMCs have modernized their operations to enable real-time price discovery, online bidding, and direct transactions. These advancements have substantially reduced the influence of intermediaries, allowing farmers to obtain fairer market prices. Data indicates that, following digital initiatives, farmer participation increased by approximately 30%, and price realization improved by 15-20% due to heightened competitive bidding. Mobile applications and SMS services further support over 50,000 farmers with timely information on market prices, trends, and weather, enhancing their ability to make informed decisions. However, challenges such as limited digital literacy, insufficient internet connectivity in rural areas, and inadequate infrastructure remain. Specific recommendations to address these barriers include providing digital literacy training, expanding internet and power infrastructure in APMC areas, simplifying digital processes to enhance accessibility, and increasing outreach efforts. Furthermore, integrating additional services like transport, storage, and quality certification within the digital platform and offering financial incentives could encourage broader adoption among farmers and traders. If successfully implemented, these improvements could create a more inclusive, efficient digital agricultural ecosystem in Chhattisgarh, potentially serving as a model for similar initiatives in other regions.

Keywords Digital agriculture marketing, APMC, e-NAM platform, Farmer income enhancement, Price transparency in agriculture, Digital literacy in farming

Digital transformation in agri-marketing: The impact of e-NAM in India

Dharni Sahu and Tushar Rao Pawar
Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur
Email: dharnisahu23@gmail.com

By connecting farmers and buyers online, e-NAM improves price discovery, reduces transaction costs, and enhances market efficiency. The National Agriculture Market (e-NAM) is pivotal to India's digital transformation in Agri-marketing, providing a unified platform that enables real-time pricing, transparent digital auctions, and expanded market access for farmers. However, adoption challenges, including infrastructure limitations and low digital literacy, persist. Despite these issues, e-NAM's potential to empower small farmers and promote fair pricing through continued policy support highlights its value for sustainable Agri-marketing across India.

Keywords e-NAM, digital transformation, agri-marketing, fair pricing, small farmers, price discovery.

The impact of e-commerce platforms on agricultural supply chains and market access for small-scale farmers

Dushyant Kumar, Dronak Kumar Sahu and Avan Das Sahu
Indira Gandhi Krishi Vishwavidyalaya, Raipur
Email: dushyant98agri@gmail.com

In India, the dealers of e-marketing are changing the supply chains and access to markets for small farmers that grow fruits and vegetables. Through direct consumer access and fewer middlemen, which these platforms facilitate, consumer prices, farmers' incomes and farmer vulnerability are enhanced. They also offer services including payment services, credit and training, efficiency, and market, opening access and urban markets. But issues like low computer proficiency, lacking physical and cyber infrastructures hamper the full involvement of all the farmers. It is therefore essential that these hitches are done away with to realize the impact of the e-commerce in steering the economy of agriculture in India in the right path.

Keywords e-commerce, cyber infrastructures, farmer vulnerability

A drastic shift from marketing to e-marketing especially for farmers, manufacturers, supply chain agro businesses

Muniganti Jahnavi
College of Agriculture, IGKV, Raipur
Email: munigantijahnavi123@gmail.com

Digital marketing is essential to India's agriculture sector's broader digital transformation. The agriculture industry in India is vital to the economy, as it employs and provides income for a substantial portion of the population. With the advent of digital technologies, agricultural product marketing and sales have undergone a swift transformation. Given the unique characteristics of the agriculture sector, such as the fragmented supply chain, lack of digital literacy among farmers, and limited internet penetration in rural areas, managing customer experience in digital marketing for agricultural products in India presents numerous challenges. Nonetheless, the opportunities for managing customer experience in digital marketing for agricultural products in India are vast, such as the expanding market potential for digital agriculture, the increasing adoption of smartphones and mobile internet, the emergence of e-commerce platforms and marketplaces, and so on. To surmount these obstacles and take advantage of these opportunities, best practices include developing user-friendly and accessible digital platforms, providing farmers with timely and relevant information and services, etc. The present study concludes with implications for future research and practice, concluding remarks and suggestions for managing the consumer experience in digital marketing for agricultural products in India.

Keywords India, digital marketing, farmers, agriculture, customer experience, e-commerce

Revolutionizing agricultural markets through Agri-Tech innovation

Kalyani Dahariya
Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur
Email: kalyanidahariya@gmail.com

This study investigates the transformative impact of Agri-tech start-ups on agricultural markets. By harnessing technology, these start-ups boost price transparency, accessibility, and overall market efficiency. Key findings indicate that Agri-tech start-ups boost farmer income by 15-20%, streamline market channels, reducing intermediaries by 30-40%, and stabilize prices by 25-30%. These outcomes underscore the pivotal role of agri-tech start-ups in optimizing agricultural markets, ultimately benefiting farmers, consumers, and the sector at large.

Keywords Agricultural innovation, market optimization, price stability, agri-tech solutions.

The role of digital platforms and agri-tech startups in enhancing market access and price efficiency in agriculture

Khushboo Bhagat, V K Choudhary, Lalenpuii and Urmila Bhagat
Indira Gandhi Krishi Vishwavidyalaya, Raipur
Email: kbbhagat2512@gmail.com

The study examines emerging digital platforms including digital marketplaces, mobile applications, and smart supply chain solutions in improving transparency around pricing, lowering transaction costs and facilitating farmers access to broader markets and essential financial services. Through these innovations, smallholder farmers are better positioned to make informed decisions and achieve fairer prices for their produce and further explores a range of recent agri-tech developments, including blockchain enabled traceability for ensuring product authenticity, Internet of Things (IoT) based monitoring systems to optimize yields and mobile-based financial solutions that offer secure, accessible payment options and credit services to rural farmers. By integrating these technologies, agri-tech firms not only address inefficiencies in traditional agricultural supply chains but also create more resilient, data-driven ecosystems that align with global demands for sustainable and transparent food production systems. However, infrastructure limitations, particularly in rural and underserved regions, pose barriers to reliable digital connectivity, while regulatory frameworks often lag behind the pace of technological innovation. Adoption barriers are also prevalent among smallholder farmers, many of whom lack digital literacy or mistrust technology solutions that may appear complex or foreign. Recognizing these obstacles, this paper emphasizes the importance of public-private partnerships (PPPs) in addressing structural limitations and fostering an environment conducive to digital transformation and suggests policies such as strategic investments in digital infrastructure, incentives for innovation targeting rural needs and frameworks to encourage collaboration between governments, startups and private investors. Such policies are essential for achieving long-term improvements in market efficiency, price transparency and farmer livelihoods, contributing to more resilient and equitable agricultural systems.

Keywords Public Private Partnership, Agri-tech, digital platform, Internet of Things (IoT), blockchain

Enhancing market efficiency and price stability through agri-tech innovation: The role of startups in transforming agriculture

Mandas Banjare and Tanuja Ekka
Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur
Email: maanbanjare6226@gmail.com

The rise of agri-tech startups has transformed traditional agricultural practices and considerably influenced price stability and market efficiency in the agricultural sector. Making the best use of digital tools like artificial intelligence, data analytics, and Internet of Things (IoT) sensors, these startups are delivering key challenges such as price instability, supply chain inefficiencies, and deficit of real-time market information. By providing farmers with data-driven insights on crop yields, market prices, and weather patterns, agri-tech startups help optimize production schedules, reduce waste, and align supply more closely with demand. Moreover, digital marketplaces created by these startups have benefited direct farmer-to-consumer sales, diminishing overreliance on intermediaries and highlighting pricing clarity. This access to real-time information also enables farmers to make better decisions, reducing price inconstancy caused by supply abundance or insufficiencies. However, the overall impact on market efficiency and pricing is intricate and varies across regions, depending on factors such as digital literacy, infrastructure, and access to technology. This paper finds out the multi-dimensional role of agri-tech startups in promoting price stagnation and market competency, analyzing both their benefits and the challenges that could limit their impression on global agricultural markets.

Keywords Agri-Tech Startups, artificial intelligence, supply chain, digital literacy, technology

Value chain dynamics and farmer participation: Insights from Basmati rice value chain in Uttarakhand

Neha Joshi[1], Anil Kumar[2], and Purushottam Sharma[1]
[1]ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi
[2]GBPUAT, Pantnagar
Email: nehaagrieco@gmail.com

The study explores the export-oriented value chain for Basmati rice in Uttarakhand, aiming to assess its functioning and identifying barriers. A participatory analysis, based on a primary survey of 120 producers and 12 stakeholders across the state revealed that, despite its geographical advantages, the state's contribution to India's Basmati exports remains underutilized due to a weakly integrated value chain and limited institutional support. Smallholders dominating the production (68%), face barriers such as inadequate access to institutional credit, weak market linkages, and insufficient knowledge of export standards. Using a value chain approach, the study mapped key actors, their roles, and interdependencies. Wholesalers govern 72% of transactions informally, restricting producers' access to equitable pricing. Exporters, while contributing to value addition through processing, lack direct engagement with producers. Empirical results based on the Heckman two-step model identified landholding size, livestock ownership, and access to market information as drivers influencing participation in export-led value chains, while non-farm income sources and declining yields deter engagement. Institutional gaps, particularly in quality certification, export facilitation, and credit accessibility, further exacerbate these challenges. The study recommends strengthening the market information system and inclusion of public institutions to ensure access to quality seeds and foster direct producer-exporter linkages.

Keywords Basmati, value chain, public institutions.

Digital transformation in agri-marketing: Private market in agriculture sector

Laxmi Bagh, Neha Lakra, Siddharth kumar and Siya Ram
Indira Gandhi Agricultural University, Raipur
Email: laxmibagh890@gmail.com

The Private Market in Agriculture refers to the part of the Agricultural Sector where Businesses, producers, and investors operate outside of government-controlled or publicly funded systems. These entities engage in the Production, Distribution, and sale of Agricultural Products with the primary goal of making a profit. The Private Market in Agriculture can encompass a wide range of activities, From Farming and Food Production to Agribusiness Services, Technology, and Retail. Private financial sector investment in agriculture is a small but rapidly growing phenomenon, involving Large Scale Financial Institutions, Hedge Funds and Real Estate Investment trusts as well as Private/Public companies pursuing farm Ownership/ Management Strategies. Here's a breakdown of its key Components: Private Farms and Agricultural Producers, Agribusinesses, Agricultural Finance and Investment, Technology and Innovation. The private market is the home of private equity and private debt. Due to the historic performance of these asset classes, the markets have grown exponentially. Increasing numbers of investors are attracted by the opportunity to target returns which can be superior to those available on public markets, but it's associated with some demerits like Market Challenges, Market Fluctuations, Access to Capital, Regulation and Risk. Private Market investments in the Agricultural Sector are crucial. They offer more flexibility and longer-term strategic support than Public Market Investments, Stakeholder, Venture Capitalist etc, Enabling Agricultural Enterprises to navigate industry-specific challenges with agility and resilience Overall, the Private Market in Agriculture plays a pivotal role in ensuring that food reaches consumers efficiently, drives technological advancements, and responds to the demand for diverse products.

Keywords Agri-marketing, digital transformation, private market

Enhancing Price and Market Efficiency through Agri-Startups

Mahendra Kumar Kemro
Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur
Email: mkemro2000@gmail.com

This study investigates the impact of agri-startups on price and market efficiency in agricultural markets, revealing significant benefits. By leveraging innovative technologies and business models, agri-startups improve market transparency, reduce transaction costs, and enhance farmer access to markets. Notably, the analysis shows a 10-15% reduction in price volatility, a 20-25% increase in farmer income, and a 30-40% reduction in market intermediaries. These findings suggest that agri-startups substantially enhance price discovery, market liquidity, and efficiency, underscoring the potential for targeted policy support to foster inclusive and sustainable agricultural growth through these innovative ventures.

Keywords Agri-startups, market efficiency, price volatility, agricultural development.

Empowering farmers through e-commerce: Enhancing market access, reducing intermediaries, and building sustainable agriculture

Siya Ram, Laxmi Bagh. Virendra Kumar, Sidharth Kumar, and Bhawana Patel
Indira Gandhi Krishi Vishwavidyalaya, Raipur
Email: siyaramsingh0886@gmail.com

Agriculture is crucial for global food security, poverty reduction, and economic stability, especially in developing regions, yet smallholder farmers often struggle with limited market access, leading to reliance on intermediaries. This study presents "Harvest Hub," an E-Commerce Application designed to empower farmers by enabling direct market access in local languages, allowing them to buy and sell agricultural products from seeds to produce. Examining case studies like Tanzania's NINAYO program, the research highlights how improved informational capabilities (ICs) enhance farmer satisfaction and economic success. Findings show e-commerce platforms can boost market access, rural development, and sustainable practices, although digital literacy and infrastructure barriers persist. Strategic policies in training, infrastructure, and financial access are vital for maximizing the benefits of digital agriculture in promoting inclusive growth and food security.

Keywords e-commerce, digital agriculture, rural development, sustainable agriculture, food security

Transforming agricultural markets: The power of Public-Private Partnerships

Omica Lakra
Indira Gandhi Krishi Vishwavidyalaya, Raipur
Email: omicalakra10@gmail.com

Public-private partnerships (PPPs) are driving the digital transformation of agricultural marketing, enhancing farmer livelihoods and promoting sustainable agriculture. This study analyzed over 20 PPPs, identifying key success factors: enhanced market access, improved price discovery and transparency, and increased supply chain efficiency. Notably, PPPs boost farmer income by 25%, reduce transaction costs by 30%, and increase market efficiency by 40%. By leveraging these partnerships, agricultural marketing can be revolutionized, fostering economic growth and sustainable agriculture. This research underscores the potential of PPPs to transform the agricultural sector, promoting a more equitable and efficient food system.

Keywords Public-Private Partnerships (PPPs), digital agriculture, agricultural marketing, digital transformation, sustainable agriculture.

A case study on modern adaptation of value chain in central Chhattisgarh

Prawindra Bhagat and Mandas Banjare
Indira Gandhi Krishi Vishwavidyalaya, Raipur
Email: bprem0085@gmail.com; Maanbanjare6226@gmail.com

The study revealed that differentiation in the institutional situations of agricultural materials and markets in Central Chhattisgarh are linked to differing levels of harmonization and control within the facilitating environment across supply chains. National and local networks play a vital role in strengthening value chains by increasing value addition, improving methodology, expanding market access, and increasing the benefit of agricultural products. However, critical challenges persist in the growth of value chains in Central Chhattisgarh. There is a need to strengthen financial systems, particularly by emphasizing formal financial mechanisms. Addressing cultural factors that may hinder value chain efficiency is essential. Mitigating risks related to climate change remains a significant concern. By addressing these issues, the study highlights the potential to enhance agricultural value chains in Central Chhattisgarh, improve farmer livelihoods, and promote sustainable adaptation to climate change.

Keywords Value chain, livelihood, supply chain, financial mechanism, marketing

Price transmission and behaviour of tea markets: An empirical investigation

S. Elamathy and K.M. Shivakumar
Tamil Nadu Agricultural University, Coimbatore
Email: elamathykavi24@gmail.com

Tea is an important beverage crop which is consumed often next to water worldwide. It is valued for its young leaves and buds from which tea is produced. Globally, India stands second in production and fourth in exports next to China, Kenya and Sri Lanka. Two third of domestically produced tea is consumed within our country and stands as home for CTC (Crush Tea and Curl), orthodox and green tea. This paper examines whether the Indian tea market is integrated with international tea market. Domestic markets chosen are Kolkata and Coonoor and International markets, Colombo and Mombosa are selected. Using Johansen co-integration and Vector Error Correction Model (VECM) the long run and short run integration between markets is studied. The test affirms that the markets are integrated in long run and short run, with kolkata as a most influential market among chosen markets. The volatile behaviour of tea market is estimated by Auto-Regressive Conditional Heteroscedasticity (ARCH) and Generalized Auto-Regressive Conditional Heteroscedasticity (GARCH). Kolkata market is highly volatile followed by Coonoor and Mombosa. Despite the challenges faced by Indian tea industry the performance of Indian tea market is more efficient. However, to ensure the resilience of Indian tea market globally the quality standards and production practices must be taken care amid the climate change decade.

Keywords Market Integration, Price Volatility, Price transmission

Revolutionizing agri-product distribution through innovation

Homesh Jaiswal
Indira Gandhi Krishi Vishwavidyalaya, Raipur
Email: hkjaisewal998@gmail.com

This study delves into ground-breaking innovations transforming the distribution of agricultural products, harnessing the power of e-commerce, sustainable logistics, smart supply chains, and blockchain technology. These cutting-edge solutions enhance farmer-consumer connectivity, reduce carbon footprint by 20-30%, optimize supply chain efficiency by 25-40%, and ensure transparency and traceability. Notably, findings indicate significant benefits, including a 15-25% increase in farmer income, 30-40% reduction in product spoilage, and 20-30% boost in consumer satisfaction. By exploring these innovations, stakeholders can create a more efficient, sustainable, and equitable agri-product distribution system, ultimately improving the livelihoods of farmers and consumers alike.

Keywords Agri-product distribution, e-commerce, sustainable logistics, smart supply chain, blockchain

A deep dive into Karnataka's pepper production and marketing: learnings from potential landscape

Saket Panbude[1], Yash Srivastava[1], Saikumar C. Bharamappanavara[1], Biswaranjan Baraj[1], Aniruddha Brahmachari[2], Bhavit Pant[2] and Subba Reddy Konda[2]
[1]Sambodhi Research and Communications Pvt. Ltd
[2]Rainforest Alliance team (India)
Email: saikumar@sambodhi.co.in

Most of the India's pepper production is concentrated in the southern states of Kerala, Karnataka, and Tamil Nadu. These states, with their humid tropical climates, are well-suited for pepper cultivation.2This research study, carried out by Sambodhi Research and Communications Pvt Ltd with support from Rainforest Alliance- [Global Environment Facility (GEF) funded], focused on evaluating pepper production, certification awareness, market dynamics, financial access, and value chain analysis the major pepper-producing areas of Karnataka. As part of the Sampling approach, a multi- stage sampling method was employed to survey 177 farmers, spread across twelve villages of two districts of Chikkamagaluru and Coorg in the state of Karnataka. Probability Proportional to Size (PPS)8 sampling was used to select villages and blocks, while systematic random sampling was used to select households within villages. Further to make study design more robust, a mixed method approach is adopted to comprehensively assess the landscape of pepper. The major finding of the study was, despite widespread awareness of Sustainable Agricultural Practices (SAPs), most farmers continue to rely on conventional methods. Pepper growers mainly sell to local and wholesale markets, favouring proximity and pricing. Farmers experience minimal post-harvest losses, mostly during harvesting. Many believe there is little potential for value addition due to a lack of skills and financial support. Informal agents and APMCs are seen as market channels for value-added products, while labour and financial constraints hinder agri- entrepreneurship. Access to finance is primarily through commercial banks and cooperatives. Their preferred financial sources are assessed using Garett ranking technique. Most respondents are unaware of crop certification and were skeptical about its potential for better pricing. Hence, efforts are much needed to create awareness and capacitating farmers on certification.

Keywords Pepper, Sustainable Agricultural Practices (SAPs), Marketing channels, financial sources, Crop Certification

Agriculture marketing laws and regulations

Shailesh Kumar and Ashish Timothy
Indira Gandhi Krishi Vishwavidhyalaya, Raipur
Email: ashish.timothy19@gmail.com

Agricultural marketing in India is governed by a complex legal framework. The Agricultural Produce Market Committee (APMC) Act regulates market infrastructure, while the Essential Commodities Act controls production, distribution, and pricing. The Food Safety and Standards Act ensures quality standards. Other key regulations include the Contract Farming Act and state-specific APMC Acts. These laws impact market access, price discovery, and quality standards. Stakeholders must understand them to navigate the landscape effectively. Effective compliance enhances market efficiency, farmer benefits, and consumer protection. Regulatory clarity is essential for India's agricultural growth and global competitiveness, necessitating ongoing legal framework evaluations.

Keywords Agricultural marketing, APMC, regulation

Sustainable agri-marketing through digital innovations

Rahul Kumar Kaushik[1], Hem Prakash Verma[2] and Sanket Kaushik[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur
[2]ICAR-National Institute of Biotic Stress Management, Raipur
Email: rahulkaushik292929@gmail.com

The integration of digital innovations into Agri-marketing is revolutionising the agricultural sector by promoting sustainability alongside economic growth. Technologies such as blockchain, IoT, artificial intelligence, and e-commerce platforms are enabling transparent supply chains, optimising resource usage, and reducing waste. These tools empower farmers through direct market access, real-time monitoring of crop production, and data-driven decision-making, ensuring eco-friendly and socially inclusive practices. Digital platforms also play a pivotal role in educating consumers about sustainable products, encouraging the adoption of environmentally responsible purchasing behaviours. By fostering closer connections between producers and consumers, these technologies create opportunities for more resilient agricultural markets. However, the journey towards widespread adoption is not without challenges. Issues like the digital divide, inadequate rural infrastructure, and the need for policy interventions must be addressed to ensure equitable access to these transformative tools. This highlight the potential of combining digital technology with sustainability objectives to create a more efficient, transparent, and environmentally conscious agricultural marketing system. Strategic efforts and targeted investments are essential to maximise the impact of these innovations while addressing global challenges like food security and climate change.

Keywords Sustainable agriculture, digital innovations, agri-marketing, blockchain, IoT, eco-friendly practices, consumer awareness.

A study on asymmetric price transmission in Gujarat's major cereal markets

Damor Joyal Rupsinh
Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India.
Email: damorjoyal14@gmail.com

For analysing asymmetric price transmission of major cereals of Gujarat state from 2001-2022 Paddy, Wheat, Maize, and Pearl Millet was selected purposively for the study as they were contributing maximum to the markets of Gujarat in terms of arrivals. On the basis of highest wholesale and retail price during January 2001 to December-2022 , twelve markets ; three markets for each selected cereal were selected . Negative values of ECT (+) (Error Correction Term) markets of selected cereals indicated slow adjustments when the prices were above equilibrium. Positive values of ECT (-) in markets of selected cereals indicated quicker adjustments when the prices were above equilibrium. All the markets of selected cereals rejected null hypothesis of test of symmetry and resulted in asymmetry of price behaviour, which showed potential market inefficiencies or retailer power in market.

Keywords Asymmetric price transmission, error correction term, equilibrium, market inefficiencies, stationarity, Unit root test.

Value chain analysis of mushroom marketing systems in Bilaspur district of Chhattisgarh

Krishna and Praveen Kumar Verma
Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh
Email: krishna15031996@gmail.com

The study was conducted in Bilaspur district of Chhattisgarh during the year 2022-23 to 2023-24, had analysed the value chain analysis and cost and return of value-added products of mushroom. The overall total cost incurred in value-added product of mushroom overall total cost incurred was 836.03 Rs. Per kg. of dry mushroom, 155.07 Rs. Per kg. of mushroom badi and 218.06 Rs. Per kg. of pickle. value-added product of mushroom overall net return was 363.97 Rs. Per kg. of dry mushroom, 344.93 Rs. Per kg. of mushroom badi and 281.94 Rs. Per kg. of pickle.

Keywords Value chain, cost and return, marketing, price spread

Technological Innovations and Agricultural Productivity

Impact of off-farm income on expenditures on farm inputs and consumption of paddy farmers: An endogenous switching regression model approach

Umanath Malaiarasan[1*], R Paramasiavam[2], V Karthick[3] and V Saravanakumar[4]
[1]Madras Institute of Development Studies, Chennai
[2]Vellore Institute of Technology, Chennai
[3]Institute for Social and Economic Change, Bengaluru
[4]Tamil Nadu Agricultural University (TNAU), Coimbatore
Email: umanatheconomics@gmail.com

Off-farm income-generating activities improve farmers' welfare and farming performance by providing financial assistances that enhance economic stability and living standards. This study investigates the impact of off-farm income-generating activities on consumption and farm input expenditures among paddy-growing farmers in India, using farm household survey data provided by the National Sample Survey Office (2017-18), Government of India, adopting endogenous switching regression model to control for confounding variables and sample selection bias. Findings revealed a significant increase in expenditure for farm households engaged in off-farm activities, especially consumer expenditure increases by about 31% and farm input expenditure by about 41%. Higher educational attainment, larger household size, and traditional media contacts raise the likelihood of participating in off-farm works, while the presence of a dwelling unit, larger farm size, and training attendance reduce it. These results emphasize the need for policymakers to promote diversified income sources and employment opportunities to enhance economic stability among paddy-growing households.

Keywords Off-farm income, ESR, farm households, selection bias, probit

Drivers for farm capital formation (institutional v/s non-institutional sources) in agriculture: Empirical evidence in Southern Karnataka

Hamsa KR[1]*, Umesh KB[2] and Veerabhadrappa Bellundagi[3]
[1]College of Agriculture and Research Station, Kurud, Chhattisgarh
[2]University of Agricultural Sciences, GKVK, Bengaluru
[3]Department of Agricultural Economics, BAU, Sabour, Bhagalpur, Bihar
Email: hmmshamsa@gmail.com

This micro-level study was conducted in Southern Karnataka, explicitly focusing on progressive and less progressive areas with the objective of understanding the institutional and non-institutional sources of farm capital formation and their drivers, with a total sample size of 240. Relatives/friends were identified as the primary source of borrowings in both progressive (39 %) and less progressive areas (56%) in farm assets investment because of easy access to immediate requirements. Analysis revealed that the credit delivery to the agriculture farm investment sector remains relatively inadequate. The banking system (institutional source) is hesitant to provide credit to small and rainfed farmers' farm capital investment on various grounds. Also, it is interesting to observe that the institutional credit was statistically significant in both areas. This shows the importance of institutional credit on capital formation as most farmers may not have investable surpluses with them, and this credit augments the capital formation. It is suggested that to reduce farmers' dependency on non-institutional sources of credit in both areas, particularly in the less progressive areas, the loan procedural formalities (administrative costs) should be made simple and farmers-friendly. Creating awareness among farmers is vital to improving the accessibility of credit (mobile banking) for medium- and long-term loans for farm capital investments.

Keywords Farm capital formation, institutional source, non-institutional source, progressive area, less progressive area

Blockchain technology in the agriculture industry: case studies of leading blockchain companies

Shaik Muneer[1*] and Hulas Pathak[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh
Email: shaikmuneer1911@gmail.com

Blockchain technology is rapidly emerging as a transformative tool in the agricultural sector, vital to many economies, including India. The technology offers a decentralized, transparent, and secure system that addresses key challenges such as inefficiencies in the supply chain, lack of transparency, and issues related to the authenticity and quality of produce. Blockchain's ability to create a tamper-proof digital ledger ensures data integrity and security, crucial for applications ranging from smart farming to agricultural insurance and land registration. The technology also enhances traceability in food supply chains, improving food safety, reducing fraud, and fostering consumer trust. Several case studies, such as APEDA's blockchain initiative for organic produce and platforms like TraceX and IBM Food Trust, demonstrate blockchain's practical benefits and wide-ranging applications in agriculture. Despite its promise, widespread adoption requires making blockchain more economically viable and gaining broader industry acceptance. A collective effort similar to the pharmaceutical industry could drive the necessary advancements and lead to a more sustainable and resilient food system.

Keywords Agriculture, blockchain technology, food supply chains, secure systems, transparent and traceability

Innovations in agri-input and services market towards sustainable agriculture in India: a systematic literature review

Neelam Singh[1], Dibakar Sahoo[2*] and Prasanta Moharaj[3]
[1]Faculty of Social Sciences, Banaras Hindu University, Uttar Pradesh
[2]School of Law, Dayananda Sagar University, Bangalore
Email: dibakar@bhu.ac.in

This study provides a systematic literature review on innovations in agri-input and services markets aimed at fostering sustainable agriculture in India. Climate change substantially challenges agricultural productivity, particularly for smallholder farmers with limited adaptive capacities. Innovations such as agroforestry, precision agriculture, climate-smart practices, and digital agricultural extension services have demonstrated the potential to enhance the resilience and productivity of farming systems. This review identifies significant advancements in agri-inputs and market services, including adopting improved seed varieties, efficient irrigation techniques, and establishing Farmer Producer Organizations (FPOs) that enhance farmers' market access and financial support. The study examines the socio-economic, climatic, structural, institutional, and political factors influencing the adoption of these innovations. Additionally, it evaluates the contributions of these innovations to several Sustainable Development Goals (SDGs), including poverty reduction, zero hunger, economic growth, climate action, and sustainable land management. The findings highlight the need for enhanced data analytics, integration of advanced technologies, policy support, and gender-sensitive approaches to promote sustainable agricultural practices further. Addressing gender biases and promoting clean energy solutions are crucial for achieving broader developmental goals. The findings suggest future research avenues in data analytics, advanced technologies, sociocultural studies, policy support, climate-smart agriculture, and market services to enhance agricultural systems' resilience and sustainability. This review underscores the critical role of collaborative efforts among governments, private sectors, and international organizations in advancing sustainable agriculture in India.

Keywords Systematic review, innovative agri inputs, sustainable agriculture, ICT

Competitiveness and sustainable growth trajectory of India's horticultural sector: insights from Jammu and Kashmir

S A Wani[1], Kiran Kumara T M[2], F A Shaheen[3], S H Baba[4], Abid Sultan[5*], Irtiqa Malik[6] and Uzma Majeed[7]

[1]Faculty of Horticulture, SKUAST-K, Shalimar; [2]National Institute of Agricultural Economics and Policy Research, New Delhi; [3]Institute of Business and Policy Research, SKUAST-K, Shalimar; [4]Institute of Business and Policy Research, Shalimar-190025; [5]Institute of Business and Policy Research, Shalimar; [6]Institute of Business and Policy Research, SKUAST-K, Shalimar; [7]Division of Agricultural Statistics, SKUAST-K
Email: abidsultan@skuastkashmir.ac.in

The horticulture sector is pivotal in India's agricultural economy, particularly at the regional level. The country's diverse agro-climatic conditions allow for the year-round cultivation of various horticultural crops, creating numerous economic opportunities for value addition and trade. The horticulture sector drives national and international trade in regions such as Jammu and Kashmir, owing to a strong production base and high-quality output. The Union Territory is renowned globally for producing high-value fruits like apples, walnuts, almonds, saffron, and apricots, celebrated for their taste, quality, and export potential. Despite these resource advantages, the horticulture sector in Jammu and Kashmir faces significant challenges, especially in enhancing the competitiveness of its dominant fruit crops on the international stage. In this context, the current study offers a thorough analysis of the competitive landscape of selected horticultural crops, identifies key challenges, and proposes strategic interventions to unlock their potential in the global market fully. The study reveals that Jammu and Kashmir's horticulture sector is vital to India's agricultural output and export earnings. The region is the country's leading apple producer, with fruits and vegetables making up 59.5% of its agricultural Gross Value Added (GVA) by 2020-21. Despite their economic significance, Indian apples, walnuts, and almonds face global competitiveness challenges, with low Revealed Comparative Advantage (RCA) due to climatic issues, lower yields, and infrastructure deficiencies. The study suggests investments in R&D, infrastructure, and market access enhancements to improve competitiveness.

Keywords Horticulture, high-value fruits, export potential, competitiveness, Gross Value Added (GVA), Revealed Comparative Advantage (RCA)

Impact of crop insurance on input use in paddy: evidence from Odisha

Khirod Kumar Chaudhury
UGCTE, MSCB University, Odisha
Email: khirodabc@gmail.com

Input use holds considerable significance in determining crop yield. However, overuse of farm inputs such as fertilizer and pesticides increase the cost of production and adversely affects human health. Farmers' intensity of input use is significantly influenced by crop insurance. The existing literature indicates diverse evidence on the impact of crop insurance on input use decisions by the farmers who have adopted crop insurance. It may imply that the cost of cultivation incurred by the insured and non-insured farmers will significantly differ. This paper provides empirical evidence on the relationship between crop insurance and input use based on primary survey data collected from 400 households in Odisha in 2016. It estimates the cost of cultivation of the insured and non-insured farmers based on the Commission for Agricultural Cost and Price method. The cost of cultivation differs across the insured and non-insured farmers, the latter incurring more. The results estimated from the regression analysis reveal crop insurance to have a negative impact on input use and yield. Based on the findings, policy implications were drawn.

Keywords Input use, crop insurance, insured and non-insured farmers

Startup: the impact of alliance strategies on innovation performance

Siddharth Kumar[1]*
[1]Department of Agri Business and Rural Management, College of Agriculture, IGKV, Raipur
Email: siddharthpisda@gmail.com

India has the 3rd largest startup ecosystem globally and is expected to witness a consistent annual growth of 12-15%. India had about 50,000 startups in 2018; around 8,900 - 9,300 were technology-based, which is increasing over the years. Around 1300 new tech startups were established in 2019 alone, implying 2-3 tech startups are born daily. Indian startup ecosystem could see 370 growth-stage startup funding deals in 2023, up only 4.5% from 354 such deals in 2022. Further, the growth-stage funding could touch $7.4 Bn in 2023, approximately 3.9% less than the $7.7 Bn raised in 2022. This study contributes to such a dynamic perspective by incorporating a time dimension in analyzing the innovation performance implications of alliance strategies. At the same time, it is acknowledged that managing such a balanced alliance portfolio is not straightforward for startups. Also, policymakers increasingly adopt an open innovation paradigm. Policymakers have started recognizing that intensive collaboration between different actors is vital to a healthy national or regional innovation system. The open innovation paradigm emphasizes the importance of alliances for improving firms' innovation performance. However, existing empirical research on innovation performance implications of alliances is dominated by cross-sectional studies. As a result, the time frame of alliances influencing innovation performance is unknown. This study assessed the impact of different time frames of alliance strategies on innovation performance. In order to do so, panel data was collected on 217 Flemish startup firms. The results show a positive association between 'discontinuous alliance strategies' with suppliers, customers, and competitors and 'incremental' innovation performance. In addition, a positive impact of 'continuous alliance strategies' with suppliers, competitors, universities, and other research institutes on 'radical' innovation performance was observed. These findings encourage startup firms to balance their alliance portfolio in terms of different kinds of partners and different kinds of time frames.

Keywords Innovation, policymakers, portfolio, performance, alliance strategies

Ex-ante assessment of bio-ethanol program: implication for crops, land and water

Seema Arya[1*] and Kingsly Immanuelraj[2]
[1]Division of Agrl. Economics, ICAR-Indian Agricultural Research Institute, New Delhi
[2]ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi
Email: seemaarya10695@gmail.com

India's search for alternative fuel sources has intensified in recent years with the crucial amendment to the National Policy on Biofuel, 2018, intending to achieve 20% ethanol blending by 2025-26. This study uses a price endogenous mathematical programming model to assess the impact of the trade-off between food and fuel crops, particularly the competition for land and water. The results show that the area under cultivation of fuel crops such as sugarcane and maize will increase to meet ethanol demand. The extent of the increase in acreage and irrigation water depends on the regulation scenarios on the type of feedstock used, such as sugarcane juice, B-molasses, C-molasses, maize, and damaged grains.

Keywords Ex-ante assessment, sugarcane, bio-ethanol, biofuel

Rental services of combine harvester's uses in Nepal's Terai: recent innovation in technologies and in hiring practices

Madhusudan Bhattarai[1*] and Ujjal Raj Acharya[2]
[1]Senior development economist, Kathmandu, Nepal
[2]Economist, Kathmandu, Nepal
Email: madhu.bhattarai2010@gmail.com

The rental services for combine harvesters (CH) in Nepal's Terai have significantly improved access to agricultural mechanization for smallholder farmers, addressing seasonal labor shortages and enhancing crop productivity and profitability. The recent growth of Custom Hiring Centers (CHCs) and the use of digital technology (GPS) (and digital platforms) have made the rental services more efficient, effective, easy to supervise by owners, and accessible to large numbers of farmers, which was not the case 8-10 years ago. This paper is prepared with a rapid survey of rental markets of combine harvester rental uses across 12 districts from west to east parts of Nepal's Terai carried out in the middle of 2024. The rental price is generally charged on an hourly basis or per hectare of land harvested. In the Terai, the average rental cost for a combine harvester for paddy ranges from NPR 7,000 to 10,000 per hectare, depending on the location, field types, crop type, and machine specifications. Some providers offer discounts for bulk bookings of CH by farmers or cooperative groups for efficient machine uses and foster long-term relationships with farmers. Findings reveal that rental services have improved the harvesting efficiency of rice, wheat, and maize, reduced post-harvest losses, reduced the cost of harvesting by 50% compared to the available alternatives, and enabled timely completion of operations, crucial for the success of rice and wheat farming in the Terai of Nepal. The rental model of CH in Nepal has seen several innovations, such as dynamic pricing based on seasonal demand and field location. However, challenges include high initial costs for purchasing combine harvesters, limited rural infrastructure (village roads), and a shortage of trained CH operators. Government policies, subsidies of initial capital cost for CHC, and cooperative models are recommended to enhance access to mechanization. The success of rental services is evident in their widespread adoption, with potential for further growth through targeted policy support, infrastructure improvements, and the expansion of digital platforms. The successful scaling up of CH technology in Nepal's Terai, with the average size of land holding less than 0.50ha per household and with much smaller plot size, suggests that large-scale pulling of land among farmers is not needed for smallholder farm mechanization and for widespread use of even such bulky machinery like harvester in Nepal. The same applies to other developing countries. The fast-paced adoption of GPS-based surveillance systems on the machine and the use of digital platforms have substantially reduced transaction costs on rental businesses and provided ease to owners in monitoring the machine uses in distance locations and ease in receiving payment from distanced-located customers. Scaling-up harvester use in Nepal has increased cropping intensity significantly in Nepal's Terai within 8 to 10 years. Overall, combine harvester rental services are playing a critical role in modernizing Nepal's agriculture, improving cropping intensity and crops productivity at scale, and improving smallholder farmers' income and livelihoods in Nepal's Terai.

Keywords Combine harvesters, Nepal's Terai, GPS, CHCs

Impact of information on wheat productivity in India: evidence from a large-scale household survey

Vinita Kanwal[1], Soumya Mohapatra[2], Jyothimol Joseph[3], Balaganesh G[4], Pouchepparadjou Anandan[5] and Ramadas Sendhil[3*]

[1] Punjab Agricultural University, Ludhiana
[2] ICAR-Central Institute of Post Harvest Engineering & Technology (CIPHET), Ludhiana
[3] Pondicherry University (A Central University), Puducherry
[4] ICFRE- Forest Research Institute (FRI), Dehradun
[5] PJN College of Agriculture and Research Institute, Karaikal
Email: sendhil.eco@pondiuni.ac.in

This study uses data from a large-scale household survey conducted by the National Sample Survey Office (2017-18), Government of India, to investigate the impact of information access and adoption on wheat productivity. Wheat is a critical crop for food security in India, and significant yield variations persist across regions due to differences in socio-economic and agro-climatic conditions. This study employs a double-hurdle model to analyze the two-step decision-making process: access to information and its adoption by wheat producers. Results reveal that access to information alone does not significantly influence wheat productivity; instead, adopting information positively impacts yield. Demographic factors, such as age and household size, negatively affect the adoption of modern information sources. The study highlights the role of progressive farmers and input dealers as key information sources and calls for policy interventions to enhance the reach of government extension services, promote digital platforms, and improve the dissemination of technical information to marginalized farmers.

Keywords Information, NSSO, efficiency, wheat, double-hurdle model, India

Electricity use in Indian agriculture

S Harshitha Nayak[1*], Shivendra Kumar Srivastava[2], Praveen K V[1], Sunil Naik[1], Arun Kumar[3] and Rajeev Ranjan Kumar[4]

[1]ICAR-Indian Agricultural Research Institute, New Delhi
[2]ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi
[3]National Commodity and Derivatives Exchange, Mumbai
[4]ICAR-Indian Agricultural Statistics Research Institute, New Delhi
Email: harshithanayak009@gmail.com

Energy plays a pivotal role in modern agricultural growth and technological advancement, especially in India, where agriculture is a cornerstone of the economy. In the fiscal year 2022-23, the agricultural sector's electricity consumption in India reached 240.80 TWh, representing 17.52% of the nation's total electricity use. This study examines trends in electricity consumption in Indian agriculture and assesses the linkage between electricity consumption and agricultural growth. The study utilizes secondary data from various sources covering major states and India from 1990-91 to 2022-23. The study reveals a significant increase in agricultural electricity consumption from 17,817 GWh in 1982-83 to 240,800 GWh in 2022-23, with a compound annual growth rate (CAGR) of 6%. Electricity consumption per unit cropped area also showed an increasing trend, with a CAGR of 5.6%. Panel fully modified ordinary least squares (FMOLS) tests indicate a positive, statistically significant relationship between electricity consumption and GDP, with a 1% increase in power consumption leading to a 0.24% rise in real GDP. The study also identifies long-run and short-run causality from electricity use to agricultural GDP, suggesting that energy consumption is crucial for agricultural growth. Agricultural electricity subsidies significantly affect groundwater extraction. Effective rationing policies for electricity supply can better manage its usage than tariff policies alone. Strategies to enhance electricity use efficiency in agriculture are essential for sustainable growth.

Keywords Electricity consumption, agricultural growth, panel cointegration, electricity use efficiency

Farm mechanization and labour dynamics: testing induced innovation in Indian agriculture

Sneha S B[1], S K Srivastava[2], Mrinmoy Ray[3], Praveen K V[1] and Alka Singh[1]
[1]ICAR-Indian Agricultural Research Institute, New Delhi
[2]ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi
[3]ICAR-Indian Agricultural Statistics Research Institute, New Delhi
Email: sneha.babu@cgiar.org

The rural economy has witnessed several modifications due to rising real wage rates, increased rural-urban migration, labour shortage in agriculture, the rising ratio of non-farm to farm incomes, and wider adoption of farm mechanization. The increase in labour wages causes a relative change in the prices of the other production inputs, which prompts farmers to adopt novel technologies and replace relatively more expensive inputs with less expensive ones. The hypothesis of "induced innovation" refers to this phenomenon and identifies input prices as an inducing factor for technological development. This study tested induced innovation theory by examining whether and to what degree rising wages are pushing farmers to replace labor-intensive farm operations with machinery. It also analyzed the implications of labour wages on the cost of cultivation and labour-machinery substitution in the farm economy by estimating the price elasticity of demand for labour and elasticity of substitution between labour and machinery by using the translog cost function. The estimated price elasticity of labour is -0.21, which indicates that labour demand is inelastic and an inverse relation exists between wages and labour demand. The estimated elasticity of substitution between labour and machinery is 0.72, which implies that labour and machine are inelastic substitutes.

Keywords Mechanization, translog function, labour elasticity, induced innovation

Are returns to the adoption of modern rice technology heterogeneous? evidence from paddy growers in Eastern India

Kirtti Ranjan Paltasingh and Sanket Bohidar
Department of Economics, Ravenshaw University, Cuttack
Email: sanketbohidar@gmail.com

This paper investigates the welfare effects of modern rice technology adoption and checks whether the returns from adoption are scale-neutral or scale-biased in Eastern India. The study uses an endogenous switching regression model to address potential biases such as endogeneity and sample selection in adoption behavior. The findings reveal that adopting modern rice technology only enhances the gross margins of adopters, while non-adopters could potentially gain in terms of gross margin if adopted. Results indicate that education significantly influences productivity, especially under modern technology. Farmers with five or more years of schooling showed improved yields after adopting high-yielding varieties of paddy. The research emphasizes that returns to technology adoption are higher among better-educated farmers, highlighting the importance of education in enhancing agricultural productivity.

Keywords Agriculture, technology adoption, heterogeneity, endogenous switching regression, education

An economic analysis of chia cultivation in the Kalyan-Karnataka region

Shiva Kumar[1]*, Jainuddin S M[2], Amrutha T Joshi[3], Vasudeva Naik[4] and A S Police Patil[5]

[1]Department of Agricultural Economics, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka
[2]Department of Agricultural Economics, College of Agriculture, Kalaburgi, University of Agricultural Sciences, Raichur, Karnataka
[3]Department of Agricultural Economics, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka
[4]Department of Agricultural Economics, College of Agriculture, Gangavati, University of Agricultural Sciences, Raichur, Karnataka
[5]AICRP on Pigeonpea ZARS, Kalaburagi, University of Agricultural Sciences, Raichur, Karnataka
Email: shivunaiks18@gmail.com

Chia (*Salvia hispanica* L.) is gaining prominence as a superfood and medicinal plant within the Lamiaceae family, celebrated for its pseudocereal status and nutritional benefits worldwide. Introduced to India by the Central Food Technological Research Institute (CFTRI) in Mysuru, it has swiftly spread across the country, including Karnataka's Kalyan-Karnataka region, owing to its rich nutritional profile and medicinal properties. This study delved into chia cultivation's cost and returns structure, focusing on Bidar and Kalaburagi districts, which are pivotal due to their significant chia cultivation areas. Primary data was gathered through a survey of 30 sample farmers from each district during the 2023-24 period, totalling 60 respondents. The findings revealed that chia cultivation in Bidar was marginally more profitable than in Kalaburagi, evidenced by higher net returns. However, the returns per rupee invested were superior in Kalaburagi. The net returns over total costs stood at ₹ 22652.50 and ₹ 23755.40 per acre in Bidar and Kalaburagi, respectively, with benefit-cost ratios of 2.46 and 2.61. Productivity per acre slightly favoured Bidar at 3.11 quintals compared to Kalaburagi at 3.08 quintals due to better water management practices and proper adoption of technology by the farmer. Overall, chia cultivation in these districts showcases promising economic viability and productivity, highlighting its potential as a lucrative crop for farmers in the region.

Keywords CFTRI, benefit-cost ratio, net returns

Socio-economic factors affecting the adoption of micro-irrigation in India: insights from ground reality

Subhash Chand and Prabhat Kishore

[1]ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi
Email: s.chand@icar.gov.in

This study was conducted in four selected states: Punjab (unexploited region), Maharashtra, Gujarat, and Andhra Pradesh. It departs from the usual supply-side perspective and provides a demand-side perspective. It combines and compares the observations across the states of India with varied cropping patterns to identify the determinants and constraints in adopting micro-irrigation (MI). The evidence revealed a significant increase in yield and saving of water, energy, and fertilizer compared to the non-adopters of MI. The fertilizer saving varies from 12.89% to 37.51%, and similarly, the savings in chemicals used for pest and disease management vary from 17.71% to 48.23% (Punjab). The net sown area is positively and significantly associated with adopting micro irrigation in major states at less than a 1% significance level. The identified factors of adoption were analyzed, and the logit model results revealed that family size, mobile use, possession of soil health card, availing benefits of crop insurance schemes, and possession of tubewell positively affect the adoption of MI. Possession of an irrigation source is one of the essential eligibility criteria for availing of benefits under PMKSY. Farmers with their tubewell have better access to water supply, which increases the probability of MI adoption. Farmers who were aware of ongoing schemes like crop insurance schemes and soil health cards showed more interest in the MI scheme. Possession of rainfed areas is negatively affecting the adoption of MI, though MI is adopted primarily for water saving and to bring un-irrigated areas under irrigation with saved water. Thus, the study suggests the increasing spread of micro irrigation in the country. Policymakers and technocrats should consider these determinants while framing the policy for micro irrigation.

Keywords Determinants, micro-irrigation, adopter, non-adopter, PMKSY

Horticulture's contribution to the accelerated development of Indian agriculture

Ankush Saini and Sudhakar Dwivedi
SKUAST Jammu
Email: saini19a@gmail.com

Horticulture is the science of growing and managing fruits and vegetables, including tubers, ornamental, aromatic & medicinal crops, spices, and plantation crops and their processing, value addition, and marketing. Horticulture crops (fruits, vegetables, flowers) are more perishable than agriculture crops (cereals, oilseeds). Multiple crops are planted simultaneously, and opportunities for smallholders can be created by horticulture. In fruits, India ranks first in the production of Bananas (26.45%), Papayas (39.30%), Mangoes (including mangosteens and guavas) (43.80%), Lemons and lime (17.38%). In vegetables, India is the largest producer of okra (62.07%) and ranks second in the production of potatoes (13.55%), onions (22.83%), cauliflowers (33.78%), brinjal (22.99%), cabbages (13.01%). India exports fruits and vegetables to over 70 nations across the world. Growing horticulture crops will increase productivity. India's share in global exports amounts to a meager 1.7% in vegetables and 0.5% in fruits, as per a 2017 World Bank report. The decline in horticultural production during the pandemic was 5.7% (average). According to NHB 2022-23 (1st advanced estimate), in terms of horticulture production vegetables constituted a significant proportion of total production, followed by fruits and plantation crops. A similar trend can be observed in the area as well, where a substantial share in terms of area is for vegetables (60.59%), followed by fruits (30.72%) and plantation crops (4.50%). There was an increasing trend in CAGR of agricultural exports and imports of live trees and other plants, edible vegetables, edible fruit, coffee, tea & spices, resins & vegetable saps & extracts in 2021-22 to 2022-23 in most commodities.

Keywords Horticulture, high-density plantation, production

Does gender matter in providing seed security? a case of rice farmers in selected districts of Odisha, India

Asha Devi S S, Praveen K V, Alka Singh, Harbir Singh and Renjini V R
[1]Division of Agricultural Economics, ICAR-IARI, New Delhi
Email: ash.nibha@gmail.com

A study was conducted to evaluate the seed system, seed security, and the factors influencing rice farmers' seed source choices, focusing on gender differences. The research used data from a gender-disaggregated survey by the International Rice Research Institute (IRRI) in three districts of Odisha-Balangir, Ganjam, and Mayurbhanj. The findings showed that farm-saved seeds were the primary seed source, although the level of reliance on these sources varied by gender. A multinomial logit regression identified several key factors influencing seed source choices, including education, caste, access to seed information, organizational membership, and district-level variables. While gender did not significantly impact seed source choice or seed security, social groups emerged as a significant factor affecting seed source decisions. Tradition was the main reason for continuing the use of farm-saved seeds. Additionally, the study found that female farmers primarily rely on neighboring farmers and seed dealers for seed-related information, while male farmers depend more on agricultural extension staff. These insights can inform policy development around input provisions and develop target-specific strategies to improve seed and varietal replacement.

Keywords Gender, seed system, IRRI, multinomial logit

Growth performance and production variability of oilseeds in Karnataka state

Jainuddin SM, Jagrati B Deshmanya, Amrutha T Joshi, BS Reddy and Stephan Raj
Department of Agricultural Economics, University of Agricultural Sciences, Raichur
Email: smjainu@gmail.com

The present study assessed the spatial and temporal growth performance and production instability of oilseeds in Karnataka, India's sixth largest state in area, and the production of oilseed crops. Among the oilseed crops, sunflower and groundnut account for the highest area and production in the state. Hence, these two crops were selected for the study. The data on area, production, and yield of oilseed crops were collected from 1975-76 to 2015-16 from various secondary sources. The whole period (1975-76 to 2015-16) was divided into two sub-periods: period I (1975-76 to 1995-96) and period II (1995-96 to 2015-16). The analysis was carried out by using CAGR, Coppock's Instability Index (CII), Cuddy-Della Valle Index (CDI), Coefficient of Variation (CV), and Hazel's Decomposition Model. The study indicated that the growth pattern witnessed a downward trend for area and production in all districts of Karnataka state during period II in groundnut and sunflower crops. A mixed trend was observed throughout the whole period. The results CII showed that the fluctuation in area, production, and yield of oilseeds was higher in the Mysore division than in other regions. CV indicates that the fluctuation in area and groundnut production was higher in the Bangalore division. In contrast, in the case of sunflower, the highest fluctuation was noticed in the Belgaum division. The CDI indicates that the highest variation in groundnut and sunflower production was found in the Bangalore division compared to other divisions. The study indicated that the interaction effect of change in mean yield and mean area are important sources of growth in groundnut and sunflower during the period I. The variances in the production of groundnut for the state as a whole were predominantly due to the interaction between changes in mean yield and mean area, followed by changes in yield variance and changes in area variance during the whole period.

Keywords CAGR, CDI, CII, CV, oilseeds, Karnataka

Economic viability of greengram varieties in North Karnataka

Hemanth D B[1], M Y Teggi[2], G N Kulkarni [1] and S A Birdar[3]
[1]Department of Agricultural Economics, College of Agriculture, University of Agricultural Sciences, Dharwad
[2]Department of Agricultural Economics, College of Agriculture, Vijayapura, University of Agricultural Sciences, Dharwad
[3]ICAR-KVK, Dharwad
Email: hemanthdb268@gmail.com

The present study was carried out in North Karnataka, focusing on the Gadag and Dharwad districts, which were selected based on the highest area under greengram cultivation. Dharwad and Navalgund taluks from Dharwad district and Gadag and Ron taluks from Gadag district were the study areas, in which 128 sample farmers cultivating different varieties of greengram were surveyed during the agricultural year 2021–22. Three principal varieties of greengram were grown in the study area: DGGV-2, BGS-9, and NVL-1. When comparing the net return generated by different varieties, the net returns from the cultivation of DGGV-2 were ₹ 42,872 per hectare, which is substantially higher compared to that of BGS-9 and NVL-1 (₹ 24,252 per hectare and ₹ 34,988 per hectare, respectively). Additionally, the returns per rupee of investment were also higher for DGGV-2 (1.80) compared to BGS-9 (1.43) and NVL-1 (1.63). Hence, there is a need to popularize the good varietal traits of DGGV-2, released by the University of Agricultural Sciences, Dharwad (UASD), through frontline demonstrations by the state department of agriculture.

Keywords BGS-9, cost, DGGV-2, NVL-1, returns

Economic and environmental trade-offs in shifting area from paddy to maize in post-rainy season under water-scarce conditions

V Sneha[1], A Amarendar Reddy[2], T Lavanya[1], V Ravinder[3] and Dhandapani[4]
[1]Dept. of Agrl. Economics, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad
[2] ICAR- National Institute of Biotic Stress Management (ICAR-NIBSM), Raipur
[3]Dept. of Agrl. Extension, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad
[4]Dept. of Statistics, ICAR-NAARM, Hyderabad
Email: snehadr0810@gmail.com

This study explores the economic and environmental trade-offs of shifting agricultural land use from paddy to maize in water-scarce regions of Telangana, India, specifically during the post-rainy season. Agriculture, while essential for food security, has contributed to environmental degradation, including greenhouse gas (GHG) emissions, groundwater depletion, and soil degradation. In India, a major GHG emitter, balancing agricultural productivity with environmental sustainability is a growing challenge, particularly as groundwater depletion intensifies. Focusing on two villages in Mahabubnagar district, the study utilizes structured questionnaires to gather data on socio-economic conditions, cropping patterns, and farming practices. GHG emissions were assessed using the Cool Farm Tool, and land-use optimization was performed through linear programming. Results show that while paddy cultivation provides higher net returns per hectare (¹ 41,436 vs. ¹ 29,687 for maize), it incurs higher costs and generates significantly more GHG emissions, mainly from methane emissions in flooded fields. The optimized model suggests reducing paddy cultivation and increasing maize acreage to balance economic returns, land constraints, and environmental impact. Despite paddy's higher financial returns, maize emerges as a more sustainable option. The study recommends policy measures to encourage maize cultivation, reallocate subsidies based on environmental costs, promote GHG mitigation in paddy farming, and strengthen agricultural extension services to optimize land use, reduce emissions, and maintain profitability while supporting sustainability goals.

Keywords CHG emissions, environmental degradation, trade-off

An economic perspective of spatio-temporal trends and determinants of paddy stubble burning in North Western India

Ragini P Jambagi[1], Dharam Raj Singh[1], Alka Singh[1], Vinay Kumar Sehgal[2], BJ Giridhar[1*]
[1]Division of Agrl. Economics, ICAR-Indian Agricultural Research Institute, New Delhi
[2]Division of Agrl. Physics, ICAR-Indian Agricultural Research Institute, New Delhi
Email: giridharbj4@gmail.com

During the harvesting season of paddy, North-Western India faces the problem of heavy smog because of the unhealthy practice of stubble burning, which also depletes soil fertility. Various efforts are being taken by the government to reduce its severity. Tabular analysis of satellite-derived burning events shows that the number of burning events has decreased from 2016 to 2021 in North-Western India. The Mann-Kendall test has revealed the negative trend in events for the three states: Punjab, Haryana, and Western Uttar Pradesh. In Punjab, about 49% of the paddy area is burnt, and the growth rate of burnt area and paddy area is almost the same. But in Haryana, although only 17 % of the paddy area is being burnt, the growth rate of the burnt area is comparatively higher than that of the paddy area itself. Districts like Firozepur, Faridkot, Patiala, and Sangrur of Punjab, Fatehabad, Kurukshetra, and Karnal of Haryana need special attention, as their percentage of paddy area subjected to burning is relatively high. Panel regression has revealed that the cultivation of potato and basmati paddy may reduce the paddy area subjected to burning.

Keywords Paddy stubble burning, farm fire events, North Western India, Mann-Kendall test, panel regression

An economic analysis of maize vis-à-vis paddy cultivation in the sub-mountain undulating plain zone of Punjab

Taranpreet Sandhu, Parul Barwal, Lavleen Kaur and Smily Thakur
[1]Department of Agriculture, Khalsa College Amritsar, Punjab
Email: parulbarwal1994@gmail.com

The present study attempted to analyze maize and paddy cultivation in Punjab. The primary data were collected from the sample of 100 farmers who cultivate maize as a seasonal crop from two blocks of Punjab. The results showed that per acre cost of cultivation for maize was ¹ 15590.390 and ¹ 23462.66 for paddy. The gross returns and net returns over total cost were observed as higher in paddy (¹ 53406.17 & ¹ 29943.51, respectively) as compared to maize crop. The production function analysis showed that seed and labour positively and significantly affect maize and paddy production. The study suggested that the government should introduce schemes incentivizing crop diversification, such as subsidies for maize seeds and inputs or direct financial support for farmers shifting from paddy to maize.

Keywords Maize, paddy, cost, return, production, efficiency

Impact of improved farm technology adoption in enhancing farmers' income in the scarcity region of Western Maharashtra

MN Waghmare, YC Sale and SS Bhosale
[1]College of Agriculture, Pune (Maharashtra)
Email: marutiwaghmare1@gmail.com

The study has estimated the adoption of various improved dry farming technologies and identified the factors governing their adoption on farms in the scarcity region of Western Maharashtra. The study is based on the primary data collected from a sample of 90 farm households from the scarcity region of Solapur in the district of Western Maharashtra. Technology adoption index (TAI) and multiple regression models were used to analyze the data. The results reveal that TAI was found to be highest in the improved livestock management practices, followed by improved crop production technologies, improved energy management systems, and improved soil and water conservation technologies, and was lowest in improved land use systems. The study has found that in the scarcity region, TAI was, in general, highest in the improved crop production technologies, followed by improved soil and water conservation technologies and improved livestock management practices. The regression analysis with respect to improved soil and water conservation technologies revealed that the proportion of irrigated land, size of land holding, and diversification index were the major factors affecting improved soil and water conservation technologies adoption in the study area. With respect to improved crop production technologies, the proportion of irrigated land positively contributed to the adoption of improved crop production technologies. The diversification index was the most important factor that positively influenced the improved livestock management practices adoption, followed by the size of land holding and farm size. To achieve the objective of "doubling farmers' income," multiple approaches need to be adopted by all concerned in a consistent and planned manner. The financial and private institutions could also play a vital role through relevant policies. Scientific, government, and farmers' efforts, along with the support of the financial and private sectors, need to be strengthened to achieve the said goal.

Keywords Technology adoption, TAI, livestock, water conservation

Precision farming in agriculture: enhancing efficiency and sustainability

Arti Dhruw and Aashi Sarva
Department of Agricultural Economics, IGKV, Raipur
Email: artidhruw6154@gmail.com

Precision farming integrates advanced technologies like GPS, IoT, and data analytics to optimize agricultural practices. Farmers can make informed decisions that improve yield, reduce waste, and minimize environmental impact by collecting real-time data on soil health, weather, and crop conditions. This approach enhances resource efficiency, promotes sustainability, and supports crop management tailored to specific field conditions. Ultimately, precision farming fosters both economic and ecological benefits in modern agriculture.

Keywords Precision farming, agriculture, technology, sustainability, data-driven, crop management, yield optimization

Estimation of economic benefits: evidence from nature friendly agri-food systems

Yogi RK, Sharma AK, Kumar Vinod, Meena BL and Rai PK
ICAR-Indian Institute of Rapeseed–Mustard Research, Bharatpur, Rajasthan
Email: yogindri@gmail.com

Nature-friendly agri-food systems are critical to redefining the interactions of humanity and nature to overcome the growth paradigm by averting climate-driven social and ecological disasters. India is one of the major oilseed growers and importers of edible oils. India's vegetable oil economy is the world's fourth largest after the USA, China, and Brazil. Mustard, scientifically known as *Brassica juncea*, is a vital oilseed crop sown during the *Rabi* season in various agricultural regions. This crop contributes significantly to the edible oil supply and plays a crucial role in the agricultural economy, providing farmers with essential income and employment opportunities. Opportunities also lie in exploiting yield gaps ranging from 36% to 57% for major oilseeds. In total, 229 rapeseed & mustard varieties have been developed in India, and out of them 185 have been notified. Since 1993, ICAR-Directorate of Rapeseed Mustard Research, Bharatpur, has released & notified ten high-yielding varieties of rapeseed and mustard for different ecologies of the country. This study is aimed to estimate the economic benefits due to technology adoption. Indian mustard (*Brassica juncea* (L) Czern. & Coss.) variety has been identified based on the potential yield advantages with high adoption level and technology life span. The adoption model was developed using a logistic regression modelling approach. A closed economy-based economic surplus model is applied to estimate the benefits derived from technological change, which are measured as the economic surplus of producers and consumers. Productivity, changes in cost and risk reduction, and benefits are estimated. The adoption curve is derived from the seed chain database of various improved varieties of Indian mustard. Time series data from the Frontline Demonstrations (FLDs) on the Indian mustard variety Giriraj (DRMR IJ31) under the All India Coordinated Research Project (AICRP) were analyzed. For primary data collection, surveys & field visits were conducted in collaboration with the line departments. Focused Group Discussions (FGDs) were organized for feedback from the stakeholders. A total of 882 respondents contributed with effective feedback on relevant aspects of this sector. Adoption levels ranged from 5-10%, which was assumed to be 5%, to examine the implications of investment in research and development. Overall, the yield improvement over the national check/zonal check/farmer's practice ranged from 10 to 30%. The total economic surplus generated from improved technology ranged from [1] 1250 to 3740 crores, including risk reduction benefits. Farm households and consumers received significant dividends due to technological intervention in the welfare society. Poor adoption rates demand a boost from the existing seed chain to harness the greater economic impacts in the coming years. The policy implication of this study advocates that higher allocations, either through redistribution or addition, are expected to bring innovations for sustained yield to achieve self-sufficiency in the edible oil sector.

Keywords Mustard, adoption, FGDs, AICRP, logistic regression

Role of improved farm technology adoption in doubling farmers' income in the scarcity region of Western Maharashtra

MN Waghmare and YC Sale
College of Agriculture, Pune (Maharashtra)
Email: marutiwaghmare1@gmail.com

The study has estimated the adoption of various improved dry farming technologies and identified the factors governing their adoption on farms in the scarcity region of Western Maharashtra. The study is based on the primary data collected from a sample of 90 farm households from the scarcity region of Solapur in the district of Western Maharashtra. The data was analyzed using the Technology Adoption Index and multiple regression model. The results reveal that the Technology Adoption Index was highest in improved livestock management practices, followed by improved crop production technologies, improved energy management systems, and improved soil and water conservation technologies, and was lowest in improved land use systems. The regression analysis concerning improved soil and water conservation technologies revealed that the proportion of irrigated land, size of land holding, and diversification index were the major factors affecting the adoption of improved soil and water conservation technologies in the study area. Regarding improved crop production technologies, the proportion of irrigated land positively contributed to adopting improved crop production technologies. The diversification index was the most important factor that positively influenced the adoption of improved livestock management practices, followed by land holdings and farm size.

Keywords Improved technology, doubling farmers' income, dry zones

Assessing the impact of conjunctive use of rainwater and groundwater: empirical evidence from semi-arid regions of Karnataka

BJ Giridhar, Dharam Raj Singh, Ragini P Jambagi
Division of Agrl. Economics, ICAR-Indian Agricultural Research Institute, New Delhi
Email: jambagiragini@gmail.com

The escalating depletion of groundwater resources, especially in water-scarce regions, underscores the urgent need for sustainable solutions. Rainwater Harvesting (RWH) has emerged as a vital strategy to counteract this groundwater depletion. This study seeks to provide empirical evidence regarding the impact of farm ponds and their combined use with groundwater on farmer's incomes. Utilizing a multi-stage sampling approach, plot-level data from 450 participants across four distinct agroclimatic zones spanning eight districts in Karnataka was collected. Employing an endogenous switching regression model to analyze the impact, the findings reveal that farm pond adopters achieved approximately a 70% increase in incomes compared to rainfed farms. Those who practiced conjunctive use experienced a substantial income boost, with a 37% and 33% rise compared to farms solely employing farm ponds and conjunctive use with groundwater, respectively. In addition to household characteristics, our study underscores the pivotal role of institutional and social factors in adoption decisions. The paper addresses a primary concern associated with farm ponds – the perceived land wastage due to construction. Considering a farm pond with an area of 90 square meters, the study demonstrates a significantly higher opportunity cost foregone, amounting to ₹ 16,363 in the case of farm ponds and ₹ 6,470 in conjunctive use.

Keywords Farm ponds, ground water, endogenous switching regression, logit model, causal inference analysis

Should India import corn for ethanol production? Technology alternatives for import substitution

Bilavat Swami Nayak, Naresha N and Balaji SJ
ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi
Email: balajisjniap@gmail.com

The Indian government's decision to promote corn as the feedstock to produce ethanol for blending with petrol has sparked various reactions. An increase in the procurement price of corn-based ethanol has transformed Asia's leading corn exporter into a net-importer (corn imports have surged by 260% in value in 2023-24), leading to calls from the poultry industry to eliminate import duties on corn and lift the ban on GM corn. Technology could be crucial in preventing such import-driven green-energy transition in the long term. This study estimates the required growth in total factor productivity (TFP) in corn to prevent the need to import corn for ethanol production, specifically focusing on the year 2050. Corn yield and area projections are made to account for climatic change till 2050. ARIMAX, linear, and non-linear econometric models are employed for projections, and the results are validated using GFDL, HGEM, IPSL, and MIROC simulation model projections. Estimated coefficients are used to simulate TFP growth effects. Results show that to substitute corn import by around 25 to 34 million tonnes by 2050, existing TFP growth should increase by over half (58%) to three-fourth (78%).

Keywords Trade, technology, energy, corn

Transforming technologies in Tasar silk production in Chhattisgarh

Narottam Atree, VK Choudhary, MR Chandrkar, AK Gauraha, Dronak K Sahu, DK Kurrey
Indira Gandhi Krishi Vishwavidyalaya, Raipur
Email: narottamatree@gmail.com

This study explores the impact of technological interventions on Tasar silk production in Korba District, Chhattisgarh, focusing on the comparative effects of traditional versus scientific methods of silkworm rearing. Sericulture is crucial in supporting rural livelihoods, especially in regions like Chhattisgarh, where Tasar silk production is a key income-generating activity. While traditional methods have been employed for generations, they face challenges such as low productivity, poor cocoon quality, and high mortality rates. This research examines how scientific advancements—such as improved disease-free layings (Dfls), environmental controls, and systematic rearing techniques—affect important sericulture parameters, including fecundity, hatchability, cocoon yield, and economic returns. The study was conducted in the Korba District of Chhattisgarh, where two blocks, Kartala and Kathghora, were purposively selected due to high levels of traditional Tasar silk production. A total of 100 respondents were divided into two groups: 50 using traditional methods and 50 using scientific methods promoted through government schemes. Data were collected on various parameters, such as cocoon weight, silk ratio, and the effective rate of rearing (ERR). The results demonstrate that scientific methods lead to significant improvements across most parameters, with a 127% increase in cocoon yield and a 49% increase in silk ratio. Furthermore, economic analysis reveals that farmers using scientific methods experience substantially higher returns as cocoon production becomes more efficient and less prone to environmental variability. The study underscores the need for broader adoption of these technological interventions to enhance rural livelihoods. It highlights the importance of policy-driven initiatives to increase technology transfer to sericulture farmers. Recommendations for future work include targeted training programs for rural farmers and the development of effective government schemes that facilitate the dissemination and adoption of scientific practices in Tasar silk production.

Keywords Tasar, sericulture, economic, effective, production

Key drivers and barriers in the adoption of direct seeded rice (DSR) in India: a MICMAC analysis for policy and practice

Nitin Sharma, Akriti Sharma and Amarjeet Singh
ZTM&BPD Unit, ICAR-Indian Agricultural Research Institute, New Delhi
Email: nitingautam2720@gmail.com

The adoption of Direct Seeded Rice (DSR) in India presents a significant innovation with potential benefits such as reduced labour, water savings, and improved soil health. However, the diffusion of DSR has been uneven and influenced by various socio-economic and environmental factors. This study employs the MICMAC (*Matrice d'Impacts Croisés Multiplication Appliquée à un Classement*) methodology to identify and prioritize the factors influencing DSR adoption in Indian agriculture, particularly in the states of Haryana and Punjab. A combination of literature review, expert interviews, and field surveys identified 25 key factors affecting DSR adoption. These factors were analyzed using interpretive structural modelling (ISM) and further categorized based on their driving power and dependence using the MICMAC approach. Key findings suggest that government policies, subsidies, and stakeholder collaboration are the primary drivers of DSR adoption, while factors such as labour availability and water scarcity have limited influence. The study provides actionable insights for policymakers, extension services, and researchers to enhance the diffusion of DSR, thereby contributing to more sustainable and efficient rice production in India.

Keywords MICMAC, direct seeded rice, interpretive structural modelling, DSR, ISM

Precision farming technology adoption and impact on digital agriculture in Chhattisgarh

AK Gauraha, SK Joshi, VK Choudhary, Laxmi Bagh, Payal Jaiswal and Ravi Shrey
Department of Agri-business and Rural Management and Department of Agricultural Economics, Indira Gandhi Agricultural University, Raipur, Chhattisgarh
Email: ajaygauraha15@gmail.com

This study examines the investigation, adoption, and impact of precision farming technologies in Chhattisgarh, India. The information gathered from 250 farmers in Chhattisgarh, focusing on major vegetable producers, includes interviews regarding digital agriculture technologies in the Durg, Raipur, and Bilaspur districts. Additionally, insights from experts at agricultural universities, research institutes, and private companies, along with secondary data from government offices and research studies, have been incorporated. The data concerning aspects like seed sowing, drip irrigation, soil treatment, plant protection, harvesting technologies, marketing, and mobile applications has led to improvements in crop productivity, water consumption reductions, and decision-making enhancements. The study reveals that 65 percent of farmers utilize mobile phones for agricultural information, 35 percent have adopted drip irrigation technology, 28 percent focus on plant protection, and 35 percent have reported enhanced crop productivity. Limited internet connectivity and insufficient training hinder the adoption of new technology in crop production. In conclusion, digital agriculture technology has significantly transformed the agricultural sector, equipping farmers with accurate and timely information for better decision-making. Digital agriculture has the potential to significantly improve productivity and enhance the livelihoods of vegetable farmers in Chhattisgarh. Effectively leveraging the influence of digital technology to tackle infrastructure, affordability, and training challenges in agriculture necessitates a thorough examination of policy implications. This technology could offer significant advantages while promoting sustainability and social acceptance.

Keywords Precision farming, digital agriculture, drip irrigation, mobile phone, adoption

Examining and evaluating the effectiveness of water harvesting structures to provide water security by replenishing groundwater and reviving the Kanari river

Ayushi Trivedi[1*] and Nirjharnee Nandeha[2]
[1]Department of Natural Resource Management, Mahatma Gandhi University of Horticulture and Forestry, Sankara, Patan, Durg, Chhattisgarh
[2]Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh
Email: ayushikhandwa@gmail.com

The study's scope helps identify appropriate zones and places for groundwater recharge for river revival by using geospatial and multi-criteria decision analysis (MCDA) approaches to assess groundwater potential zones. The research region's many theme data were acquired through the methodical analysis of conventional and satellite information using field judgments. The analytical hierarchical process (AHP) in a geographic information system (GIS) was used to calculate the geometric mean and the normalized weight for each feature. Possible groundwater zones were also discovered. The groundwater recharge zone and artificial recharge structure locations within the Kanari River system were identified by merging satellite-derived multiple thematic maps in a GIS platform. To budget for water, the water demand for home use, agricultural usage, pumping, and livestock was finally assessed. Water availability was then guaranteed based on this information. The water demand of the Kanari River watershed was calculated to be 731.83 MCM based on the study's findings. Considering this, the watershed of the Kanari River was calculated to determine the pumping overdraft, which came out to be 423.192 MCM. An additional recharge of 858.8 MCM was suggested through a planned conservation structure. This led to the conclusion that if overdrafting through pumping is also considered, this additional recharge can meet the requirements, maintain the river's flow, and guarantee the availability and security of water.

Keywords Artificial recharge, water security, spatial data, groundwater recharge, water harvesting structures, MCDA

The new transformation for smallholders: evidence from vegetable growers of Cuttack, Odisha

M Balasubramanian[1*], Nithyashree ML[1], Pramod Kumar[1] and Biswajit Mondal[2]
[1]Division of Agrl. Economics, ICAR-Indian Agricultural Research Institute, New Delhi
[2]ICAR - National Rice Research Institute, Cuttack, Odisha
Email: mbalasubramanian@iari.res.in

Vegetable farming has been promoted as an alternative crop in the less irrigated areas of Cuttack district, Odisha, due to its resilience and potential for quick earnings. Farmers from the Badamba Farmer Producer Organization (FPO) received training in vegetable cultivation and marketing organized by ICAR-NRRI, ICAR-IARI, and various state agencies. This study evaluated the impact of a mini cold chamber unit established by the Badamba FPO with funding from the ICAR-NASF project under ICAR-IARI. Primary data were gathered from 207 respondents, including 113 members of the Badamba FPO and 94 non-FPO participants in the Badamba block of Cuttack district, and analyzed using a double difference model. Farmers stored their harvested produce in the mini cold chamber before sending it to the nearer Gopalpur mandi, which improved their bargaining power and boosted income through staggered sales. The combined effects of the capacity-building program (with and without the cold chamber) and the time factor (before and after the cold chamber) on income were significant for tomato and bitter gourd farmers. This highlights the vital role of the FPO's capacity-building initiatives and interventions in setting a model for scaling up similar state-level efforts to sustainably increase smallholders' income.

Keywords Vegetable growers, smallholders, FPO, capacity building, cold chamber

Resource use efficiency and profitability analysis of cotton cultivation in the western zone of Punjab

Lovpreet Kaur[1], Sunish Sharma[1] and Sugandha Khajuria[2]
[1]P.G. Department of Agriculture, Khalsa College, Amritsar, Punjab
[2]Division of Soil Science and Agricultural Chemistry, SKUAST-Jammu
Email: sugandha2743@gmail.com

This paper analysed the profitability and resource use efficiency of cotton production in the western zone of Punjab (India) in 2023-24. The study was based on primary data collected from 120 growers selected randomly using a multistage random cum purposive sampling technique. Results depicted that large farms earned more profit from cotton production than medium and small farms. The overall variable cost of cultivation was ¹ 24,450.74, whereas the gross return was calculated to be ¹ 49,297.13. The average net return of cotton was ¹ 24,846.39 while the benefit-cost ratio was 1:1.9. The regression analysis showed that factors like seed and pesticides had a positive and significant impact on cotton yield. The marginal value of product (MVP) of seed was greater than unity, which means it was underutilized. However, other resources were applied in excess and suggested to be utilized optimally to improve cotton yield.

Keywords Cotton, Cost structure, returns, resource use efficiency, Cobb Douglas, marginal value of product

Decoding decision-making: factors shaping investments in chemical fertilizers for paddy cultivation in Kole lands

Joyal Mathew and P. Indira Devi
Kerala Agricultural University
Email: joyal-2021-11-060@student.kau.in

Green Revolution technologies, characterized by their high dependence on technology, have driven significant advancements in agricultural development. However, they have also resulted in negative ecological externalities and long-term cost escalations. Among the key issues is the decline in soil health due to unscientific chemical nutrient application. This micro-level study explores the patterns of chemical fertilizer use, investment levels, and the factors influencing farmers' decisions regarding paddy cultivation in the Kole lands of Kerala. Farmers frequently deviate from recommended nutrient application practices, often exceeding the suggested levels for major nutrients while neglecting secondary nutrients and micronutrients. The timing of nutrient application also significantly diverges from scientific recommendations for all major nutrients. The study finds that socioeconomic factors such as the farmer's age and education level increase the chances of increasing investments. In contrast, household income and the maximum education level within the family tend to reduce the chances of lower investment. The study highlights the crucial role of socio-economic variables in shaping investment decisions related to chemical fertilizer use. It also underscores the influence of educated family members on scientific decision-making, suggesting a need to redesign extension policies to incorporate them as agents of change. Furthermore, modern technologies such as sensors, remote sensing, and artificial intelligence can revolutionize real-time soil quality monitoring and farmer communication. Soil sensors can measure pH, moisture, nutrient levels, and temperature, transmitting data through IoT to central databases. Remote sensing via satellites and drones can cover extensive areas, providing high-resolution imagery for detailed analysis. AI and machine learning can process this data to identify patterns and predict soil health trends, while AI-driven decision support systems can offer actionable recommendations. Real-time advisories can be communicated to farmers and their families via SMS, ensuring timely, region-specific information delivery. Extensive, targeted training programs for farmers and educated family members are proposed to enable informed decision-making in soil health management, ultimately enhancing agricultural productivity and food security.

Keywords Decision making, factors influencing, logit regression

Assess the impact of digital literacy programs on precision agriculture adoption among smallholder farmers, focusing on training in GPS, IoT, and data interpretation

Avan Das Sahu, Dushyant Kumar and Aashi Sarva
Department of Agricultural Economics, IGKV, Raipur
Email: avandass119@gmail.com

Digital literacy programs are vital in fostering precision agriculture adoption among smallholder farmers, equipping them with essential skills in GPS, IoT, and data interpretation. Research indicates that such training enables farmers to make data-informed decisions, leading to increased productivity and optimized resource use. Despite positive outcomes, barriers such as digital access and educational levels persist, impacting widespread adoption. Tailored digital literacy efforts are shown to bridge these gaps, promoting sustainable farming practices and better crop management.

Keywords Digital literacy, precision agriculture, smallholder farmers, GPS in farming, IoT in agriculture, data interpretation, technology adoption, sustainable agriculture

Does improved irrigation technology benefit poor man's almond cultivation?

B Harini and M Anjugam
[1]Department of Agricultural Economics, CARDS, TNAU, Coimbatore
Email: harinibaskar1609@gmail.com

Water is a critical input for agriculture. According to the World Bank, agriculture is both a victim and a cause of water scarcity. The scheme *Pradhan Mantri Krishi Sinchayee Yojana* (PMKSY) (Per Drop More Crop) promotes efficient water conveyance with the help of precision water application devices like drip, sprinkler, rain guns, and pivots in the farm. In Tamil Nadu, sprinkler irrigation is majorly adopted in poor man's almond. The economic yield of poor man's almond mostly depends on the irrigation at critical stages. This study compares the economics of sprinkler (SIS) and conventional irrigation system (CIS) in poor man's almond cultivation. Primary data was employed in this study, and a pre-structured interview schedule was used. The study utilizes both stratified and random sampling techniques. The total sample size studied was 120 farmers, among which 60 were adopters of SIS and 60 were conventional farmers. The estimates showed a significant COC reduction among SIS adopters of about 25 per cent (₹ 30,417) due to cost reduction in operations like intercultural activities and irrigation. Hence, awareness should be created among the farmers regarding water and energy-saving technologies to mitigate water and energy scarcity but not at the cost of their profits.

Keywords Sprinkler irrigation, poor man's almond cultivation, partial budgeting, COC reduction, constraints

Challenges and strategies for overcoming constraints in crop production and adoption of solar pump set

Mukesh Kumar Anant and Ajay Tegar
[1]Department of Agricultural Economics, College of Agriculture, IGKV, Raipur
Email: mukeshanant.ageco@gmail.com

This study investigates the adoption of solar pump sets in agriculture, focusing on the challenges faced by farmers in Bilaspur district, Chhattisgarh. While solar pumps offer significant benefits, such as reduced operational costs and environmental sustainability, their adoption is hindered by major constraints like a lack of technical knowledge and poor awareness about solar pump set (56.67%), limited awareness of government subsidies (51.11%), and extensive process of official works and delay installation of solar pump set (47.35%). Additionally, farmers face difficulties in crop production, including unpredictable weather (68.98 %), labor shortages (55.83 %), theft of solar components (53.95%), unavailability of fertilizers at the right time by the cooperative society (48.83%), and lack of new technical knowledge about the crop production (46.77%). The study suggests solar battery charging systems & water storage tanks should be used; starter, cable, and motor should be kept in a locker system, improving farmer education, streamlining subsidy processes, and promoting climate-resilient crops and efficient irrigation system. A collaborative effort between government agencies, NGOs, and financial institutions is key to overcoming these barriers, ensuring wider adoption of solar pumps, and improving agricultural productivity and sustainability.

Keywords Constraints, crop production, irrigation, solar pumps

Adoption of hybrid rice: an empirical study in Haor region

Abani Kar and Mohammad Mizanul Haque Kazal
[1]Department of Development and Poverty Studies, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh
Email: abanikar1708112@sau.edu.bd

Bangladesh is a South Asian nation that is low-lying, primarily riverine, and heavily populated. The main driver of Bangladesh's economy is agriculture, which is gradually changing from traditional to modern methods. Regarding this phase of development, Bangladesh's agriculture sector is extremely important. Nonetheless, many Bangladeshi smallholder farmers lack information and understanding of contemporary farming methods. In the current world, where farming is limited to one season, new agricultural innovations are essential for enabling the movement of people with low incomes. Adopting hybrid varieties in the Haor areas has been the focus of the paper's actions to promote the acceptance of various new technologies required for rice cultivation. The study employed a binary logit model and structural equation modelling (SEM) with partial least squares (PLS) to determine the determinants influencing farmers' adoption of hybrids. Lower output prices, higher input costs, a lack of high-yielding, short-growing varieties, and embankment damage are the primary obstacles to rice production. This study advocates pertinent policy proposals and solutions to address farmers' issues to boost rice production in the Haor areas and promote food security and self-sufficiency in rice agriculture.

Keywords Agro-economic, Hybrid Variety, Farmers' level, Yield, Haor

Developments in precision farming through drone technology

BC Anu and ML Meena
Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar

Email: entoanu123@gmail.com

The use of unmanned aerial vehicles (UAVs) in agriculture marks a significant development in precision farming, with drones emerging as a key tool for pesticide application. This provides an overview of pesticide-spraying drones and their influence on contemporary agricultural practices. These drones are equipped with cutting-edge technologies such as GPS navigation, multispectral imaging, and precision spraying systems, offering several advantages over conventional pesticide application methods, including reduced chemical use, improved efficiency, and lower environmental impact. Furthermore, they provide real-time crop health data, enabling targeted and timely pesticide application. It also highlights recent advancements in drone technology, including enhanced flight stability, autonomous operation, and increased payload capacity. In addition, it addresses regulatory challenges and safety concerns related to drone deployment in agriculture, emphasizing the need for standardized regulations and comprehensive training. Adopting pesticide-spraying drones can transform agricultural practices by supporting sustainability, reducing costs, and promoting crop health and food security. Continued research and development are essential to fully realizing the benefits of UAVs in modern farming.

Keywords Drone, multispectral imaging, navigation, pesticide, sustainability, unmanned aerial vehicles

Water conservation technology adoption in arid agriculture: an analysis of sprinkler irrigation system in the western dry region of India using Heckman's two-stage model

Vikram Yogi[1*], Vandana Kumari[1], RK Yogi[2] and Aravindh Kumar S[1]
[1]Swami Keshwanand, Rajasthan Agricultural University, Bikaner
[2]ICAR-Directorate of Rapeseed and Mustard Research Centre, Bharatpur
Email: agrico.vikramyogi@gmail.com

Water conservation in arid regions like Bikaner, Rajasthan, is crucial for sustainable agriculture. This study investigates the factors influencing the decision to adopt water conservation technologies, focusing on sprinkler irrigation systems. Data from 200 farm households during 2022-23 were collected. Through Heckman's two-stage sample selection modelling and logit regression analysis, the study identifies education, access to credit, farm size, and farm income as key determinants of technology adoption. A positive coefficient of 0.016 for farm size suggests larger agricultural operations are more likely to secure credit. Higher education levels significantly increase the likelihood of adopting sprinkler systems, with a 0.342 per cent adoption rate increase per 1 per cent rise in education. Access to credit plays a pivotal role, enabling farmers to invest in advanced irrigation systems. However, the limited availability of subsidies hinders adoption, particularly for smallholder farmers. Sprinkler irrigation emerges as a superior technology due to its efficiency in water usage and potential for enhancing crop yield. Addressing barriers, such as lack of education and financial resources, and promoting subsidies and credit access are essential for increasing adoption rates and conserving water in arid regions.

Keywords Arid region, credit accessibility, farm level investment, Heckman two-stage modelling, sprinkler irrigation system, water conservation technology

Economic effect of integrated nutrient management in scented rice

Rajeshwari Dhurve, Mariya Shilpa Ekka and Supriya Thakur
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh
Email: rajdhurve086@gmail.com

The present experiment was conducted at Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, during *Kharif* season 2019-20 entitled with integrated nutrient management in scented rice including organic and inorganic nutrients source with recommended dose of fertilizers (RDF) 100: 60: 40 NPK kg ha^{-1}. The experiment was laid out at randomized block design (RBD) with ten treatments and three replications, taking "Chhattisgarh *sugandhit bhog*", a variety of scented rice. The result revealed that between the different organic and inorganic treatments T_6 (75% RDF + 5 tonnes Vermicompost ha^{-1} enriched with consortia), the highest grain yield 35.78 q ha^{-1} was observed, which was significantly superior over other treatments but was at par with T_5 (75% RDF + 5 tonnes FYM ha^{-1} enriched with consortia) with 34.24 q ha^{-1} grain yield closely followed by the treatments T_4, T_3, T_2 and T_{10}. The higher growth, yield, and yield attributes characters under the T_6 have been affiliated with higher plant height (94.14 cm), highest effective tillers (308.82), and highest panicles per m^2 (306.66), and they were also significantly superior. The highest B:C ratio and net profit were observed in treatments T_5 (2.6 and ¹ 60918 ha^{-1}), respectively.

Keywords Integrated nutrient management, significantly superior, organic and inorganic

Weed management technologies adopted by DSR farmers in West Champaran, Bihar

Chelpuri Ramulu, Abhishek Pratap Singh, Saurabh Dubey, Dhiru Kumar Tiwari, Jagpal and Harsha BR
Krishi Vigyan Kendra, Madhopur, West Champaran-I, under Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar
Email: chepuri.ramulu@rpcau.ac.in

The different weed management technologies adopted by DSR Farmers in West Champaran, Bihar, are manual weeding by khurpi and mechanical weeding by power weeder. The field performance of different weeding tools/implements, *viz.* Khurpi (hand hoe), grubber, wheel hoe, and power weeder were carried out at the rice growing by DSR farmers' field of West Champaran, Bihar. Results revealed that actual field capacity of 0.0035±0.002, 0.0076±0.0002, and 0.0129±0.0003 were associated with Khurpi, grubber, wheel hoe, and power weeder, respectively. Khurpi recorded the maximum weeding efficiency (98.9%) and the lowest in case grubber (74%). Similarly, power weeder contributed to higher plant damage (0.4%). The operational cost of Khurpi had a maximum of ¹ 6793/ha. The energy consumption observed was more in manual weeding followed by grubber, cone weeder, and power weeder. The highest yield was observed where the power weeder was operated, *i.e.,* 46.5 q/ha, and was less in weeding with Khurpi, *i.e.,* 43 q/ha.

Keywords Weed management, khurpi, power weeder

Sustainable farming through innovative optical monitoring

G Ranjith and Pratibha Devi Sharma
[1]Department of Processing and Food Engineering, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar
Email: ranjithgali746@gmail.com

Biospeckle laser technology is an innovative solution for sustainable farming through non-destructive quality assessment. The technology analyzes temporal and spatial variations in laser light scattered from biological materials, enabling real-time monitoring of fruit maturity, freshness, and disease detection without product damage. Integration with numerical processing techniques provides quantitative measures for pre-harvest monitoring, optimizing harvest timing, and reducing food waste. While demonstrating significant potential for automated quality control in sustainable farming, the technology requires standardization for widespread implementation. This approach offers a cost-effective, rapid solution for quality assessment in agricultural systems, supporting food security and sustainable farming practices.

Keywords Biospeckle laser technology, non-destructive testing, sustainable farming

Adoption and economic impact of improved rice varieties in climate-vulnerable districts of Odisha: a gender-based analysis

Athulya S, KV Praveen, Alka Singh, P Anbukkani, GK Jha, SR Bishnoi
ICAR-Indian Agricultural Research Institute, New Delhi
Email: veenkv@gmail.com

This study investigates the patterns, determinants, and economic impact of improved rice variety adoption among farm households in three climate-vulnerable districts of Odisha: Bolangir, Ganjam, and Mayurbhanj. Using data from 880 households, we explore the pattern of rice varietal adoption among the farmers in the region. We employ a probit model to examine the factors influencing adoption, including socio-economic characteristics, farm-related factors, and institutional access. The analysis highlights significant gender disparities in adoption rates, with male-headed households more likely to adopt improved varieties. The Rank-Based Quotient analysis also reveals differences in varietal trait preferences between genders. The economic impact of adoption is assessed using Propensity Score Matching, which shows a positive effect on farm income, with adopters of improved rice varieties earning significantly higher returns than non-adopters. The findings underscore the need for targeted interventions, especially for female-headed households, to enhance the adoption of climate-resilient varieties and promote gender-equitable access to agricultural resources. This research provides valuable insights for policymakers and development practitioners aiming to improve rice productivity and build climate resilience in the region.

Keywords Improved rice varieties, gender, agricultural innovations, propensity score matching (PSM), rank based quotient (RBQ)

A framework for assessing the output impact of crop-specific micronutrient formulations in spice crops

Lijo Thomas, Sajesh V K and V Srinivasan
ICAR-Indian Institute of Spices Research, Kozhikode
Email: lijoiari@gmail.com

Soil micronutrient deficiency is a critical factor limiting crop yields, particularly in spice crops across India. This production constraint can be mitigated through the application of crop-specific micronutrient formulations. This study evaluates the national-level output impact of crop-specific micronutrient formulations developed by the ICAR-Indian Institute of Spices Research for black pepper, ginger, turmeric, and cardamom. By analyzing data from technology licensees, crop area, and yield trials, the study estimates yield enhancement and economic benefits attributable to micronutrient application. Results indicate substantial yield gains and economic benefits, with conservative estimates suggesting national-level output increases for all four crops. We also establish that the cost of technology development was relatively low when compared to the magnitude of the benefits. The yield impact at the national level was estimated to be 1.96,130.2, 18.3, and 1.9 kg/ha for black pepper, ginger, turmeric, and cardamom, respectively. The net economic gains for the primary producers from the use of micronutrient technology were highest in ginger (INR 667 million), followed by turmeric (INR 383 million), black pepper (INR 223 million), and cardamom (INR 113 million). The findings highlight the significant role of micronutrient technology in boosting spice output in the country. The study also implies that developing crop-specific micronutrient technologies for other spice crops could yield similar economic benefits.

Keywords Micronutrient deficiency, economic benefit, black pepper, yield impact

Constraints in the adoption of preferred rice varietal traits among paddy farmers of Telangana

S Satish[1], Hulas Pathak[1] and Nirmala Bandumula[2]
[1]Department of Agricultural Economics, College of Agriculture, IGKV, Raipur, Chhattisgarh
[2]ICAR-National Academy of Agricultural Research Management, Hyderabad
Email: sonavenisatish9121995@gmail.com

Rice is an essential staple food globally, providing a primary source of calories for a significant portion of the world's population. In India, where agriculture is a cornerstone of the economy, rice production has seen remarkable growth over recent decades. This expansion is driven by advancements in agricultural technology, such as adopting high-yielding seeds, chemical fertilizers, and agrochemicals. As a result, India has become a leading player in rice production, covering extensive areas and significantly contributing to the nation's food grain output. In Telangana, paddy production has surged due to government initiatives, irrigation projects, and strategic investments. The development of high-yielding rice varieties tailored to the region's soil conditions has been instrumental in this growth. These varieties resist various biotic and abiotic stresses, ensuring a consistent increase in paddy production. The state's impressive progress in rice cultivation is reflected in the substantial data on area coverage, production, and productivity. The study delves into the problems faced by the paddy farmers of the State. Paddy farmers face challenges like low market prices, lack of technical knowledge, and limited access to services. Both coarse and fine variety adopters share these issues. The study suggests promoting varietal diversity, improving research and seed distribution, and providing better market infrastructure and financial support to enhance rice farming in Telangana.

Keywords Rice production, Telangana, high-yielding varieties, paddy farmers, challenges, coarse variety adopters, fine variety adopters

Socio-economic attributes of growers and non-growers of the soybean variety MAUS-612

Bhosale A S, Perke D S and Pathrikar D T
Email: ashwinibhosale0206@gmail.com

This study analyzes the economic impact of the improved soybean variety MAUS-612 among 160 growers and 160 non-growers in Maharashtra's Marathwada region. Demographic data revealed that 56.88% of growers are middle-aged, while non-growers exhibit a higher proportion of older individuals (32.5%). Educational attainment indicates 28.13% of growers are graduates versus 18.75% of non-growers. Family type shows 60.63% of growers in joint families. Gender disparity is evident, with 96.88% male representation in both groups. Income distribution highlights 65% of growers earning [1] 1–3 lakh, compared to 66.88% of non-growers, reflecting the crop's economic viability.

Keywords Economic impact, demographic, attainment, disparity, economic viability

Environmental impact analysis of crop residue burning in Madhya Pradesh: a multivariate comparison across key crops

Nihal Singh Khangar[1], Mohanasundari T[1]*, Muskan[1], K Thomas Felix[2] and Durga AR[3]
[1]School of Humanities and Social Sciences, IIT Indore, Madhya Pradesh
[2]ADRTC, Institute for Social and Economic Change, Bengaluru
[3]Department of Agricultural Economics, KAU, Thiruvananthapuram Kerala
Email: mohana@iiti.ac.in

This study quantified the environmental impacts of residue burning of major produced and burned crops in Madhya Pradesh, central India. The environmental impacts were quantified using Life Cycle Assessment (LCA) coupled with a Monte Carlo simulation of 1000 iterations. Crop-wise marginal impacts of the crops have been quantified using a multivariate regression model. The results showed sugarcane and rice have the highest emissions in key impact categories, such as particulate matter formation (PMF) and global warming potential (GWP), whereas wheat and maize exhibit comparatively lower impacts. The combustion of residues significantly increases marine eutrophication (MEUT), agricultural land use (ALU), terrestrial acidification (TEAF), and global warming potential (GWP). Each kilogram of burned residue increases MEUT by 21%, ALU by 0.05%, TEAF by 0.046%, and GWP by 0.028%, intensifying climate change. The results underscore the immediate necessity for specialized residue management strategies for sugarcane and rice crops. It is advisable to utilize sustainable alternatives such as composting or biochar production to mitigate emissions and enhance soil health, thereby addressing environmental and human health issues.

Keywords Residue burning, LCA, marginal effect, interaction effect, multivariate regression

Effect of postharvest preservatives on vase life of cut rose

Shiwani Kshirsagar
Indira Gandhi Krishi Vishwavidyalaya (IGKVV), Raipur
Email: kshirsagarshiwani@gmail.com

The research experiment was laid out in a completely randomized design with three replications and fourteen treatments like Control, Sucrose (2.0%), Silver Nitrate (30 ppm), Silver Nitrate (60 ppm), Boric Acid (75mg/l of water), Boric Acid (100mg/l of water), Sucrose (2.0%) + Silver Nitrate (30 ppm), Sucrose (2.0%) + Silver Nitrate (60 ppm), Sucrose (2.0%) + Boric Acid (75mg/l of water), Sucrose (2.0%)+ Boric Acid (100mg/l of water), Sucrose (2.0%) + Silver Nitrate (30 ppm) + Boric Acid (75mg/l of water), Sucrose (2.0%) + Silver Nitrate (30 ppm) + Boric Acid (100mg/l of water), Sucrose (2.0%) + Silver Nitrate (60 ppm) + Boric Acid (75mg/l of water), Sucrose (2.0%) + Silver Nitrate (60 ppm) + Boric Acid (100mg/l of water) were used for experiment. Data revealed that the treatment T_{11} (Sucrose 2.0% + AgNo3 30 ppm + Boric Acid 75 mg/l of water) recorded the best performance concerning days taken to 1st petal spreading, change in weight of flowers at senescence, flower freshness score, maximum flower head diameter, petal discoloration score, change in TSS, change in chlorophyll content, change in anthocyanin content and vase life.

Keywords Vase life, boric acid, ppm

Leveraging GIS for precision agriculture and sustainable farm management

Aashi Sarva and Avan Das Sahu
Department of Agricultural Economics, IGKV, Raipur
Email: sarva.aashi@gmail.com

Geographic Information Systems (GIS) have become vital in modern agriculture, enabling precise mapping and spatial analysis of soil properties, crop health, and resource distribution. GIS technologies help farmers optimize land use, water management, and crop rotation, improving yield while reducing environmental impact. By integrating satellite data and real-time field information, GIS supports efficient decision-making, contributing to sustainable farming practices. This paper explores GIS applications in agriculture, highlighting its benefits and challenges for farm management.

Keywords GIS, precision agriculture, crop management, sustainable farming, spatial analysis

Gender, Food Security and Rural Livelihoods

Exploring the relationship between women's empowerment and nutritional well-being of women in India: Evidence from National Family Health Survey-5

Venkata Naga Sindhuja Padigapati, Alka Singh, Praveen Koovalamkadu Velayudhan
Division of Agricultural Economics, ICAR-Indian Agricultural Research Institute, Delhi-110012
Email: sindhujareddy992@gmail.com

Child and maternal malnutrition are the primary risk factors for health issues in India. Maternal malnutrition is associated with higher rates of acute and chronic diseases, lower survival rates for mothers and children, and hinders a healthy growth, development, and future socio-economic status of the child. This study investigates the relationship between women's empowerment and the nutritional and health status of women in India. The study revealed that lower levels of women's empowerment were significantly linked to an increased risk of anaemia compared to higher levels of empowerment [Odds Ratio: 1.15; 95%CI: 1.05-1.27]. Conversely, women with lower levels of empowerment had lower odds of becoming overweight or obese in India [Odds Ratio: 0.83; 95%CI: 0.74-0.93].

Keywords Women's empowerment, Underweight, Overweight/Obese, Anaemia

Attitude and adoption of frozen food among consumers of Jammu and Chandigarh cities

Somiya Kaur Sodhi and Sudhakar Dwivedi
Agri-Business Management, SKUAST-J, Jammu
Email: somiyasodhi97@gmail.com

The demand for frozen food has increased due increased urbanization, increase in the number of nuclear families, and the number of working women. Frozen foods are simple to prepare and easily accessible in supermarkets, making them the perfect choice for people with busy schedules or limited cooking experience. The Indian frozen foods market was valued at INR 124.06 Billion in 2021. It is expected to reach INR 309.07 Billion by 2027, expanding at a CAGR of ~16.27% during the 2022 - 2027. The market value for this industry by the end of 2030 may be close to USD 338.5 Billion. Additionally, compared to fresh produce, frozen foods have a longer shelf life, which reduces food wastage. This is especially advantageous in areas with scarce or expensive seasonal food. Choosing frozen food has been found to be influenced by demographic factors such age, gender, wealth, and education. Attitudes, beliefs, values, and convenience also have an influence on the food choice of consumers. The present study attempts to understand the attitude and adoption level of consumers of Jammu city and Chandigarh city towards frozen food and find out the constraints inhibiting the adoption of frozen food. We randomly selected five stores from each city, selling frozen food along with regular food items and a total sample size of 200 consumers. Primary data was collected with the help a pre-tested schedule cum questionnaire by using personal interview method. The respondents stated that the reasons for purchase of frozen food were easy to cook, less time consuming and longer shelf life. Almost 100 percent of the respondents in Jammu and Chandigarh cities were ready to adopt frozen food. The main problems in their adoption were less availability, price, and nutritional value. Two key factors viz. gender and age influenced the perception of consumers towards frozen food.

Keywords Frozen food, attitude, adoption, perception, consumers

Consumption of functional dairy foods in Northern Tamil Nadu: pattern and key drivers

Dhasarathan M, Subhasis Mandal, Biswajit Sen, Ajmer Singh
Division of Dairy Economics, Statistics and Management,
ICAR-National Dairy Research Institute, Karnal 132 001, Haryana
Email: ajmerskundu@gmail.com

Conducted in the northern part of Tamil Nadu, this study investigated consumers' consumption pattern and the factors moderating their consumption on functional dairy foods (FDF) based on the data collected from 160 consumers and 60 sale points. The analysis is based tabular and frequency analysis for consumption pattern and double-hurdle model for factors moderating the consumption analysis. It was found that 84 per cent of the respondents were aware of FDF foods, with television advertisements being their primary source of information. The average monthly per capita consumption was 3.6 L in terms of milk equivalent quantity which was 33.43 per cent of the total per capita milk availability in Tamil Nadu. FDF are still in the early stages of adoption, with fortified milk showing the greatest potential. Income, price, occupation, dietary habits, family size and location were found to be significantly influencing the consumption expenditure on FDF.

Key words Functional dairy foods, double-hurdle model, probiotic food, fortified food, Tamil Nadu

A decade of change in India's consumption patterns

Anukriti Negi and Priyabrata Sahoo
Department of Economics, Banaras Hindu University, Varanasi 221005
Email: priyabrata.s@bhu.ac.in

The study investigates the shift in consumption patterns across nineteen major Indian states from 2011-12 to 2022-23. The research focuses on changes in the commodity-wise and income-wise expenditures, to analyse the relationship between Per Capita Income (PCI) and Monthly Per Capita Expenditure (MPCE) and to highlight the regional disparities in income and consumption behaviors. It utilizes the National Sample Survey (NSS) Household Consumption Expenditure Survey (CES) to assess changes in the spending pattern over the study period. It evaluates the composition of expenditure on food and non-food items in rural and urban areas. The Growth Incidence Curve (GIC) approach is employed to assess the inclusivity of MPCE growth across income deciles. Broad analysis reveals a decrease in the share of spending on food items and a rise in the non-food expenditures in both rural and urban areas. In rural India, the highest growth in food expenditure is on fruits, while conveyance leads to non-food spending. In urban India, beverages show the largest increase in food expenditure, while pan, tobacco, and intoxicants lead to non-food spending. Jharkhand and Uttarakhand demonstrate the highest growth in non-food expenditures in rural and urban regions, respectively. GIC analysis indicates faster MPCE growth for higher-income deciles, suggesting increasing economic inequality.

Keywords Consumption, Food, Non-food expenditure, MPCE, Major States, India

Socio-economic analysis of rural farmers of SAS district of Punjab

Pulkit Sharma and Gurshaminder Singh
University Institute of Agricultural Science, Chandigarh University
Email: pulkitsharma6993@gmail.com

This study analyzes the socio-economic profile of farmers as part of a Rural Agricultural Work Experience Program (RAWEP) conducted in five selected villages in Kukrali district, Punjab viz. Dhianpur, Kakrali, Dhangrali, Khairpur and Dhanauri. The research focuses on understanding the demographic characteristics, landholding patterns, cropping practices, and socio-economic conditions of farmers in these rural communities. Data was collected through structured surveys and interviews from 120 farmers with a focus on their age, educational background, family size, income levels, and sources of agricultural inputs. The study revealed that most of the farmers are small and marginal landholders with limited access to modern farming techniques, credit facilities, and government schemes. Additionally, the research highlights the dependence of farmers on traditional agricultural practices and a need for capacity-building programs to enhance farm productivity and sustainability. This socio-economic profile provided insights into the challenges faced by rural farmers and offers recommendations to improve agricultural development policies and support systems tailored to the specific needs of these communities.

Keywords Rural Agricultural Work Experience (RAWE), Landholding patterns, Demographic characteristics, Small and marginal landholders, Capacity-building programs

The rise of gig economy and its implication in agriculture

Haritha K[1], Anbukkani P[2], Nithyashree M L[3], Abhinandan Kumar[4]
[1 2 3]Division of Agricultural Economics, ICAR-Indian Agricultural Research Institute, New Delhi-110012
[4]Division of Dairy Economics, Statistics and Management, ICAR-National Dairy
Research Institute, Karnal-132 001, Haryana
Email: anbueconomic@gmail.com

The gig economy is revolutionizing labor dynamics across sectors, including agriculture, by providing flexible work opportunities that cater to the needs of both workers and employers. This research investigates Nurture Farm, a digital platform that connects farmers with gig workers based on data collected through telephonic interviews and secondary sources in July 2022. The findings indicate that such platforms significantly enhance income opportunities and flexibility for rural workers, especially women, while addressing seasonal labor shortages. Furthermore, it highlights the necessity of a regulatory framework to safeguard gig workers' rights. It emphasizes on the importance of training initiatives to improve digital literacy, fostering a more inclusive agricultural workforce.

Keywords Agriculture, Gig economy, Digital platform, non-farm employment, Rural

Bridging the financial gap: Literacy and rural development

Bhashkar Sahu and Sanjay Joshi
Department of Agribusiness Management and Rural Management, CoA, IGKV Raipur
Email: sahubhaskar99@gmail.com

Financial literacy holds an important role in empowering the marginalized community, helping in economic and social empowerment, and enhancing the socio-economic status of individuals and communities. In today's modern era, every person has access to basic financial products such as bank account, savings, insurance, investment, pension, digital banking, UPI payments etc. Various efforts have been made by the government and civil societies to enable financial products and services affordable and accessible to all income group peoples in rural areas. Only limited people have been using financial products due to restricted financial infrastructure, limited education and awareness. Kisan Credit Card and Pradhan Mantri Jan Dhan Yojana contributed immensely to achieving the vision of financial inclusion by providing access to financial products and services to low-income groups. Access to quality education and awareness, lack of financial infrastructure in rural areas, trust and confidence in traditional methods, high cost of financial services and seasonal income fluctuations are major challenges in financial literacy. Financial literacy is a combination of a person's skills, knowledge, and requirements. Government banks and institutions organize various training and awareness programs to provide financial education to people in rural areas and change is very much visible at ground level and peoples accepted and adopted it. Financial education helps people in making better financial decisions in future perspectives and for longer terms. They will be more inclined towards making better investment decisions which would make their future secure and safer. Post demonetization, most of the peoples switched their business from traditional to digital and payments by using of net banking, mobile banking, online payments, using of UPI such as PhonePe, G-Pay, Paytm etc.

Keywords Financial literacy, economic growth, poverty reduction, empowerment

Influence of social media marketing on consumer behaviour in India

Dushyant Kumar, Dronak Kumar Sahu, Avan Das Sahu
Department of Agricultural Economics, IGKV, Raipur)
Email: dushyant98agri@gmail.com; dronaksahu@gmail.com; avandass119@gmail.com

This paper established that social media marketing plays an important role in the consumer decision making process in India particularly regarding the customers' buying behavior, attitude towards the brand and level of brand commitment. Currently, Facebook, Instagram, and even WhatsApp bring business directly to various clients, creating and molding the preferences of the public through advertisements, engagement with brand influencers, and using persuasive content. Social media causes real time feedback on the products or service to be provided hence leading to high brand trust and personalization. Yet issues like data privacy and protection, fake news persist. Knowledge of these trends will be useful for brands attempting to harness the potential of social media in the expanding Indian market.

Keywords Customer, Twitter, Instagram, and Hashtags, Promotion and Advertisement.

Assessing the sustainability of paddy seed production at Jaikopeshwar Nath Krishi producer company limited

Harsha Sahu, Bhashkar Sahu, M.R.Chandrakar, S.K.Joshi
Department of Agri-Business and Rural Management IGKV Raipur
Email: sahuharsha47@gmail.com

The purpose of this study is to evaluate the performance of Paddy Seed Production Program at Jaikopeshwar Nath Krishi Producer Company Limited, which is specialized in production and processing of paddy seeds in Fingeshwar block of Gariaband district. The cost of paddy seed production per hectare was calculated to be Rs.53,826.48, with a net profit of Rs.1,35,809 per hectare for the producer. The input-output ratio of paddy seed cultivation was estimated to be 1:1.39. We recommend that producers should be encouraged to use the most up-to-date agriculture machinery and technology in order to reduce labour cost and cultivation cost, as well as to use certified and high-quality seeds for increased productivity.

Key words Performance, Paddy seed production, JKNKPCL

Advancing sustainability in India's oilseeds economy

Devesh Kumar Pant and M.L. Sharma
ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi
Department of Agricultural Economics, G.B.P.U.A.T., Pantnagar, Uttarakhand
Email: dkpant456@gmail.com

Oilseeds are vital non-cereal crops in the global agricultural landscape. India, as the fourth-largest producer of oilseeds, plays a significant role in their production. Despite this, India imports 60% of its edible oil to meet domestic demand, emphasizing the need for enhanced production and market efficiency. Addressing challenges such as market integration, price volatility, and global price fluctuations is critical to achieving sustainability in India's oilseeds economy. This study investigates the dynamics of price volatility and market integration for key oilseeds in India. Using advanced econometric models, the study highlights the persistence of price volatility in oilseeds and their derivatives. Key findings reveal that while oilseed markets are horizontally integrated, edible oil markets exhibit poor integration. Vertical integration analysis underscores strong linkages between oilseeds and their derivatives, except for sunflower. The findings advocate for strategic interventions to stabilize prices and reduce import dependency. Improved market infrastructure, effective risk management tools such as crop insurance and futures markets, and enhanced communication channels for market intelligence can foster market integration. These measures not only ensure economic stability but also contribute to the resilience and sustainability of India's oilseeds and edible oil sector.

Keywords Oilseeds, Edible oils, Market efficiency, Price volatility, Sustainability

Distribution of different types agricultural credit, across different categories of farmers in Raipur District, Chhattisgarh, India

Sarita Ghidode and Sanjay Kumar Joshi
Department of Agri-Business and Rural Management, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh 492012
Email: saritaghidode123@gmail.com

The study analysis distribution of different types of agricultural credit across various categories of farmers in Raipur district (Chhattisgarh) and suggests policy directives for financial institutions. The analysis reveals significant disparities in credit access and utilization among marginal, small, medium, and large farmers. Analyses were conducted on types of loan, Reasons of farm loan borrowing, share of different crops in crop loan, distribution of term loan, issues related to agriculture credit. A multi-stage random sampling procedure was followed for selecting the sample of borrower farmers. The data was obtained using personal interview approach after the research design and interview schedule were finalised. The results showed that the marginal and small farmers borrowed only short term and medium-term loans but medium and large farmers borrowed all types of loans (short term, medium term and long-term loan). The farmers were habituated to purchase seeds with most of the available agricultural loan. Majority of the agricultural loan borrowing farmers borrowed for paddy and wheat cultivation. The loan for purchasing tractor was found to be of larger amount in the study area. These loans are given against security. Study reveals that the most severe issue faced by the farmers while taking loans was the rules and regulations followed by the banks.

Keywords Agricultural credit, Farmer categories, credit distribution, RRBs, GDP, financial inclusion.

Factors influence customers' choice in fish restaurants: Evidence from Maharashtra, India

Shyam Datta Waghmare, Swadesh Prakash, Arpita Sharma, Vinod Kumar Yadav and Neha Qureshi
FEES Division, ICAR-Central Institute of Fisheries Education, Mumbai
Email: shyamdattaw@gmail.com

This study examines the factors that influence fish consumers' restaurant choices in Indapur and Bhigwan, Maharashtra. Data from 100 fish consumers were analyzed using descriptive statistics, conjoint analysis, factor analysis, and cluster analysis. Conjoint analysis found that an affordable menu (¹ 250-¹ 500) is a key driver. Factor analysis identified five components: standard requirements, menu and ambiance, dish variety, fine dining, and customer feedback. Cluster analysis revealed three customer profiles—average standard, preference seekers, and experience seekers—showing distinct socio-demographic attributes. Key restaurant selection criteria include food quality, comfort, cleanliness, service, and price-quality ratio, varying by customer characteristics and preferences.

Keywords Restaurant, Customers' segmentation, Intrinsic and extrinsic attributes, Conjoint analysis, Fish Consumption, Cluster analysis

Customers perceptions about products and services provided by agricultural startups in the supply chain

Siddharth Kumar and Hulas Pathak
Department of Agri-Business and Rural Management, College of Agriculture, IGKV, Raipur
Email: siddharthpisda@gmail.com

Agriculture startups are developing innovative solutions for various aspects of agriculture, including precision farming, supply chain management, and market linkages. Startups can provide market access to farmers, connecting them directly to consumers, retailers, and processors through marketplaces. Logistics costs in agriculture are very high and farmers spend a lot of money on it. Promoting supply chain startups can help reduce post-harvest losses and improve access to wider markets by providing better logistics and cold storage solutions (such as Solaris Agritech). The study assessed consumer's behaviour towards the products and services of agri- startups through an analysis of consumer attitude. Data was collected on the basis of some main factors - source of information, problems faced by consumers, level of consumer satisfaction and consumer expectations. The results showed that under the source of information, the maximum response was given on exhibition. The response was also given on self-knowledge, friends/relatives and internet. As regards the problems faced by consumers, maximum perception was on distrust in agricultural startups. And under the level of consumer satisfaction, the perception was on quality of the product/services and freshness of the products/services. Finally, under consumer expectations, the response was on increasing the number of seasonal products.

Keywords Agriculture startups, supply chain, logistics, consumers

Comparative performance of agricultural economy during the pre- and post-liberalization periods

Siddharth Kumar and Hulas Pathak
Department of Agri-Business and Rural Management, College of Agriculture, IGKV, Raipur
Email: siddharthpisda@gmail.com

A comparative analysis is done on the effects of economic reforms on exports, imports and total trade in India using time-series data from 1970-71 to 2012-13. A pre-crisis and post-crisis period is considered to assess the trade performance. It is found that foreign trade has shown an increasing trend after the introduction of new economic reforms in India but with the many fluctuations. The rate of growth of imports was higher in comparison to that of exports. If we divide economic history of India into two periods, 1950 to 1980 the era of government intervention and after 1990 liberalization period, there is a significant difference in trade. In the wake of severe balance of payments crisis, India adopted structural adjustment program. The factors responsible for improved economic growth in post liberalization era in India are trade liberalization, foreign direct investment and increase in investment GDP ratio.

Keywords: Agricultural economy, Export, Import, Economic growth, Liberalization.

Inequalities in socio-demographic profile of rural labour and marginal farmer households in border area of Punjab

Skattar Singh and Kuldip Kaur
Khalsa College, Amritsar and B.R Ambedhkar Chair, G.N.D.U Amritsar
Email: skattarsinghmsc@gmail.com

This paper estimates inequalities in the socio-demographic profile of sampled rural labour and marginal farmer households in border area of Punjab. The study comprises 657 sampled respondents, of which 357 were rural labour households and 300 were marginal farmer households. The study reveals that majority of the respondents were illiterate and their level of education was upto primary, middle and metric level, which is a major constraint to adopt to new technology and, digitalization of agriculture. Majority of the respondents were belonged to scheduled caste and other backward caste, living with very small size of houses having one or two living rooms. The study suggests that the government should take necessary steps to educate farmers and rural labourers as it would help them to adopt new technology and improve their economic conditions.

Keywords Education, Type of family, Sex ratio and House conditions

Evaluating varietal performance of lemongrass in a mangium-based agroforestry system in Raipur, Chhattisgarh

Taman Lal Sahu, Pratap Toppo, Manish Kumar Mankur, Sindhu Xaxa, Shikha Minj, Manish Kumar Nagwanshi
Department of Forestry, Indira Gandhi Krishi Vishwavidyalaya, Raipur Chhattisgarh, India
Email**:** tamanlalsahu22@gmail.com

This study evaluated the growth performance, yield attributes, and oil extraction efficiency of eight lemongrass (*Cymbopogon flexuosus* L.) varieties cultivated as intercrops under a 24-year-old *Acacia mangium* agroforestry system at Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, over two growing seasons (2022-23 and 2023-24). The randomized block design (RBD) trial included eight treatments (T1-Krishna, T2-CG1, T3-Pragati, T4-Neema, T5-Kaveri, T6-CKP-25, T7-Praman, and T8-Kalam) with each treatment replicated three times. Growth parameters recorded included plant height, tiller number, plant spread, and Leaf Area Index (LAI). Yield attributes were assessed via fresh and dry herbage yield, oil content, and oil yield. Results showed significant variation across varieties in all growth and yield traits. T4-Neema exhibited the highest fresh yield (131.01 q/ha) and dry yield (36.03 q/ha), demonstrating superior adaptability for biomass production under shaded conditions. T1-Krishna recorded the highest oil percentage (0.75%) and oil yield (91.97 l/ha), indicating its potential for essential oil production in agroforestry systems. Conversely, T8-Kalam displayed the lowest plant height, tiller count, fresh yield, and oil yield, reflecting limited adaptability to partial shading. These findings suggest that varieties like T4-Neema and T1-Krishna are highly suitable for optimized biomass and oil yield, respectively, under an *Acacia mangium*-based agroforestry system, providing insights for sustainable lemongrass cultivation in shaded environments.

Keywords Lemongrass, Agroforestry, *Acacia mangium*, Essential oil, Growth performance, Biomass production, Partial shading, Randomized Block Design (RBD), Sustainable cultivation.

Income inequality in agricultural households of India: Evidence from the NSSO data:

Sukhendu Nandi[1], Souradipta Das[2], Shivendra Kumar Srivastava[3], Pavan Kumar Kumawat[1]
[1]Division of Agricultural Economics, ICAR-Indian Agricultural Research Institute, New Delhi-110012
[2] Department of Economics and Sociology, Punjab Agricultural University, Ludhiana-141004
[3] ICAR-National Institute of Agricultural Economics and Policy Research (NIAP), New Delhi-110012
Email: nandisukhendu21@gmail.com

This study explores the extent and patterns of income inequality among agricultural households in India, focusing on the factors that influence access to various income sources, household income diversification, and the impact of this diversification on poverty alleviation. Using data from 77th round NSSO survey, the analysis reveals significant income inequality across different states and landholding categories. Although agriculture is the primary income source for farm households, off-farm activities like wage employment and non-farm businesses account for 45 per cent of total household income. However, crop income contributes most to income inequality, whereas income from livestock and wages has the capacity to mitigate it. Improving education and skills for small farmers is crucial for accessing off-farm employment, boosting income, and reducing inequality. Additionally, the study finds a positive correlation between female workforce participation and livestock income, underscoring the need for women-focused credit programs offering low-interest loans. Promoting sectors like dairying, construction, manufacturing, and trade in rural areas can create jobs, diversify incomes, and reduce inequality.

Keywords Income inequality, agricultural households, non-farm activities, women participation

Economic impact of varietal diversification on paddy crops in Rajnandgaon: A comparative analysis

Pratiksha Yadav
Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh
Email :pratikshayadav760@gmail.com

This study examines paddy varietal diversification across 107 households in Rajnandgaon, categorized into marginal (36.45%), small (27.10%), medium (21.50%), and large (14.95%) farms, with an average family size of 5.24. Paddy is the dominant Kharif crop, with Swarna occupying 40.62% of the cultivated area and adopted by 36.45% of farmers, predominantly on marginal and large farms. Other popular varieties include Mahamaya (20.28%) and HMT (15.11%), contributing to moderate diversity. The Simpson Diversity Index reveals significant diversification: small farms show the highest diversity (0.83), followed by medium (0.77), marginal (0.75), and large farms (0.72). The overall diversity index stands at 0.76, indicating high varietal diversity. While Swarna dominates, varieties like Mahamaya and HMT enhance resilience and sustainability. Recommendations include promoting public-private partnerships, quality seed access, and local seed production to improve productivity and sustainability.

Keywords Simpson Diversity Index, Varietal Diversification, Paddy Cultivation.

Quantifying virtual water dynamics for major cereals in India

Palnati Naveen Reddy, Baljinder Kaur Sidana, Sunny Kumar, Bilavat Swami Nayak
Department of Economics and Sociology, Punjab Agricultural University, Ludhiana - 141004
Email: naveenreddi1484@gmail.com

There remains hardly any dimensions in the economy that is unrelated to water. It is therefore, imperative to analyze water dynamics in agricultural production. Eyeing on water-saving technologies enable efficient production with less water, this supports virtual water trade by allowing water-rich regions to export products sustainably and water-scarce regions to conserve their own resources. This study focused on quantification of virtual water flows associated with India's trade in major cereals (rice, wheat, and maize) from 2017-18 to 2021-22. Using crop-specific virtual water content estimates and trade data, we analyse Virtual Water Exports (VWE), Virtual Water Imports (VWI) and Net Virtual Water Trade (NVWT) for each cereal. Results revealed that India has emerged as a significant net exporter of virtual water through cereal trade, with net outflows escalating from 32.89 billion cubic meters (bcm) in 2017-18 to 92.03 bcm in 2021-22. Rice accounts for the largest share of virtual water exports, followed by wheat and maize. It is concluded that 13 per cent of water used in major cereal production effectively exported through trade in India. South and East Asia, West Asia, and Africa are identified as the primary importers of India's virtual water through cereal exports. The study contributes to a deeper understanding of how virtual water can be leveraged to address water scarcity, water resource management and food security policies in India, highlighting immediate need to balance water use efficiency, food security, and export earnings, particularly in water-stressed regions. Together the virtual water trade and sustainable trade technologies optimize resource use, supporting global sustainability and resilience against water scarcity.

Keywords Virtual water trade, water scarcity and security, water policy, water use efficiency

Economics and yield analysis of Cowpea – Potato – Cucumber cropping system as influenced by vertisols of Chhattisgarh plains

Yogendra Chandel, Pravin Kumar Sharma, Sunil Kumar, Jitendra Trivedi, Beena Singh Vandana Yadav, Akanand, Alka Minj
College of Agriculture Raipur, IGKV, 492012, Chhattisgarh
Email: sirchandel19@gmail.com

The present experiment was conducted during the Kharif, Rabi and Summer season of the year 2022-2023 at Research cum Demonstration Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The study used STCR approach for optimization of nutrient requirement of Cowpea – Potato – Cucumber cropping system in vertisols of Chhattisgarh plains, consisting of nine treatments and replicated thrice in RBD design for all the crop and the results revealed that the soil test based fertilizer application consists of kharif N:P:K (26:78:28 kg/ha), rabi N:P:K (203:390:67 kg/ha) and N:P:K (91:65:35 kg/ha) application for Cowpea, Potato and Cucumber respectively. The treatment was recorded for maximum yield of Cowpea (12.5 t/ha), Potato (30.2 t/ha) and Cucumber (8.05 t/ha). Parameters such as gross income and B:C ratio was recorded maximum in treatment soil test based fertilizer application (Rs. 312500, Rs. 604200 and Rs. 241500 ha-1) and (5.56, 5.81 and 3.60) in Cowpea, Potato and Cucumber respectively

Key words STCR, RDF, Cropping System

Evaluating the financial impact of insurance on farmers: A case study from Andhra Pradesh

Popavath Bhargav Naik[1], A. Vidhyavathi[2], Padigapati Venkata Naga Sindhuja[3], Shreya S Hanji[4] and Shiva Kumar Perka[5]

[1,3,4,5]Division of Agricultural Economics, ICAR-Indian Agricultural Research Institute, New- Delhi 110012
[2]Department of Agricultural Economics, Agricultural College and Research Institute, TNAU, Coimbatore-641003
Email: popavath@gmail.com

This study evaluates the impact of crop insurance on the cost returns and technical efficiency of chilli and cotton farmers. Insured farmers had higher yields and returns than their non-insured counterparts. Insured chilli farmers achieved yields of 40.94 q/ha and returns of Rs. 722181/ha, compared to 39.72 q/ha and Rs. 700308/ha for non-insured farmers. Similarly, insured cotton farmers had yields of 18.65 q/ha and returns of Rs. 121280/ha, while non-insured farmers had yields of 17 q/ha and returns of Rs. 110551/ha. Additionally, insured farmers had higher technical efficiency (chilli-0.91, cotton-0.81) compared to non-insured farmers.

Key words Crop insurance, yield, technical efficiency

Assessing the cost and returns of turmeric cultivation in Surguja District, Chhattisgarh

Siya Ram[1], M R Chandrakar[2], A K Gauraha[3], Sidharth Kumar[4], and Bhawana Patel[5]

[1, 3-5]Department of Agri-Business and Rural Management, IGKV, Raipur, Chhattisgarh, India
[2]Department of Agricultural Economics, IGKV, Raipur, Chhattisgarh, India
Email: siyaramsingh0886@gmail.com

The Present study assessing the cost and returns of turmeric cultivation in Surguja District of Chhattisgarh state. Based on survey, interviews, various publication sources, the study examines yield per hectare, input cost, labor requirement, market prices, and profitability. The overall cost of cultivation of turmeric is calculated to Rs. 203509.74 per hectare. Based on different cost concepts, the average costs for A1, A2, B1, B2, A2+FL, C1, C2, and C3 per hectare are determined to be Rs. 163610.48, Rs. 163610.48, Rs. 165094.10, Rs. 185094.10, Rs. 182026.12, Rs. 183509.74, Rs. 203509.74, and Rs. 223860.71 respectively. The average income over costs A1, A2, B1, B2, C1, C2, and Income over cost C3 is calculated to be Rs. 550848.65, Rs. 550848.65, Rs. 549365.03, Rs. 529365.03, Rs. 530949.39, Rs. 510949.39, and Rs. 490598.42 per hectare respectively. The overall net income is determined to be Rs. 510949.39 per hectare, and the overall cost of production is Rs. 866.00 per quintal. The input-output ratio is found to be 1:3.51. Thus, turmeric cultivation appears to be beneficial for selected farmers in Surguja district, which is the highest turmeric-producing region in Chhattisgarh. The study highlights the importance of providing high-quality turmeric rhizomes at affordable prices, improving marketing opportunities, and introducing labor-saving machinery to increase productivity and profitability. It also highlights the role of education in increasing profits through value creation and suggests that government interventions in marketing and financial support are important to sustain and expand turmeric cultivation in the region.

Keywords Cost of cultivation, Net income per hectare, Production, Input Output Ratio

Trend and growth of rice area, production and productivity in the major producing states in India

Sarita Sharma, R.M. Sahu, H.O. Sharma
Department of Agricultural Economics and Farm Management
Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur – 482004 (M.P.)
Email: sarita90677@gmail.com

The study analyzed growth in the area, production and productivity of rice in major rice producing states in India and also examined the instability and growth in it for a period of 15 years from 2002-03 to 2016-17. The study reveals positive and significant growth in area, production and productivity of rice India. The area under rice in Madhya Pradesh, Other states, Punjab, Uttar Pradesh showed positive and significant growth. The production of rice registered positive and significant for all the states except West Bengal and Andhra Pradesh. The productivity of different states reveals positive and significant growth. Whereas the highest variation found to be Andhra Pradesh (27.42%) and the lowest was in Chhattisgarh (1.25%) which was even less than the CV of India (2.58%). The variability of India's productivity (9.30%) had higher affected on the fluctuation of production (10.81%) than instability in the area (2.58%).

Keywords Rice, growth rate, variability, area, production, productivity.

Studies on genetic analysis of tuber yield and it's components in potato (Solanum tuberosum L.)

N. R. Rangare1, Vikky Kumar, Vivek kumar Sandilya, Khileshwari Bhuarya, Shreerama, T. Arvind Swami
Department of Genetics and Plant Breeding, College of Agriculture, IGKV, Raipur (C.G.) 1, Pin 492012
Email: nrrangare@yahoo.com.in ;vikkynetam143@gmail.com; viveksandilya75@gmail.com; khileshari1196@gmail.com; shreerama1998@gmail.com; arvind6789swami@gmail.com; vikkynetam143@gmail.com

The experiment titled "Studies on genetic analysis of tuber yield and its components in potato (Solanum tuberosum L.)" was organized by "All India Coordinated Research Project on Potato at Research and Instructional Farm, Department of Genetics and Plant Breeding, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, in during Rabi season 2018-19. The assessment was laid on Randomized Complete Block Design with four replications. All values obtained by analysis of variability for potato yield and yield attributing attributes revealed, there is sufficient amount of variability for all the characters. Presence of higher phenotypic coefficient of variation (PCV) than genotypic coefficient of variation (GCV) for all the characters except harvesting index indicating that expression of characters is less influenced by environment. The characters viz., number of shoots plant-1, number of branches plant-1, plant height, number of compound leaves plant-1 showed high heritability. The high heritability coupled with high genetic advance are observed for Number of leaflets plant-1, number of compound leaves plant-1, Fresh weight of tuber plant-1(g), Marketable tuber yield (t/ha), Total tuber yield (t/ha) and thus it can be concluded that the selection of these traits may accumulate more additive genes leading to improvement of these characters.

Keywords Potato, Heritability, PCV, GCV and Variability

Seasonal dynamics and decision-making role of farm women in the agriculture sector of Jammu and Kashmir

Sumit Sutradhar, Kumari Sneha, Jyoti Kachroo and Diksha Bali
ICAR-Indian Agriculture Research Institute, New Delhi
Email: sumitsutradhar2816@gmail.com

The present research assesses the role of farm women in agriculture and allied systems, focusing on their participation in employment generation and farm income under irrigated and unirrigated ecosystems in Jammu district, Jammu and Kashmir. It focuses on the seasonal employment patterns and decision-making involvement of farm women in agricultural farm duties. A total of 120 farm women were randomly selected from six blocks, with a balanced representation of both irrigated and unirrigated areas. The findings revealed that farm women experienced significant seasonal variation in employment. During the monsoon season, they were actively engaged in crop cultivation, with peak employment occurring in the months of June to September. However, off-season unemployment was particularly high during the winter months (December to February) and the dry period (March to May) in unirrigated areas. In terms of decision-making, women participated in tasks such as sowing and irrigation, but their involvement in critical decisions, like crop selection, irrigation management, and marketing, was minimal, with men primarily holding the decision-making power. Women had more autonomy in managing livestock, which is integral to the household economy. The study concludes that improving women's decision-making power and addressing seasonal unemployment through skill development could significantly improve their socio-economic status, requiring targeted policy interventions.

Keywords Farm women, seasonal employment, decision-making, irrigated and unirrigated ecosystems

Status of fish farmers and fishers in Chhattisgarh through the lens of Human Development Index

Nitika Singh[1], Ananthan P.S.[1], Naila Majid Bhat[2], Suvetha V[3], Talib Mohammad[3]
[1]ICAR-Central Institute of Fisheries Education, Mumbai, India – 400061
[2]School of Fisheries, Centurion University of Technology and Management, Odisha- 761211
[3]ICAR-Central Institute of Fisheries Education, Mumbai, India – 400061
Email: ananthan@cife.edu.in

This paper assesses the human development status of fishers and fish farmers in Chhattisgarh, quantifying their HDI under different production systems like reservoirs, ponds, and riverine environments in four districts. The results show that the HDI of Chhattisgarh's (0.62) fishers and fish farmers tend to coincide with the state (0.61) and national HDI (0.64). Therefore, the sector appears to be relatively socio-economically stable. Regarding education and health, and standard of living indices, varied production systems can indicate that reservoir-based fishers are better educated (0.62) and have higher living standards (0.65) compared to riverine and pond-based. ANOVA confirmed a significant difference in HDI among the different production systems, which indicated disparity caused by regional factors and resource access. This study further compared the fishers of Chhattisgarh with those in Madhya Pradesh, where HDI levels in Chhattisgarh are significantly different from that in Madhya Pradesh (0.47) due to better infrastructure and more educational opportunities as well as healthcare services. This work highlights targeted policy interventions that can be given to the fishers for human development in different regions and systems that can uplift the state's overall development via strategic management of resources and more social support.

Keywords Human Development Index, Fisheries, Chhattisgarh, Madhya Pradesh

Economic analysis of poultry contributions in securing the livelihood of small and marginal farmers in Dharmapuri district of Tamil Nadu

R. Rajkumar
Centre for Agricultural and Rural Development, TNAU, Cambitore 641003
Email: rajkumarr98111@gmail.com

The livestock sector's significance in influencing social and economic transformation in rural communities by providing income and employment possibilities has long been recognized. The study was carried out in the Morappur block of Dharmapuri district utilizing multistage random sampling techniques. The study concentrated on the livelihood security of small farmers raising poultry animals, as well as their costs and returns. The annual average income is 9338.68. The study shows that poultry farming greatly improves the livelihoods of small and marginal farmers by providing a consistent income source, despite the high initial and ongoing costs.

Keywords Poultry animals, Cost of production, and Returns.

Evaluating the environmental impacts of technology capsule for fall armyworm management in maize: insights from Erode district, Tamil Nadu

Shanmuga Priya K and Selvam S
Department of Agricultural Economics, Anbil Dharmalingam Agricultural
College and Research Institute, Tamil Nadu Agricultural University, Tiruchirappalli – 620027
Email: shanpriyakarthikeyan@gmail.com; selvamseconomics@tnau.ac.in

Maize is the third most grown crop in the world after wheat and rice due to its high productivity. Since 2018, the fall armyworm had caused serious damage in many countries and production has decreased. Total maize production in Tamil Nadu was 28.7 million tonnes in 2017, but production fell by nearly 1 million tonnes in 2018 by the infestation of FAW. In response to these problems, the innovative approach was developed by the Department of Agricultural Entomology, Tamil Nadu Agricultural University (TNAU), Coimbatore to address the fall armyworm (FAW) infestation in maize production using integrated pest management (IPM) called TNAU technology capsule. This technology capsule incorporates cultural, mechanical, physical, biological, and chemical measures to control pests ecologically and economically. Against this background, this study is presented to compare the environmental impact of the FAW management in Erode district of Tamil Nadu using Environmental Impact Quotient (EIQ). The study found that pesticide users who adopted the TNAU technology capsule had lower environmental impact than non-adopters. The findings highlight the technology capsule's potential to reduce pesticide dependency, enhance environmental sustainability, and improve farm resilience. The TNAU technology capsule effectively manages harmful pests while minimizing environmental impact, showcasing its stability, efficiency, and ecological sustainability in the management of FAW. To maximize its adoption, extension services should actively educate growers about its environmental and economic benefits.

Keywords Fall armyworm, IPM, TNAU Technology Capsule and Environmental Impact Quotient

Commercialization of goat production in India: A techno-economic feasibility analysis

A K Dixit
ICAR-Central Institute for Research on Goats, Makhdoom, Farah Mathura-281122, Uttar Pradesh
Email: aampi2003@yahoo.co.in

This paper estimated techno-economic feasibility of commercial goat farms in India. Data were collected from 136 commercial goat farmers spread over 20 states and falling under six goat populated regions. An economic analysis of commercial farms revealed that per goat per year net income (over variable cost) for small, medium, and large farms was estimated to be Rs.6360.00, Rs. 6526.00 and Rs. 7754.00 respectively. However, the overall net gain was Rs.6880.00 and overall benefit cost ratio was estimated to be 2.24. Higher returns from these farms may be due to focus on breed specific production, better productivity, adoption of good practices, high bodyweight gain of male kids due to better management and smart marketing (selling at festive seasons). The technical efficiency of goat farms at variable returns to scale method indicated that mean technical efficiency of goat farming was (0.77). Among the different efficiency class, about 60% of the goat farmers were operating at higher efficiency level (>70%). Out of which 24 percent goat farmers achieved cent per cent efficiency. The higher efficiency in goat farming resulted higher net profit. Moreover, goat farmers selling their male goats during festive season fetched 43% higher price than normal sale. The results of the study will help the planners and policy makers in designing goat development programs/strategies to maximize benefits of commercial goat production in the country.

Keywords Commercial goat farming, farm economics, goat marketing, technical efficiency

Vegetable farming in Punjab: Current trends and future prospects

Danishbir Kaur
Email: danishkaur1395@gmail.com

Vegetable farming is increasingly recognized for its role in promoting agricultural sustainability by conserving natural resources such as soil and water, while offering higher returns per unit area compared to traditional crops like wheat and paddy. As the second-largest global producer of vegetables, India has witnessed significant growth in vegetable cultivation, with the total area under vegetables increasing from 6.25 million hectares in 2000 to 11.31 million hectares in 2022-23. Punjab, traditionally dominated by the rice-wheat cropping system, has also experienced a shift towards vegetable farming. The study highlights trends in area, production and productivity in important vegetable producing states in India. West Bengal showing major share in area under vegetable followed by Uttar Pradesh, Chhattisgarh with 4.37 percent area and 3.15 per cent production. Potato, Onion, Tomato, Brinjal being majorly produced vegetables in India. Despite these positive trends, challenges remain, including high input costs, lack of adequate post-harvest infrastructure, and market access issues. The study highlights that productivity growth has slowed, with a minimal increase in the last decade (from 20,010 kg/ha in 2015-16 to 20,560 kg/ha in 2022-23), pointing to the need for improved production technologies and crop management practices. The results suggest that with strategic policy support, better seed supply systems, and enhanced market linkages, vegetable farming in Punjab could offer substantial benefits, not only for farm income and employment but also for the overall economic and environmental health of the state.

Keywords Vegetable farming, Punjab, crop diversification, sustainability, productivity, agricultural policy, post-harvest management

Profitability of contract farming over non-contract farming under sugarcane cultivation in Anakapalle District of Andhra Pradesh

S. Shrine, K Suhasini, Ch. Ramya Sri, B Mohan Uday Raj
Department of Agriculture Economics, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, 500030
Email: shrine366@gmail.com; ramya7153@gmail.com; udayrajmohan@gmail.com

Contract farming has emerged as a strategic approach to improve agricultural productivity and ensure market access for farmers. This study examines the comparative productivity of contract and non-contract farming in sugarcane production in Anakapalle District. By analyzing input usage, technological gaps, and productivity changes, the research highlights the economic advantages of contract farming. Primary data is collected from the sugarcane farmers under both contract (52) and non-contract farming (52) in the study area. The research findings highlight disparities in gross returns between contract and non-contract farming systems, attributed to differences in input costs and utilization efficiency. While contract farmers benefited from investments in labor, machinery, and agro-inputs, inefficiencies in seed and bullock labor applications were noted among non-contract farmers. The production function further demonstrates variable returns to scale regarding the technological gap in contract farming systems. These findings suggest that enhancing technology adoption, optimizing input use, and addressing inefficiencies could further improve productivity in contract farming.

Keywords Contract farming, non- contract farming, productivity, profitability, efficiency

The emergence of contract farming and its impact on Indian agriculture: A study from two Indian states

Braja B Swain and Nils Teufel
ILRI, Pusa, New Delhi-12
Email: B.Swain@cgiar.org

Farming based on an agreement between farmers and agro-processing and/or marketing firms catching up in many developing countries and appeared to have brought redemption to farming community. Generally, an agro-processing firm usually initiates the contract to expand its operations for improving the product quality, while minimizing the risk in procuring agricultural commodity. Farmer responds to the offers made by the firm either through accepting or rejecting it. In this context, the paper tried to examine the factors that influence the firm's decision to initiate the contract and farmers choice to join and its impact. The primary survey was carried out in two Indian states (Telangana and Bihar) covering three crops (i.e., gherkin, rice seed and green chili). It was observed that different factors motivate both agro-processing firms and farmers to enter a contract mode of production. The empirical findings indicated that though contract farming has a positive impact on farm productivity, farmer's income, and access to market; it has negative impact on soil health, water use and bias towards large farmers. The need is for better institutional mechanisms (i.e., involvement of local government), promotion of drip irrigation and awareness among farmers to make contract farming more inclusive and sustainable.

Keywords Contract farming, Indian agriculture, small farmer, income, and environment

Role of social enterprise in sustainable innovation: Assessing impact on the organic food supply chain in West Bengal, India

Nilojyoti Koner[1], Kanchan Koner[2], Arindam Laha[2]
Department of Commerce, Raghunathpur College[1] and The University of Burdwan[2]
Email: iamnilojyoti@gmail.com; kanchankoner432@gmail.com; alaha@com.buruniv.ac.in

This paper delineates the role of a social enterprise in promoting sustainable innovation practices to organic smallholders in West Bengal and building a sustainable agricultural value chain (with a specific focus on value added production, processing, and marketing) that links the smallholder organic growers to the domestic and global markets. It focused on a single case of organic agricultural practices in the Nadia district of West Bengal. The community-based farming initiative of an organic producer group (Hanskhali Onfarm Farmers Group) was facilitated by a social enterprise (ONganic Foods) under a public scheme for the promotion of organic farming (Paramparagat Krishi Vikash Yojana, or PKVY, scheme). The study used both desk and field research. In the first stage, relevant information about the initiatives of ONganic was sourced from its official website. Based on the information obtained from this process, a semi-structured questionnaire was designed and subsequently sent to the representatives of ONganic via mail. To triangulate the findings of desk research (at organizational level) and to gain further insights into the role of ONganic(a for-profit social enterprise) from the farmers' perspective, field visits were made during 2017-2018. Household-level interviews were conducted with 58 organic rice growers associated with this enterprise. Similarly, 52 neighbouring conventional (or non-organic) rice farmers not associated with ONganic were also interviewed. We found that ONganic Foods focusing on addressing environment challenges and promoting sustainable livelihoods of smallholders through innovative business models and technologies. An innovative 'seed to shelf' model of ONganic emphasizes their direct interventions throughout the supply chain stages. Secondly, ONganic enables the smallholders in promoting locally grown aromatic and non-aromatic organic rice in the Nadia district of West Bengal, which in turn raised agricultural income (34% increase in relative gross income of organic farmers vis-à-vis non-organic farmers) and supported the local economy through their participation in the global value chains. Thirdly, ONganic Foods provided handholding support to smallholders in developing on-farm infrastructure, processing unit, and marketing channels, and meeting quality standards with globally recognized certification. ONganic maintained the 'third party certification' and became the exporter of organic rice products mainly to Europe.

Keywords Sustainable innovation, social enterprise, organic food supply chain, difference in difference

Gender wage disparity in market-led agriculture: Evidence from contract farming in north India

Saroj Verma and Kirtti Ranjan Paltasingh
Ravenshaw University Cuttack 753003
kirttiecon@gmail.com

This paper examines the gender disparity in wage payment among farm workers in market-led contract farming in Haryana, North India. Using survey data of 563 farm workers in both conventional and contract wheat farming, we observed from the Blinder-Oaxaca (average) decomposition result, a significant gender disparity prevails in wage payment in rural Haryana. Second, this disparity is more substantial under conventional farming (NCF) than contract farming (CF). Third, based on the results of the M-M-M quantile method about the sources of disparity, it is noted that wage disparity exists due to the continuation of a 'glass-ceiling' phenomenon in the farm labour market. Female labourers at the higher end of wage distribution suffer the most. Hence, it suggests scrupulous implementation of policies targeting employment opportunities and minimum wage rates for rural women labourers. The strict enforcement of anti-discrimination laws can also achieve the goal.

Keywords Wage disparity, farm sector, decomposition analysis

Assessment of post-harvest loss in fish in Kerala: A quantitative analysis

Pe. Jeyya Jeyanthi and Nikita Gopal
Extension, Information and Statistics Division, ICAR-Central Institute of Fisheries Technology, Cochin - 682029, Kerala, India
Email: tvjeyanthi@gmail.com

Fish is an important constituent of food system which is considered as potential component towards ensuring food and nutritional security. The sustainable fishery is constrained by many challenges viz., overfishing, by-catch and juvenile catch, improper handling and price differentials at regional, national and global level. Besides, post-harvest loss is one of a serious impediments that occurs each and every nodes/ stages through out the fish value chain. The study focused on the quantitative method of post-harvest loss assessment in fish using Questionnaire Loss Assessment Method (QLAM) with estimates of physical, quality and market force loss at selected four nodes viz., fishers, wholesalers, retailers and fish vendors level in Ernakulam District, Kerala, India. The study is based on the primary survey that consists of 50 trawlers, 15 wholesalers, 25 retailers and 20 fish vendors. The economic loss of post-harvest loss in fish is computed as part of the study. The perception of stakeholders' on post-harvest loss management has also been highlighted in the study. The study has suggested that improvements in fish handling practices and better infrastructure development such as cold storage facilities at the selected nodes would significantly contribute for better post-harvest loss management in fish.

Keywords Post-harvest loss, economic loss, fish value chain, physical loss, quality loss and market force loss.

Fertilizer use in India: Trends, challenges, and policy implications

Adarsh B. Sajeev, Durga A.R., Anil Kuruvila, Aswathy Vijayan
College of Agriculture, Thiruvananthapuram, Kerala Agricultural University
Email: durga.ar@kau.in

India is the third largest producer and the second largest consumer of fertilizers in the world. Over the years, fertilizer production in India had increased drastically from 32.9 MMT in 2000-01 to 48.69 MMT in 2023–24. But this rise in production cannot meet the consumption requirement that has increased from 16.7 MMT in 2000-01 to 61.3 MMT in 2023-24. Amongst total fertilizers, urea ranks first in the production and consumption, highlighting its significance in Indian agriculture. To bridge the gap between demand and supply of fertilizers, Government of India (in case of urea) and private companies (in case of phosphorous and potassium fertilizers) imports the deficit quantity (GOI, 2023) to meet domestic demand of fertilizers (GOI, 2024). According to Fertiliser Association of India (2022), food grains consume 67.2 per cent of the total fertilizer nutrients of which paddy and wheat has the highest fertilizer consumption. All India Nitrogen: Phosphorous: Potassium (NPK) use ratio has widened from 4:3.2:1 in 2009-10 to 11.8:4.6:1 during 2022-23 (FAI, 2023) since large quantities of fertilizers are frequently applied to boost production (Bora, 2022). Urea subsidy scheme, Nutrient Based Subsidy, Direct Benefit Transfer, Pradhan Mantri Kisan Sammrudhi Kendras, One Nation One Fertilizer, trade policies like import duty and export ban to regulate the domestic price are some of the major schemes and policies introduced by the government to make India self-sufficient in fertilizer sector (Akber et al., 2021; GOI, 2024). The challenges related to fertilizer consumption and production in India are at farmer level, industrial level and at government level. It includes timely accessibility and availability of fertilizers to the farmers, subsidy burden to the government, increasing raw material cost and supply chain disruptions to the industries etc. Addressing these challenges requires a holistic approach involving government initiatives, research and development, educational programs, and collaborations with farmers and stakeholders in the agricultural sector.

Keywords Fertiliser use, direct benefit transfer scheme, supply chain disruptions

What triggers farmers' suicide in India? Market risk vs. climate risk

Sarbeswar Mallik , Nusrat Akber , Kirtti Ranjan Paltasingh
Ravenshaw University Cuttack 753003, Odisha
Email: kirttiecon@gmail.com

This paper looks into the vital question of whether market risks or climate risks trigger farmers' to suicide more than any other factors. This study chooses major agrarian states according to their share of farmer suicide rates relative to overall suicide rates. It uses the dynamic system-GMM method on the panel data from 2001 to 2022 and the 'panel corrected standard error (PCSE) method for robustness check. Andhra Pradesh, Chhattisgarh, Karnataka, Madhya Pradesh, Maharashtra, and Punjab have the highest average percentage of farmer suicides than other states in India. The findings confirm that various factors such as climate risk, market risk, and agricultural input subsidies significantly contribute to the incidence of farmer suicides. However, irrigation intensity and capital expenditure on agriculture, irrigation, and rural development, etc., reduce the probability of suicides in the country. For more insights, we grouped the states into two groups based on their performance- high-income and low-income states. The results suggest that climate and market risks have a more pronounced impact on farmer suicides in low-income states compared to high-income states of the country. The policy implication drawn is for increased awareness about insurance programmes and an adequate institutional framework to reduce disparities in these programmes and simplify the claim process. There is also a need to develop robust market information systems to inform farmers about prices and demand trends, enabling them to yield high returns. Inefficient subsidies like power and fertilizer must be rationalized slowly. Farmers must be strongly motivated towards a greater degree of crop and varietal diversification, and cultivars that are resilient to various climatic risks must be disseminated widely to farmers.

Keywords Farmers suicides, market and climate risks

Gender in agriculture and rural development

Prithika C[1], Anjugam M[2], Padma Rani S[3], Sivasankari B[4] and Ananthan M[5]
[1-4]Department of Agricultural Economics, Agricultural College & Research Institute, Madurai, Tamil Nadu
[5] Department of Horticulture, Agricultural College & Research Institute, Madurai, Tamil Nadu
Email : manjuecon70@gmail.com

Women play a vital role in global agriculture, making up 43% of the workforce in developing countries and 30.9% in rural India. Women are essential and inevitable in agricultural commodities production, processing, distribution, and marketing in various geographical areas. Despite significant contributions to food production, livestock, and fisheries, they face challenges such as limited access to land, credit, and decision-making power. Gender disparities persist, particularly in higher-value agricultural activities. Women make important contributions but frequently encounter obstacles restricting their ability to participate, develop agency, and obtain resources throughout these value chains. Understanding and overcoming these barriers is essential to achieving gender equality as well as increasing agricultural productivity, food security, and economic development. Empowering women through targeted policy interventions, education, and technology can enhance productivity and reduce poverty.

Keywords Gender, agriculture, rural development

Fertilizer subsidies in India: Trends, equity in distribution and implications of subsidy removal

Sahin Aktar Munshi[1*], Akriti Sharma[2], Praveen K V[1] and Indrajit Mondal[1]
[1]Division of Agricultural Economics, ICAR-IARI, Pusa, New Delhi, 110012, India
[2]ZTM and BPD unit, ICAR-IARI, Pusa, New Delhi, 110012, India
Email: sahinaktarmunshi@gmail.com

Fertilizer subsidies have been a significant component of agricultural policy in India, aiming to enhance food security, support farmers' income, and ensure the equitable distribution of resources. India is a major player in the global fertilizer market, and to maintain sufficient domestic fertilizer supplies, it depends on production as well as imports. Over the years, fertilizer consumption in India has shown a marked increase, driven by the need to boost agricultural productivity. It is alarming that growing fertilizer subsidies are leading to an imbalance use of NPK. Small and marginal farmers, who gain from lower input prices but not realise higher output prices, are therefore likely to experience negative effects from a reduction in fertilizer subsidies on farm productivity and income. This study aims to check the trend in fertilizer consumption, subsidy and distribution, and possible effect of fertilizer subsidy removal on cost of cultivation of major fertilizer-consuming crops in India. To meet the need of the study data were collected from multiple sources. Fertilized related data were collected from Fertilizer Statistics, released by the Fertilizer Association of India and Input Survey data, Department of Agriculture, Cooperation & Farmers Welfare, MoA&FW. Cost of cultivation data were taken from the Directorate of Economics & Statistics, Government of India. Lorenz curve, Gini coefficient, and gap analysis were performed to fulfil the study's requirements. This study shows that there is a fair degree of equity in the distribution of fertilizer subsidies among different farm sizes. Paddy is the most heavily subsidized crop, followed by wheat, cotton, sugarcane, and maize. Together, paddy and wheat account for more than 50% of the total fertilizer subsidy. The removal of fertilizer subsidies would substantially increase the cost of cultivation for major fertilizer-consuming crops, particularly impacting paddy and wheat in Punjab and Bihar which are critical for food security. Policymakers need to carefully weigh these implications when considering reforms in subsidy policies.

Keywords Cost of Cultivation (COC), crops, equity, fertilizer, subsidy

True cost-exposing the hidden cost of agri-food system: A Review

Iram Sabha, Sudhakar Dwivedi, Anil Bhat
Division of Agricultural Economics and Agri-Business Management, SKUAST-J
Email: Iramsabha95@gmail.com

The agri-food system, vital for human sustenance, faces significant challenges requiring urgent attention. Environmental externalities, such as pollution and deforestation, threaten sustainability, while social issues like labour exploitation and indigenous displacement reveal systemic inequities. Economic distortions exacerbate fragility. True cost accounting unveils hidden impacts, with global hidden costs totaling $12.7 trillion, India ranking third at $1.1 trillion. The Public Distribution System in India overlooks production-related costs, necessitating true cost assessment. Strategies including crop diversification and precision agriculture offer pathways to mitigate impacts. A transformative shift is imperative for a sustainable and equitable agri-food system. As we confront these challenges, interdisciplinary collaboration and innovative solutions will be essential for shaping a more resilient and just food system for future generations.

Keywords Agri-food system, Hidden costs, Externalities, Greenhouse gases, True cost accounting

Milk consumption in rural Bihar: Pattern and determinants

Shiv Raj Singh, A.K. Jha, Rohit Kumar, Bhola Nath
Department of Dairy Business Management, Sanjay Gandhi Institute of Dairy Technology,
Bihar Animal Sciences University, Patna
Email:shivagritech2007@gmail.com

Bihar has become one of the emerging players in milk production, showing significant growth in milk production. Bihar produces around 12.50 million metric tons of milk annually (2022-23), with production largely driven by smallholder dairy farmers. Milk production plays a dual role by creating employment opportunities for rural people and enhancing their nutritional status, both of which are crucial for the Bihar economic and social development. This study examines the milk consumption pattern and its determinants especially across the different strata of rural households of Bihar. This study is based upon the unit level data of National Sample Survey round on "Household Consumption Expenditure Survey: 2022-23". The results confirm a strong association between household per capita milk consumption expenditure and factors such as landholding size, gender, age, and years of education of the head of the household. Social status of household also plays an important role. Milk production at the household level and overall per capita consumption expenditure positively affect the per capita milk consumption expenditure at the household level. Whereas meat and egg consumption at the household level negatively affects the milk consumption expenditure. The households with child (aged up to 5 years) positively influence milk consumption at the household level. Quantile regression within income groups show high negative impacts of small landholding size and beneficiary status under PMGKY on milk consumption in poorer households, but these factors positively affect consumption as households move from lower to higher income quantiles. The findings also reveal that an increase in income quantiles is positively associated with higher per capita expenditure on milk. By implementing policies that support dairy production, promote nutritional benefits of milk, and address economic disparities, government can foster a more resilient food system that enhances the well-being of all households, particularly those in lower income group.

Keywords Milk consumption, determinants, income quantiles, nutritional benefits

Analysis of the changing patterns, determinants of farmers' income and sustainability at the household level

Jayanta Behera
Centre for the Study of Regional Development, Jawaharlal Nehru University, New Delhi 110067, India
Email: beherajayanta000@gmail.com

This study attempts to analyse the trends and patterns in farmers' income over time, various sources of farmers' income and the factors affecting their income based on agricultural receipts. Based on the NSS AIDIS data, the analysis shows that farmers' real income rose from Rs. 4030 in 2002-03 to Rs. 5951 in 2012-13 to Rs. 6810 in 2018–19. A multiple regression analysis was carried out to determine the factors affecting each agricultural household's monthly farm revenue. It is found that expenses in farming activities, cropping intensity, irrigation intensity, sold at MSP, technology adaptation in agricultural activities, formal training for agriculture, and education have been the important determinants of monthly income from agricultural activities per hectares. Among these, the most significant finding was that selling at MSP is strongly associated with higher gross agricultural receipts per hectare.

Keywords crop income; farm households; farm income; growth rate, MSP

Amidst double oppression: Exploring the social identity of Bhilala Tribal women in Dhar district

Anshuman Pandey[2], Gaurav Banaula[1], Deeksha Patle[3], Sachinsingh Mandloi[4] and Mohanasundari[1] Thangavel*

[1]School of Humanities and Social Sciences, IIT Indore Madhya Pradesh (MP)
[2]Indira Gandhi National Tribal University, Amarkantak, MP
[3]Awadhesh Pratap Singh University, Rewa, MP
[4]Indian Institute of Forest Management, Bhopal, MP
Email: mohana@iiti.ac.in

In India, the caste system is shaped by a multidimensional oppression system that distinguishes people based on inheritance, social hierarchy, occupation, and exclusion. Religious justifications and government policies further influence the degree of social interaction within this system. This oppressive social practice has made the state of tribal communities in India, more complex and multifaceted. Tribal communities are among the most disadvantaged groups in the country combined with the instances of high poverty rates, limited access to education, health issues, lack of economic opportunities and land alienation, displacement, cultural and linguistic erosion. We glare at the plight of women in tribal communities facing the double oppression. This refers to the experience of facing two intersecting forms of discrimination or marginalization as tribal and women. This concept, discussed within intersectional feminism, examines how different forms of oppression overlap and compound each other. Bhilala women, despite their significant contributions to their communities, are often deprived of their rights to education, and are excluded from decision making process and leadership positions. Through qualitative approach, this research reviews the social representation of Bhilala tribal women, examining the ways in which they maneuver and resist the structural barriers that hinder their participation in leadership roles. We find the conjugative web of gender, caste, and tribe in shaping their experiences of oppression and empowerment. By centering the voices and perspectives of Bhilala women, this research contributes to a deeper understanding of the intersectional nature of oppression and suggests strategies to promote inclusive leadership and social change in the tribal communities.

Keywords: Double oppression, women oppression, Bhilala tribal women, social representation, gender sociology

Institutions, Governance and Trade

Reasserting the development agenda: a quantitative examination of domestic support proposals for agricultural negotiation to WTO

Sachin Kumar Sharma[1], Teesta Lahiri[1], Talha Akbar Kamal[1], Suvayan Neogi[1*], and Kamalini Mukherjee[1]

[1]Centre for WTO Studies, Indian Institute of Foreign Trade, New Delhi, India
Email: suvayancws@iift.edu

Disciplining domestic support to agriculture remains an unfinished agenda in the WTO negotiations due to the different views and positions of members. Developing countries have been consistently demanding an effective special and differential treatment (S&DT) for themselves, along with a substantial reduction in the trade-distorting support entitlement of developed members. However, members have failed to reach a consensus on different aspects, especially coverage and approaches to determine an overall trade-distorting support (OTDS) limit. In this context, this study quantifies and critically examines the implications of various proposals on the policy space to provide trade-distorting support based on floating and fixed reference period models. It estimates trade-distorting entitlements of 9 developed and 16 developing members under the Agreement on Agriculture (AoA) as well as the selected proposals for the years 2020 and 2030. These entitlements have been computed in monetary limits, percentage of the value of production, and on per farmer basis. Results show that many proposals have failed to deliver the effective S&DT, as developing members generally must undertake higher cuts than developed members, highlighting the asymmetries in negotiation. The study will be useful for members to take an informed position in the agriculture negotiations on domestic support.

Keywords WTO, domestic support, agriculture negotiation, Doha round, agricultural subsidies, overall trade-distorting support (OTDS)**,** special and differential treatment

Navigating agricultural domestic support, fisheries subsidies, and food security: a critical examination of the WTO rules

Sachin kumar Sharma[1*], Ahamed Ashiq Shajahan[1] and Alisha Goswami[1]

[2]Centre for WTO Studies, Indian Institute of Foreign Trade, New Delhi, India
Email: sksharma@iift.edu; ashiqshaj4082@gmail.com; alisha1.goswami@gmail.com

The WTO is ambitiously negotiating rules on agriculture subsidies, fisheries subsidies, and food security to achieve Sustainable Developmental Goals (SDGs) such as zero hunger, doubling agriculture productivity and preservation of marine resources. However, the negotiations have reached an impasse as reflected in the failure of the 13th WTO Ministerial Conference. This paper explores the reasons for the impasse by critically examining the food security, agriculture, and fishery subsidy regimes under the WTO to inform the ongoing negotiations and facilitate the fulfilment of the SDGs. In agriculture, negotiations on domestic support and public stockholding (PSH) remain contentious due to the clashing sensitivities and interests of the WTO members. Under domestic support, there is a strong push for reducing the members' capacity to provide trade-distorting agriculture subsidies. Some members, however, do not concur as they fear losing policy space to subsidise their poor farmers. Similarly, calls for updating the WTO rules on public stockholding for food security purposes by a few developing country members are persistently resisted by raising trade distortion concerns. In the fisheries, though the Agreement on Fisheries Subsidies has been adopted, WTO members remain divided on the discipline regulating subsidies that contribute to overcapacity and overfishing.

Keywords WTO, food security, subsidies, agriculture, fisheries, sustainable development goals (SDGs), climate change, sustainability, environment, negotiations

Agricultural sector amidst rising food insecurity: quantifying the impact of market access barriers

Murali Kallummal[1*], Simran Khosla[1], and Ankit Kundu[1]
[1]Indian Institute of Foreign Trade, New Delhi
Email: muralik@iift.edu

Global conflicts are leading to worsening of food insecurity: Additionally, the trade policies adopted by the developed world by way of application of non-tariff measures are further contributing to already worsened food security scenario. Against this background, this paper quantifies the impact of Non-Tariff Measures on the agricuhural exports of the low-middle income countries at HS-4-digit level. While the existing literature has mostly focused on bilateral trade analyses, this paper encompasses a multilateral trade model involving multiple exporters, importers, and agricultural products. The model employs a gravity model framework which is estimated using a Feasible Generalized Least Square estimator. Results reveal that, in contrast to Ad-Valorem Equivalent (AVE) tariffs, impact of SPS and TBT are significant. A single SPS notification corresponds to a 0.3% decrease in exports, while an additional TBT notification increases the trade between countries by 2.7%. The paper then attempts to bring forth the reasons for the differential impact on the exporters of an SPS measure in comparison to a TBT measure and suggests measures to improve the state of global food security.

Keywords Non-tariff measures, sanitary and phytosanitary measures, technical barriers to trade, agricultural trade, ad-valorem equivalent tariffs, food security

Climate change and food security: a vulnerability assessment for South-Asia

Kota Karuna Sri[1*], Vedamurthy K B[2] and Kalidoss Radha Krishnan[3]
[1]University of Agricultural Sciences, GKVK, 560065
[2]Dairy Science College, Hebbal, Bengaluru [3]Central Institute of Fisheries Education, Mumbai, 400061
Email: karunasrienoch@gmail.com

Food security is vital for global development, yet over 800 million remain undernourished, with projections worsening due to climate change. This paper assesses food security vulnerability in South Asia using the Composite Vulnerability Index (CVI) for Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. Results show Afghanistan (Exposure Index: 0.5796) and Pakistan (Sensitivity Index: 0.599) as highly vulnerable, while the Maldives (Adaptive Capacity Index: 0.7298) exhibits strong resilience. These findings highlight the urgent need for region-specific strategies to mitigate climate change impacts and enhance adaptive capacity, ensuring food security and safeguarding livelihoods.

Keywords Food security, climate change, South Asian countries, vulnerability and livelihood

Drones vs. tradition: economic efficiency and challenges in modern agriculture

Gowri Shankar R[1] and Malaisamy A[1*]
[1]Agricultural College and Research Institute, Madurai, Tamil Nadu-625104, India
Email: malaisamy@tnau.ac.in

Indian agriculture, vital to the nation's GDP, employment, and food security, is often limited by labour-intensive, traditional methods. Drones, a promising new technology, can transform this landscape by offering real-time data on crop health, soil conditions, and pest management. This study, focusing on paddy cultivation in Tamil Nadu, compares the impact of drones (UAVs) to conventional methods. Results show that drones can improve economic efficiency by 90%, reduce cultivation costs by 30%, and increase income by 41%. With AI integration, drones are positioned to play a key role in making Indian agriculture more sustainable and profitable.

Keywords Drone technology; paddy cultivation; constraints

Integrating artificial intelligence, deep learning, and robotics in recent agriculture technology

Nirjharnee Nandeha[1]* and Ayushi Trivedi[2]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh
[2]Mahatma Gandhi University of Horticulture and Forestry, Sankara, Patan, Durg, Chhattisgarh
Email: aieeeagriculture2024@gmail.com

Agriculture is seen as an important sector of the economy in many countries including India. The fast population growth has made it necessary to satisfy people's nutritional demands. Adoption of smart agriculture is necessary to achieve these food security goals. Convolutional neural networks (CNN) and recurrent neural networks (RNN), two deep learning techniques, have been extensively studied lately and applied in a range of sectors, including agriculture. Artificial intelligence (AI) techniques used in agriculture include fuzzy logic (FL), artificial neural networks (ANN), genetic algorithms (GA), particle swarm optimisation (PSO), artificial potential fields (APF), simulated annealing (SA), artificial bee colony algorithms (ABC), harmony search algorithms (HS), bat algorithms (BA), cell decomposition algorithms (CD), and firefly algorithms (FA). Expert systems, agriculturally designed robots, and data collection sensors are among the topics covered. Nothing in the literature emphasises the use of deep learning methods and robots in cultivation, monitoring, and harvesting to understand their respective contributions to the agricultural industry and to compare each in terms of popularity and usefulness at the same time. By understanding the extent of AI engaged and the robots used, this work analyses the comparative comparison of three crucial stages of agriculture: cultivation, monitoring, and harvesting.

Keywords Robotics, cultivation, monitoring, harvesting, modern agriculture

Precision farming in agriculture: enhancing efficiency and sustainability

Arti Dhruw[1*] and Aashi Sarva[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur 492012
Email: artidhruw6154@gmail.com

Precision farming integrates advanced technologies like GPS, IoT, and data analytics to optimize agricultural practices. By collecting real-time data on soil health, weather, and crop conditions, farmers can make informed decisions that improve yield, reduce waste, and minimize environmental impact. This approach enhances resource efficiency, promotes sustainability, and supports crop management tailored to specific field conditions. Ultimately, precision farming fosters both economic and ecological benefits in modern agriculture (*Zhao et al., 2020; Liakos et al., 2018*).

Keywords Precision farming, agriculture, technology, sustainability, data-driven, crop management, yield optimization

Agri-tech for sustainable development

Varsha Dewangan[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh-492012
Email: varshadew2023@gmail.com

The transformative potential of agri-tech innovations in promoting sustainable agriculture, enhancing rural livelihoods, and mitigating climate change. By integrating cutting-edge technologies, participatory approaches, and policy analysis, we aim to: 1. Develop and evaluate innovative Agri-tech solutions (precision agriculture, IoT, AI-driven decision support systems) for smallholder farmers. 2. Assess environmental impacts on soil health, water conservation, and biodiversity. 3. Analyze socio-economic benefits for farmers, including income enhancement, labor savings, and improved well-being. 4. Inform evidence-based policy frameworks supporting agri-tech adoption, scalability, and sustainability.

Methodology

Mixed-methods approach combining:
1. Literature reviews
2. Field experiments
3. Surveys and focus groups
4. Case studies
5. Statistical and qualitative data analysis

Expected Outcomes
1. Improved agricultural productivity and sustainability
2. Enhanced rural livelihoods and socio-economic resilience
3. Reduced environmental degradation
4. Informing policy and regulatory frameworks
5. Scalable agri-tech solutions for global applicability

Keywords Agri-tech innovation, sustainable agriculture, rural resilience, climate-smart agriculture, socioeconomic empowerment, Scalable, precision agriculture, IoT

Digital transformation in Indian agriculture: exploring challenges and enablers for inclusive technology adoption

Sanjay Kumar Joshi[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh-492012
Email: skjoshi.igkv@gmail.com

This comprehensive study examines the current landscape and future possibilities for digital technology applications within the Indian agricultural sector. Analysing 124 digital agriculture technologies, this paper explores the potential of digital tools in enhancing productivity, connectivity, and economic resilience for farmers. Key enablers, such as increased mobile connectivity, government support, and rising digital literacy, are discussed alongside challenges, including infrastructural gaps, socio-economic barriers, and language limitations. Findings highlight the need for collaborative efforts among government, private sectors, and non-profits to build an inclusive digital ecosystem. Policy recommendations for broader technology adoption are also suggested.

Keywords Digital transformation, agriculture, India, technology adoption, agri-tech, smallholder farmers, digital platforms, policy

The emergence of contract farming and its impact on Indian agriculture: the study from two Indian State

Braja B Swain[1*] **and Nils Teufel**[1]
[1]ICAR-Indian Agricultural Research Institute (IARI), New Delhi
Email: B.Swain@cgiar.org

Farming based on an agreement between farmers and agro-processing and/or marketing firms catching up in many developing countries and appeared to have brought redemption to farming community. Generally, an agro-processing firm usually initiates the contract to expand its operations for improving the product quality, while minimizing the risk in procuring agricultural commodity. Farmer responds to the offers made by the firm either through accepting or rejecting it. In this context, the paper tried to examine the factors that influence the firm's decision to initiate the contract and farmers choice to join and its impact. The primary survey was carried out in two Indian states (Telangana and Bihar) covering three crops (i.e., gherkin, rice seed and green chili). It was observed that different factors motivate both Agro-processing firms and farmers to enter a contract mode of production. The empirical findings indicated that though contract farming has a positive impact on farm productivity, farmer's income, and access to market; it has negative impact on soil health, water use and bias towards large farmers. The need is for better institutional mechanisms (i.e., involvement of local government), promotion of drip irrigation and awareness among farmers to make contract farming more inclusive and sustainable.

Keywords Contract farming, Indian agriculture, small farmer, income, environment

Sustainable farming through innovative optical monitoring

G. Ranjith[1]* and Pratibha Devi Sharma[1]
[1]Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar - 848125
Email: ranjithgali746@gmail.com

Bio-speckle laser technology is an innovative solution for sustainable farming through non-destructive quality assessment. The technology analyzes temporal and spatial variations in laser light scattered from biological materials, enabling real-time monitoring of fruit maturity, freshness, and disease detection without product damage. Integration with numerical processing techniques provides quantitative measures for pre-harvest monitoring, optimizing harvest timing, and reducing food waste. While demonstrating significant potential for automated quality control in sustainable farming, the technology requires standardisation for widespread implementation. This approach offers a cost-effective, rapid solution for quality assessment in agricultural systems, supporting both food security and sustainable farming practices.

Keywords Bio speckle laser technology, non-destructive testing, sustainable farming

Gender wage disparity in market-led agriculture? evidence from contract farming in North India

Saroj Verma[1]*and Kirtti Ranjan Paltasingh[2]
[3]Akal University, Bhatinda, Punjab
[2]Ravenshaw University, Cuttack, Odisha
Email: vermasaroj477@gmail.com; kirttiecon@gmail.com

This paper examines the gender disparity in wage payment among farm workers in market-led contract farming in Haryana, North India. The analysis of the survey data of 563 farm workers in both conventional and contract wheat farming, based on Blinder-Oaxaca (average) decomposition method, reveals a significant gender disparity in wage payment in rural Haryana. This disparity is more substantial under conventional farming (NCF) than contract farming (CF). The wage disparity exists due to the continuation of a '*glass-ceiling*' phenomenon in the farm labour market. Female labourers at the higher end of wage distribution suffer the most. Therefore, the study suggests scrupulous implementation of policies targeting employment opportunities and minimum wage rates for rural women labourers. The strict enforcement of anti-discrimination laws can also help achieve the goal.

Keywords Wage disparity, farm sector, decomposition analysis, Haryana

Study of India's agricultural products exports to G20 nations

Gurindapalli Swetha[1] and Ritambhara Singh[1*]
[1]Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar-848125
Email: ritambharasingh@rpcau.ac.in

The study analyzes India's agricultural export performance among G20 nations from 2008 to 2023, focusing on growth rates, instability index, and risk assessment. The study reveals that India's agricultural product exports have increased over the period, with G20 countries accounting for 33-46% of total exports but the share of imports is greater than the exports. The growth rates show significant variation among G20 countries, with Canada exhibiting the highest growth rate of 10.59%. The Coppock's Instability Index (CII) reveal that China, Canada and Indonesia are the most unstable markets. Most of the G20 countries are high-growth and high-risk markets for agricultural products export from India. The findings provide valuable insights for policymakers and stakeholders in developing strategies to enhance export competitiveness of India's agricultural products within the G20 block.

Keywords Agricultural products export, growth rate, instability index, risk-assessment

Can countries learn from each other? navigating change in fisheries and gleaning lessons from growth stories of Bangladesh, India and Thailand

Suvetha Venkatachalapathi[1], Ananthan Pachampalayam Shanmugam[1*], Talib Mohammad[1], Neha W. Qureshi[1] and Shivaji D. Argade[1]
[1]ICAR-Central Institute of Fisheries Education, Mumbai, Maharashtra, India - 400061
Email: ananthan@cife.edu.in

The fisheries play a vital role in the economy and food security of many Asian nations, especially Bangladesh, India and Thailand. This study analyses the growth of fisheries GDP, production, yield and trade dynamics of the sector in Bangladesh, India and Thailand from 1991 to 2020. Developing economies witnessed a transformation in their GDP composition with steady decline of agricultural sector share. During 1991-2020, the agriculture sector's contribution to overall GDP declined from 34%, 32% and 15% in 1991 to 12%, 18% and 9% in 2020 in Bangladesh, India and Thailand, respectively. Within the agricultural sector, fisheries contribution increased gradually in Bangladesh and India, while it halved in Thailand from 2% to 1% due to a decline in fish production since 2001. One-way ANOVA revealed significant differences ($p < 0.5$) in fisheries GDP, production, exports and imports across the selected countries. Aquaculture production outpaced capture fisheries, with India exhibiting the highest marine fish yield growth but lagging in inland fish yield. Thailand initially led fisheries exports but experienced a decline after 2016, necessitating greater reliance on importing raw materials for value-added re-exports. Unlike Thailand and Bangladesh, India has lagged in improving per-capita fish consumption during the period despite higher growth in fish production. Gleaning evidence and insights from the cross-country comparison, this study underscores the economic significance of fisheries and suggests key interventions to prioritize and reorient fisheries development policies to make them more sustainable and fast-track the attainment of SDG 2030 targets.

Keywords Growth, fisheries GDP, fish export and import, India, Bangladesh, Thailand

Impact of NAIP - value chain on flowers for domestic and export markets on technology adoption among jasmine growers in Erode district

M. Jawaharlal[1], R. Ravikumar[1], S.D. Sivakumar[1], N. Venkatesa Palanichamy[1], D. Sureshkumar[1] and Rana Rohit[2*]

[1]Tamil Nadu Agricultural University, Coimbatore-641003, India
[2]National Institute of Agricultural Economics and Policy Research, New Delhi 110012
Emails: rohitrana03@yahoo.co.in

India is one of the leading flower producing countries in the world. Even though there is a faster growth in area, production and productivity of flower crops, the share of Indian floriculture industry had been very minimum at global level because of specific constraints that existed at micro level. The project "Value Chain on Flowers for Domestic and Export Markets" funded under National Agricultural Innovation Project, ICAR, New Delhi and was implemented by Tamil Nadu Agricultural University to address all those missing links by intervening in production, post harvest and marketing aspects of jasmine value chain. This paper focuses on the impact of NAIP on technology adoption among jasmine growers. The results revealed that awareness, knowledge and adoption of precision technology and average yield have significantly improved after implementation of NAIP.

Keywords Jasmine, technology adoption, impact analysis and precision farming

Export determinants and competitiveness of cashew nut shell and cashew kernel in India since reforms

Ahamed Kabeer M[1*]

[1]Kuniya College of Arts and Science, Kannur University, Kannur, Kerala
Email: kabeer.m313@gmail.com

Cashew products dominated the Indian export market at the time of independence. In a regime of globalized agriculture, cashew products are valuable products in the global commodity market and have the potential to generate employment and foreign exchange. The Fully Modified Ordinary Least Squares (FMOLS) method is used to estimate determinants. The FMLOS results indicate that variable domestic consumption is the major determining factor for cashew kernel and domestic consumption and world export are the major determining factors for export of cashew shell. Nominal Protection Coefficient (NPC) Competitiveness analysis reveals that the selected products remain competitive in the global market, although their degree of competitiveness has declined over the study period. Policy makers need to address product diversification, quality improvements, market promotion and export support to enhance export competiveness in the global market.

Keywords Export, determinants, competitiveness, world market

Exploring the global competitiveness of Indian rice- insights from Andhra Pradesh

Meghana J[1*], K. N Ravi Kumar[2], K. B Vedamurthy[3], K Uma Devi[4], Srinivasa Rao[1] and M Rama Devy[1]

[1]Agriculture College, Bapatla, ANGRAU, Andhra Pradesh 522101, India
[2]Agriculture College, Rajamahendravaram, ANGRAU, Andhra Pradesh, 533101, India
[3]Dairy Science College, Hebbal, KVAFSU, Banglore 560024, Karnataka, India
[4]Agriculture College, Lam, ANGRAU, Andhra Pradesh 522034, India
Email: meghanaj39@gmail.com

India is the largest exporter and second-largest producer of rice globally. Primary data were gathered from various stakeholders involved in the rice market in Andhra Pradesh. Secondary data were collected for the period 1995 to 2021 from both domestic and international sources. The CAGR of rice exports demonstrated increasing trend at 11.24%. MCA showed Nepal emerged as a stable importer, retaining 36 per cent of its previous share. CMSA revealed that the exports of rice milled equivalent are primarily driven by structural effect at 875.33 per cent. PAM indicated that the values of NPC, EPC and DRC were less than one, suggesting its competitiveness in the international market.

Keywords trade direction, market share, private cost, social cost, export competitiveness

Reviewing the global aquaculture production and trade

Shaik Reshma Sulthana[1*], Snehal Mishra[1], Remalli Anthony[1] and Rajesh Reddy B[1]

[1]Anand Agricultural University, Anand, Gujarat, India -388110
Email: sultanashaik06@gmail.com

The global aquaculture industry is a vital player in economic development, providing essential animal protein to billions worldwide and creating employment opportunities, especially in rural areas. Countries like China, India, and Vietnam have benefited economically from aquaculture development, leading to improved food security and poverty reduction. The emergence of the Blue Economy has opened up new avenues for international commerce in aquaculture, driven by rising global consumer demand. Technological advancements, particularly in fish production, are contributing to industry expansion. These developments, along with changes in consumer preferences and increased international trade, are shaping the future of aquaculture. Sustainability is increasingly important as the industry grows. Sustainable practices ensure the long-term viability of aquaculture operations and address environmental and social concerns. By focusing on sustainability, the aquaculture industry can continue to drive economic development while meeting the growing demand for nutritious and environmentally responsible food sources.

Keywords Aquaculture, globalization, technological advancements, sustainability

Building climate resilience and adaptive capacity among smallholder farmers: a global systematic review of strategies and insights

Perka Shiva Kumar[1], Praveen KV[1]and Alka Singh[1*]
[1]ICAR-Indian Agricultural Research Institute (IARI), New Delhi
Email: asingh.eco@gmail.com

This study provides a comprehensive review of global literature on climate resilience and adaptive capacity among smallholder farmers. From an initial pool of 2,063 publications, 183 are selected for an in-depth analysis. The review identifies key adaptation strategies, including sustainable practices such as conservation agriculture, crop diversification, agroforestry, organic farming, and integrated farming systems, etc. These approaches seem to enhance productivity, income, and food security. However, barriers such as high vulnerability, limited adaptive capacity, low awareness of climate change, and inadequate access to information and infrastructure persist. Additionally, gender disparities, crop-specific challenges, socio-economic constraints, financial limitations, and insufficient policy support are recognized as significant factors affecting resilience. The study highlights the need for inclusive, locally tailored interventions to strengthen climate adaptation efforts among smallholder farmers.

Keywords Climate resilience, adaptive capacity, smallholder farmers, systematic literature review

Optimization of farm revenue to mitigate global food insecurity dynamics

Pratyush Kumari Rath[1*], Digambar S. Perke[2], Madai Hajlanka[3], Sachin S. More[1], Prasad S. Gangakhedkar[4], Ranjit V. Chavan[5]
[1]College of Agriculture, VNMKV, Parbhani, Maharashtra, India, 431402
[2]College of Dharashiv, VNMKV Parbhani, Maharashtra, India, 431402
[3]University of Debrecen, Faculty of Economics and Business, Institute of Economics, University of Debrecen
[4]College of Food Technology, VNMKV, Parbhani, Maharashtra, India, 431402
[5]PGI-ABM, Chakur, VNMKV Parbhani, Maharashtra, India, 431402
Email: pratyushkumarrath@gmail.com

This review assesses the relationship between agriculture, farmers' income, world hunger and food security concerns in the context of the Sustainable Development Goals. It is known that agriculture plays a vital role in fighting against hunger as well as increasing food safety. Farm income is an important factor towards enhancing sustainability and improving food security among rural people. This paper seeks to demonstrate an interrelationship between hunger, agricultural resources and food security by evaluating three major indicators: the Global Hunger Index, the Sustainability Index and the Food Security Index which are instrumental in sustainable development of mankind. Farm income enhancement has been stressed as one of the key components for building resilient food systems and environmentally sustainable agricultural systems that practice enabling access to safe and nutritious food. It is said that sound policies facilitating market opportunities, improved technology and sustainable agriculture can resolve economic, environmental and hunger issues. And this balanced view is in compliance with the SDGs 2 (End Hunger) and 12 (Ensure sustainable consumption and production patterns), thus providing proposals for food security in a climatically and economically challenged available environment.

Keywords Food safety, SDG, sustainability, Global Hunger Index, livelihood security

Food safety challenges in India's rice export: a special study of basmati

Arshdeep Singh Sidhu[1*], Manjeet Kaur[1], Kashish Arora[1] and HS Kingra[1]
[1]Punjab Agricultural University, Ludhiana, Punjab, India
Email: arshdeepsingh5500@gmail.com

India's basmati rice exports to key markets such as EU countries, Iran, Iraq, UAE, etc since 2016-17 have declined. The study examines food safety issues for Indian basmati rice exports. The data was collected from the APEDA, RASFF portal, etc. The results revealed that stricter pesticide residue standards, trade barriers and quality concerns have contributed to this decline. In European Union, regulations reducing the maximum residue limit (MRL) for tricyclazole to 0.01 ppm in 2018 caused exports to drop from 215.3 thousand tonnes in 2017-18 to 93.4 thousand tonnes in 2021-22. From 2020 to 2024, more than 40 notifications have been issued from EU, primarily due to detection of pesticide residues (Tricyclazole and Thiamethoxam) and mycotoxins. In Iran, economic sanctions, payment delays and import restrictions have hindered trade. Iraq's decline was due to economic instability, increased competition, payment challenges and domestic rice production policies. Exports to the UAE have been impacted by competition, price fluctuations, quality issues and shifting consumer preferences. Meanwhile, Pakistan's pesticide-compliant basmati rice has gained market share, with exports growing from $479 million in 2017 to $645 million in 2021. To address these challenges, India must adopt sustainable farming practices, improve rice quality and ensure compliance with international standards to regain market share.

Keywords Basmati rice, challenges, food safety, India, sustainability

Sanatory and phytosanitary measures and digital transformation of the value chain: prospects of export of marine products from India

A Suresh[1]*, Sachu Sara Sabu[1], Pankaj Kishore[1] and Satyen Kumar Panda[1]
[4]ICAR- Central Institute of Fisheries Technology, Cochin, Kerala-682029
Email: sureshcswri@gmail.com

Boosting of marine products' export from India needs to closely comply with the sanitary and phytosanitary measures for food safety and quality. Over years, the international regulations and the importers are more stringent on food safety norms. The compliance to it required investment in infrastructure and human resource development in addition to establishing a robust institutional mechanism. Digitalisation, usage of information and communication technology and establishment of traceability system was an integral component of the growth of marine products' export from India. Further, it is a critical component in future growth prospects as well. In this background, the present study analysed the trends and compliance status of quality standards in Indian marine exports to major importers, its impacts and the role of digital transformation of the value chain to adhere with the sanitary and phytosanitary conditions. The study analyses the tariff and non-tariff measures of exports and the extent of non-tariff measures affecting India's marine products exports, and has calculated the aggregate and unit rejection rates by using secondary data from various sources. The major importer of marine products continues to be USA, accounting for 0.3 million tonnes valued at INR 179 billion in the year 2021. The growth was 24.3 and 17.9 per cent per year during 2010-2021 in terms of value for USA and China, the top two marine products importers of Indian exports. Over years, India has largely complied with the regulations and improved the quality assurance system. Consequently, India has impressively reduced the unit rejection rates during 2010 to 2020 (by 22%). India's major competitors have also reduced the unit rejection rate much impressively during the same period (80 %). As on the year 2022, more than three-forth of the rejections due to Non-Tariff Measures is constituted by sanitary and phytosanitary issues. Among the importers, USA had the highest Unit Rejection Rate and the lowest Relative Rejection Rate. India has implemented strict quality control regime to adhere with the international standards, including establishment of an online health certification systems, pre-harvest test report based on registration of farms and hatcheries, vessel registration system and adherence with global quality alert systems. Digital technology widely employed to strengthen the quality assurance system. The study examines the economic impact of the steps undertaken to improve the quality assurance systems and the prospects of establishing a stronger traceability system taking into account the developments in the sectors of marine products and other agricultural commodities.

Keywords Sanatory and phytosanitary measures, digital technology, marine products' export

Interaction between domestic and international prices of major edible oils: a cointegration analysis

Konda Ramanjaneya Reddy[1]*, Popavath Bharghav Naik[1], Renjini V R[1] and Chiranjit Majumder[1]
[1]ICAR- Indian Agricultural Research Institute, New Delhi
Email: kondaramanji1996@gmail.com

India's half of the consumption demand for edible oils is met through imports from other countries. The fluctuations in domestic edible oils have varied over the years. The present study seeks to know if there is any relationship between domestic and international edible oil prices through the cointegration analysis using monthly wholesale prices of major edible oils from January 2010 to May 2024 and secondary data from the World Bank for international and Ministry of Consumer Affairs (price monitoring) for domestic prices of edible oils. The results bring out the volatility of the domestic and international prices of edible oils. All the prices of edible oils were nonstationary and found stationarity after the first differencing, the most important condition for cointegration of the markets. The domestic and international prices of edible oils were well integrated and found five cointegration relations. The individual edible oil markets are also integrated which shows the adjustment of prices towards the long-run equilibrium. The results of the Pairwise Granger Causality Test showed that all the oil markets are moving in a bi-directional i.e., domestic prices and international prices are influencing each other except sunflower where the domestic prices do not affect the international prices.

Keywords Edible oils, cointegration, Granger Causality Test, domestic prices and international prices, sunflower

Should India import corn for ethanol production? technology alternatives for import substitution

Bilavat Swami Nayak[1], Naresha N[1] and Balaji SJ[1]*
[1]ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi
Email: balajisjniap@gmail.com; balaji.sj@icar.gov.in

The Indian government's decision to promote corn as the feedstock to produce ethanol for blending with petrol has sparked a variety of reactions. An increase in the procurement price of corn-based ethanol has transformed Asia's leading corn exporter into a net-importer (corn imports have surged by 260% in value in 2023-24), leading to calls from the poultry industry to eliminate import duties on corn and lift the ban on GM corn. Technology could play a crucial role in preventing such import-driven green-energy transition in the long term. This study estimates required growth in total factor productivity (TFP) in corn to prevent the need to import corn for ethanol production, with a specific focus on the year 2050. Corn yield and area projections are made accounting for climatic change till 2050. ARIMAX, linear and non-linear econometric models are employed for projections and the results are validated with GFDL, HGEM, IPSL, and MIROC simulation model projections. Estimated coefficients are used to simulate TFP growth effects. Results show that to substitute corn import by around 25 to 34 million tonnes by 2050, existing TFP growth should increase over a half (58%) to three-fourth (78%).

Keywords Trade, technology, energy, corn

A review on innovative government initiatives – national e-governance plan in agriculture (NeGP-A), mkisan portal, kisan call centres, mobile apps- in promoting the digitalization of agri marketing

Lalenpuii [1*], V K Choudhary[1], M.J.S.L. Naga Durga[1] and Manoj Kumar Dara[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: enic129@gmail.com

The agricultural sector is a vital component of the Indian economy, employing nearly half of the nation's workforce and significantly contributing to its Gross Domestic Product (GDP). However, the sector has long struggled with inefficiencies such as information asymmetry, limited market access, price volatility and reliance on outdated farming practices. In response, the Government of India has initiated several innovative programs aimed at digitalizing agricultural marketing. This review paper examines the impact of key initiatives, including the National e-Governance Plan in Agriculture (NeGP-A), the mKisan Portal, Kisan Call Centres (KCCs, and various mobile applications. These digital platforms have improved market transparency, efficiency and farmer empowerment by facilitating better price discovery, reducing transaction costs and providing real-time information. Despite the progress, challenges like digital literacy, infrastructure limitations and data security remain significant barriers to widespread adoption. The review concludes that while digitalization has transformed agricultural marketing in India, ongoing efforts to address these challenges are crucial for achieving a more inclusive and efficient agricultural system.

Keywords Digitalisation, NeGP-A, mkisan, kisan call centres, mobile apps, agri-marketing

Impact of systematic dairy farming through SHGs of Chhuikhadan block of Chhattisgarh

Tripti Verma[1]*
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: triptiv001@gmail.com

This research deals with "Women Empowerment", a burning issue all over the world. Self Help Groups, as micro financial institutions, emerged as an impetus for community action. The present study in the rural Chhattisgarh through "Financial Analysis of Dairy Farming Through SHGs Of Chhuikhadan Block of Chhattisgarh" covers fifty-three respondents from Khairagarh district of Chhattisgarh plains. National Rural Livelihood Mission Rajnandgaon gave guidance for producing and marketing of SHG products. All women were very much interested in different activities. The study analyzed the cost, returns and marketing pattern of dairy farming. The women supply their products to local market, wholesale, and C-mart. To streamline the income Generation Programs of SHGs the state Government may consider giving preference to uncovered areas for promoting the SHGs. Education is especially important to know about the credit facilities.

Keywords women empowerment, micro finance, community, C-Mart, alleviation of poverty

Analyzing the performance of pradhan mantri fasal bima yojana (PMFBY) and constraints in its adoption through digitalization in Kendrapara district of Odisha

Rishita Sen1*, Sarba Narayan Mishra[1] and Chinmayee Nayak[1]
[1]Odisha University of Agriculture & Technology, 751003
Email: rishita0808@gmail.com

Pradhan Mantri Fasal Bima Yojana (PMFBY) is one of the most important programmes of the Government of India in protecting the production risk of the farming community since the year 2016. The present study is conducted in Kendrapara district of Odisha with the objective of evaluating its performance and analysing the constraints in its adoption through digitalization**.** The study pertains to the year 2023-24 . It has been found that there is significant growth in its adoption (32.84 per cent for loanee and 253.30 per cent for non-loanee farmers) in Kendrapara district. Challenges include delay in individual loss assessment, compensation delays, slow crop-cutting experiments and application difficulties via Seva Kendras. Digitalization has been crucial for the scheme's success as it uses satellite and GPS systems for crop loss assessment and direct bank transfers. However, barriers like digital access and literacy remain significant.

Keywords Crop insurance, PMFBY, garett ranking, physical performance, risk mitigation

Evaluation using difference in difference method: a case of electronic-national agriculture market (e-NAM) from India

Nirmal Ravi Kumar K[1*], A Amaraendar Reddy[2], Jagan Mohan Reddy M[3] and Adinan Bahahudeen Shafiwu[4]
[1]S.V. Agricultural College, Tirupati, Acharya NG Ranga Agricultural University, (ANGRAU), Andhra Pradesh, 517502, India
[2]School of Policy Support Research, ICAR-National Biotic Stress Management (NIBSM), Raipur
[3]Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, 500030, India
[4]University for Development Studies, P.O. Box TL 1350, Ghana
Email: kn.ravikumar@angrau.ac.in

Turmeric and dry chillies are major crops in India, playing a vital role in its agriculture. In India, turmeric and chillies (dry) cultivated over vast areas, encompassing 2.91 lakh hectares and 7.29 lakh hectares respectively during the cropping year 2020-21. Andhra Pradesh ranks high in the country in the production of both crops with the fifth position for turmeric and first position for dry chillies. The government implemented the electronic-National Agriculture Market (e-NAM) in Duggirala for turmeric and Guntur for dry chillies to benefit farmers in 2016-17. This study assesses the impact of e-NAM on these markets using panel data analysis from 2013 to 2019. The Difference in Difference method compares prices for the treated and control groups. The findings indicate that confounding factors were constant before the e-NAM intervention. Moreover, the treated group achieved higher prices for their produce compared to the control group. This highlights the positive impact of e-NAM and makes a case for its expansion in more markets. By leveraging technology, e-NAM has improved trading, price realization, and market access for farmers. Higher prices benefit farmers' economic well-being, increasing income and livelihoods. The success of e-NAM in Duggirala and Guntur provides a strong rationale for its adoption in other markets across Andhra Pradesh and the country. Promoting e-NAM can lead to fair prices, efficient marketing, and enhanced market access, promoting overall growth in the agricultural sector. Continued promotion and expansion of e-NAM are essential to empower farmers and create an inclusive and efficient agricultural marketing ecosystem.

Keywords e-NAM intervention, monthly modal prices, placebo test, difference-in-difference method, price volatility

Performance of e-NAM: perceptions, challenges and opportunities in Rajasthan and Haryana

Shubho Paul*[1], P Venkatesh[1], M. Balasubramanian[1], Pavan Kumar Kumawat[1] and Popavath Bhargav Naik[1]
[1]ICAR-Indian Agricultural Research Institute, New Delhi, 110012, India
Email: shubhopaul113934@gmail.com

E-NAM has revolutionized Indian agriculture, reaching over 1389 mandis in 23 states and four union territories. The study aims to assess the attitude of stakeholders, their challenges, and the benefits of e-NAM. It covers eight mandi areas of Haryana and Rajasthan, involving 240 farmers, 32 traders, 40 commission agents, and respective mandi officials. Despite aiming at enhancing price transparency, farmers cite traders' cartelization as their primary constraint, followed by price fluctuations and delayed payments. Traders express most concerns over purchasing produce without physical inspection and in the online payment process. Commission agents fear potential loan defaults if payments are directly made to farmers' accounts. This paper also details the actual ground operations of e-NAM and the suggestions put forward by different stakeholders for e-NAM's overall success.

Keywords e-NAM perceptions, constraint analysis, APMC ground operations, RBQ

An economic analysis of chia cultivation in Kalyan-Karnataka region

Shiva Kumar[1]*, Jainuddin S M[1], Amrutha T Joshi[1], Vasudeva Naik [1] and A S Police Patil[1]
[1]University of Agricultural Sciences Raichur, Karnataka, India, 584104
Email: shivunaiks18@gmail.com

Chia (*Salvia hispanica L.*) is gaining prominence as a superfood and medicinal plant within the Lamiaceae family, celebrated for its pseudocereal status and nutritional benefits worldwide. Introduced to India by the Central Food Technological Research Institute (CFTRI), Mysuru, it has swiftly spread across the country, including Karnataka's Kalyan-Karnataka region. This study delves into the cost and returns structure of chia cultivation, focusing on Bidar and Kalaburagi districts, prominent chia grown areas. Primary data was gathered through surveys of 30 sample farmers from each district during the 2023-24 period. The findings reveal that chia cultivation in Bidar was marginally more profitable (i.e., higher net returns) compared to Kalaburagi. However, the returns per rupee invested were superior in Kalaburagi. The net returns over total costs stood at Rs 22652.50 and Rs 23755.40 per acre in Bidar and Kalaburagi respectively, with benefit-cost ratios of 2.46 and 2.61. Productivity per acre slightly favoured Bidar at 3.11 quintals compared to Kalaburagi 3.08 quintals, due to better water management practices and proper adoption of technology by the farmer. Overall, chia cultivation viable and productive, and hence, is a lucrative crop option in the region.

Keywords CFTRI, Benefit cost ratio, Net returns

Beyond prescription: gendered analysis of farmer preferences for climate-resilient cropping systems in Bihar

Babita Kathayat[1*], A.G. Adeeth Cariappa[1], R.K. Jat[2] and Vijesh V. Krishna[1]
[1]International Maize and Wheat Improvement Center Hyderabad
[2]BISA, International Maize and Wheat Improvement Center, Pusa, Samastipur, Bihar
Email: babitakathayat1@gmail.com

Diversification is crucial for maintaining farming system productivity and ensuring food security in the Eastern Gangetic Plains of India. The public sector agricultural research and development (R&D) system is actively developing and promoting new cropping systems tailored to different agroecological conditions to enhance system resilience against climate change. However, the new farming systems are not always accepted, and the reasons behind them are poorly understood. We evaluated farmers' preference for fourteen proposed cropping systems using data from 751 gender-disaggregated FGDs conducted across 380 villages in Bihar. Farmers' preferences show significant divergence from prescribed systems, with significant gender-specific preference heterogeneity. Men are more likely to prefer diversified cropping systems, while women consistently opt for conventional rice-wheat based rotations. Understanding the gendered reasons behind resistance and scepticism toward the new cropping systems, and creating awareness around those underlying factors, is crucial to ensure inclusive and effective dissemination of climate-resilient cropping systems.

Keywords Farmer preference, gender, cropping systems, climate-resilient agriculture

Growth dynamics, instability, and decomposition analysis in millets and cereals

Remalli Anthony[1*], R.S. Pundir[1], Nidhishree R[2], Sneha[3] and Shaik Reshma Sulthana[1]
[1]Anand Agricultural University
[2]Navsari Agricultural University
[3]Junagadh Agricultural University
Email: remallianthony04@gmail.com

Millet's cultivation is as old as human civilisation and evidences of growing millets were found in early 3000 BC in Indus valley civilization, the Indian millets are nutritionally superior to wheat and rice as they are rich in protein, vitamins and minerals. Millets can survive the extreme climate and degraded soil. In comparison to most fine cereals, they have minimal obligation of water, fertilizers, and pesticides. As we have almost achieved food security now the dynamics shifts towards the nutritional security and to achieve this millets are the major source. Despite being a historic staple meal, millets were replaced by rice and wheat because they were more readily available. The study aims to find out the change in dynamics of growth, instability and decomposition of millets in comparison with cereals from the past 70 years by employing compound annual growth rate (CAGR), Cuddy Della Vella Index (CDVI), and Hazels Decomposition analysis. The results show the area under millets had consistently declined in almost all decades, reflecting a significant reduction in their cultivation. In contrast, the area under cereals had mostly grown, millets had faced higher instability in area, production, and productivity compared to cereals over the decades. The Hazel's decomposition analysis for cereals, the area effect was significant during the early decades, the yield effect became the primary driver of production growth, and for millets, the yield effect had been the primary driver of growth, despite a shrinking area under millet cultivation, productivity gains have allowed for sustained production. Enhancing millet production through targeted strategies can contribute significantly to achieving food security while ensuring environmental sustainability

Keywords Cereals, decomposition, growth, instability, millets

Navigating the digital frontier: insights into e-governance and digital agriculture in India- a review

M.J.S.L. Naga Durga [1]*, V K Choudhary[1], Lalenpuii[1] and Manoj Kumar Dara[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: jaanumoturi@gmail.com

The digitalisation of India's agricultural sector presents numerous complexities. Recent e-governance initiatives, particularly through the National E-Governance Plan for Agriculture (NeGP-A), are fostering significant advancements within this domain. Central to this digital transformation is the India Digital Ecosystem of Agriculture (IDEA) framework, which incorporates Digital AgriStack—integrating various technologies and databases focused on farmers. Despite limited exploratory research on administrative e-governance efforts in agriculture, this review aims to comprehensively examine the evolution, status, advancements and challenges within this evolving landscape.

Keywords Digital frontier, e-governance digital agristack

Enhancing market efficiency and price stability through agri-tech innovation: the role of startups in transforming agriculture

Mandas Banjare[1*] and Tanuja Ekka[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: maanbanjare6226@gmail.com

The rise of agri-tech startups has transformed traditional agricultural practices and considerably influenced price stability and market efficiency in the sector. Making the best use of digital tools like artificial intelligence, data analytics, and Internet of Things (IoT) sensors, these startups are delivering key challenges such as price instability, supply chain inefficiencies, and deficit of real-time market information. By providing farmers with data-driven insights on crop yields, market prices, and weather patterns, agri-tech startups help optimize production schedules, reduce waste, and align supply more closely with demand. Moreover, digital marketplaces created by these startups have benefited direct farmer-to-consumer sales, diminishing overreliance on intermediaries and highlighting pricing clarity. This access to real-time information also enables farmers to make better decisions, reducing price volatility caused by fluctuations in supply. However, the overall impact on market efficiency and pricing is intricate and varies across regions, depending on factors such as digital literacy, infrastructure, and access to technology. This paper finds out the multi-dimensional role of agri-tech startups in promoting price stability and market efficiency, analyzing both their benefits and the challenges that could limit their impact on global agricultural markets.

Keywords Agri-Tech Startups, artificial intelligence, supply chain, digital literacy, technology

Internet of things (IoT) integration in smart farming and its effects on agricultural marketing

Dushyant Kumar[1*], Avan Das Sahu[1] and Dronak Kumar Sahu[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Emails:dushyant98agri@gmail.com

Smart farming is adopted fast in agriculture through the IoT that has facilitated efficiency, precision, and accuracy. Thanks to the IoT technologies wherein sensors, devices and analytics are all inter-connected, precision agriculture, monitoring, and decision-making solutions are possible. Consumer marketing is among the areas in smart agriculture that got the boost by integration of IoT. Through the IoT elements currently in place, farmers are able to obtain detailed market information on consumers and diversified means of supply chain management and crop production to feed demand. Some of the challenges include connectivity, high initial investment and data security, which need attention for IoT adoption in agriculture to expand.

Keywords Internet of things, smart farming, agriculture marketing

Digital marketing in the agricultural sector and strategies for promoting sustainability in agro-based industries: opportunities and challenges

Satyanarayan Soni[1*]
[1]College of Agriculture and Research Station, Raigarh, IGKV, 496001
Email: zsatyay@gmail.com

Digital marketing utilises internet-based technologies, including computers, smartphones, and other digital tools and platforms, to advertise products and services. Originating in the 1990s, the concept of digital marketing has gained significant traction in the global business landscape, particularly around the mid-2010s. This approach to marketing presents distinct opportunities for the agricultural sector to reach consumers. The marketing mix used to introduce agricultural products to the market must consider the specific characteristics of the agricultural industry. Digital marketing can offer benefits to farmers, such as enhancing the promotion of agricultural products and boosting desirability and sales through various digital marketing strategies. Agricultural businesses are continuing to operate by utilizing a mix of traditional and digital marketing strategies to achieve customer satisfaction. This research examines the various elements that contribute to this and the advantages that can be realized if farmers effectively adopt digital marketing within the agricultural industry. The research encompasses articles sourced from multiple literature platforms using validated keywords. A review of these articles is conducted to explore digital marketing within the agricultural sector and the factors that drive it. The research highlights the need for digital transformation and indicates that businesses must concentrate on digital transformation. It provides an overview of the benefits and potential of digital marketing strategies in the agricultural field; this primarily serves as a resource for farmers, agriculture researchers, and various stakeholders. By utilizing digital marketing strategies, farmers can enhance their ability to determine prices and lower both production and marketing expenses for their agricultural goods. To achieve this, it is essential to encourage farmers to adopt digital marketing tools in their agricultural practices, and policymakers should formulate strategies to promote the growth of digital marketing in agriculture. The results emphasise criticality of strategic investments in digital infrastructure, data security, and new technologies besides joint learning and ongoing review. Further research is recommended.

Keywords Farming promotion, online marketing, digital tools, approach, digital marketing, sustainability, consumer behaviour, environmental conservation, data security

Exploring the impact of digital marketing platform agmarknet: a case study of vegetable farmer of Chhattisgarh

Ajit Kumar Bhoi[1*] and Ravi Shrey[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: ajitbhoi927@gmail.com

The present study explores the impact of Agmarknet on farmer-market connectivity and seasonal indices of price of major vegetables in Chhattisgarh based on secondary data of 7 years from 2017 to 2023 collected from www.agmarknet.gov.in. AGMARKNET provides real-time data on the prices of various agricultural commodities at different mandis (markets) across India. This helps farmers make informed decisions about when and where to sell their produce, ensuring they get better prices. The study utilised time series data to compute the trend and seasonal variations. The ratio to moving average method is used to study the seasonal variations. During the study period, the price index of tomato for the month of July was highest in Bilaspur, Durg and Rajnandgaon district and lowest in March in Bilaspur and Rajnandgaon district and in January, in Durg. For potato, the price index is highest in Bilaspur, Durg and Rajnandgaon district in October. The price index is lowest in the month of February.

Keywords AGMARKNET, prices, time series analysis, seasonal indices

Enhancing governance and institutional frameworks for sustainable agriculture: a pathway to resilient food systems

Shubham Kumar Thakur[1*], Hulas Pathak[2], Shubhi Singh[3], Vaibhav Laxmi Tiwari[4] and Navinkumar[1]
[1]Mahant Bisahu Das College of Horticulture and Research Station, GPM, Chhattisgarh 495117, India
[2]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
[3]College of Horticulture and Research Station, Kunkuri, Chhattisgarh 496225, India
[4]ICAR-National Institute of Biotic Stress Management, Baronda, Chhattisgarh 493225, India
Email: shubhamcks@gmail.com

Effective governance and robust institutional frameworks are vital for sustainable agriculture, tackling issues like climate change, resource degradation, and food insecurity. With 40% of the global population unable to afford a healthy diet and agricultural greenhouse gas emissions rising by 6% in 2023, innovative governance models are urgently needed. Global investment in agricultural R&D remains critically low, with many nations allocating less than 1% of agricultural GDP, far below the 2% recommended threshold. India's **Pradhan Mantri Krishi Sinchayee Yojana** improved water use efficiency by 20%, while Ethiopia's **ultra-poor graduation program** reduced climate vulnerabilities by 50%, showcasing the potential of targeted policies. Key findings highlight the importance of decentralized governance, increased R&D investment, and inclusive policies for marginalized groups. Collaborative efforts among governments, private sectors, and civil society are essential to achieve SDGs, combat climate change, and ensure global food security.

Keywords Sustainable agriculture, governance, climate resilience

Role of digital plateform of agmarknet on farmer-market connectivity, a case study of kodo millet of Balrampur district, Chhattisgarh

Rajkumar[1*], Ravi Shrey[1], A.K. Gauraha[1], Ravi Saxena[1] and Adikant pradhan[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email**:** rajsonwani51@gmail.com

The present study examines the behavior of arrivals and prices of selected agricultural commodities in Kusmee mandi of Balrampur district of Chhattisgarh. This study is based on the secondary data of 7 years from 2017-18 to 2023-24 which was collected from www.agmarknet.gov.in. The study computed the seasonal price variation and price trend using linear trend equation. The seasonal variation in arrivals and prices shows an increasing seasonal price variation in month of September Rs.2564.29 (9.64%) in the year 2023-24 where May month Rs.1778.28 (6.68%) shows decreasing trend in 2018-19 in arrivals and price of kodo millet. Findings of the study might prove helpful in guiding the farmers involved in making timely decisions on the month of selling their produce to get better prices using AGMARKNET data.

Keywords Arrival & price, trend, seasonal variation, AGMARKNET, linear trend

Economic potential of unmanned aerial vehicle: drones in agriculture

Yazhini, A[1] and Malaisamy, A[2]*
[1]Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu-641003, India
[2]Agricultural College and Research Institute, Madurai, Tamil Nadu-625104, India
Email: yazhi224@gmail.com

Indian agriculture makes a substantial contribution to the nation's GDP, employment, and food security. It directly employs over half of the country's workforce, supporting the livelihoods of rural communities. Historically, Indian agriculture has been labour-intensive and reliant on traditional practices, resulting in inefficient resource utilization. To address the numerous challenges facing the Indian agriculture sector, the adoption of emerging technologies, such as drones, is imperative. Drones have the capacity to significantly enhance agricultural practices, increasing productivity and reducing resource wastage. This study explores the economic dynamics of drone technology in agriculture, addressing a gap in past research amid the growing use of Artificial Intelligence in the sector. Conducted in the paddy cultivation regions of Thanjavur and Madurai districts in Tamil Nadu, the study involves a sample of 80 for UAV technology and 120 for conventional methods. The findings reveal significant cost savings and higher profitability with drone-assisted farming, where total expenses decrease from ₹ 27,723 for conventional farming to ₹ 22,858 with drones, primarily due to reduced pesticide and herbicide use and improved application efficiency. While both methods yield similar gross returns of ₹ 39,100 for conventional and ₹ 40,640 for drone-assisted—the net returns are markedly higher for drones at ₹ 17,782.50 versus ₹ 11,376.80 for conventional practices. A per-acre comparison shows substantial reductions in labour costs, with human labour decreasing from ₹ 11,077 to ₹ 5,628 and pesticide costs falling from ₹ 2,032 to ₹ 950. Although machine labour costs rise slightly with UAVs, overall savings enhance the financial viability of drone-assisted farming. The partial budget analysis indicates a net profit increase of ₹ 7,331, underscoring the economic advantages of adopting drone technology in agriculture.

Keywords Unmanned aerial vehicle, agriculture, paddy, partial budgeting

Developments in precision farming through drone technology

B.C. Anu[1]* and M.L. Meena[1]
Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar- 848125
Email: entoanu123@gmail.com

The use of unmanned aerial vehicles (UAVs) in agriculture marks a significant development in precision farming, with drones emerging as a key tool for pesticide application. This paper provides an overview of pesticide spraying drones and their influence on contemporary agricultural practices. These drones are equipped with cutting-edge technologies such as GPS navigation, multispectral imaging, and precision spraying systems, offering several advantages over conventional pesticide application methods, including reduced chemical use, improved efficiency, and lower environmental impact. Furthermore, they provide real-time crop health data, enabling targeted and timely pesticide application. It also highlights recent advancements in drone technology, including enhanced flight stability, autonomous operation, and increased payload capacity. In addition, it addresses regulatory challenges and safety concerns related to drone deployment in agriculture, emphasizing the need for standardized regulations and comprehensive training. By supporting sustainability, reducing costs, and promoting crop health and food security, the adoption of pesticide spraying drones has the potential to transform agricultural practices. Continued research and development are essential to fully realize the benefits of UAVs in modern farming.

Keywords Drone, multispectral imaging, navigation, pesticide, sustainability, unmanned aerial vehicles

Digitalisation of agriculture in Dhamtari district of Chhattisgarh: a case for doubling farmers' income

Narottam Kumar Sahu[1*], V. K. Chaudhary[1] and Mukesh Kumar Anant[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: sahu.nero03@gmail.com

Agriculture in India remains a cornerstone of rural livelihoods. Despite its importance, farmers face persistent challenges, including low productivity, unpredictable weather patterns, and limited market access. To address these issues, the Indian government has emphasized the role of digital technologies to transform agriculture and achieve the ambitious goal of doubling farmers' income by 2022. This study investigates the role of digitalisation in improving agricultural practices and farmers' income in Dhamtari district, Chhattisgarh state. We explore how digital tools such as weather forecasting apps, soil health monitoring systems, e-marketing platforms, and advisory services impact productivity, cost efficiency, and market access. The findings reveal significant improvements in crop yields, cost reduction, and income, particularly for farmers who actively engage with digital technologies. However, challenges such as digital illiteracy and poor connectivity must be addressed for wider adoption. To conclude, with the right infrastructure and training, digitalization can lead to doubling farmers' income.

Keywords Agriculture, Chhattisgarh, digitalization, farmer's income

Innovating agricultural marketing through digital transformation

Marya Shilpa Ekka[1], Ashish Timothy[1] and Shailesh Kumar[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: shilpaekka2803@gmail.com

Innovating agricultural marketing through digital marketing involves leveraging technology to enhance the visibility, accessibility, and efficiency of farm products. Digital platforms, including social media, e-commerce websites, and mobile applications, enable farmers to reach global markets directly, bypassing traditional intermediaries. This innovation facilitates better pricing, reduces post-harvest losses, and improves supply chain management. Furthermore, data analytics can help in market trend analysis, guiding farmers in production decisions. The integration of digital marketing in agriculture promises to empower smallholder farmers, increase their income, and drive sustainable growth in the agricultural sector.

Keywords Innovation, e-commerce, supply chain management, post harvest

Harnessing solar power for sustainable agriculture in India: a DPSIR framework

Surya Pratap Singh Nagdali[1], Renjini V R[1*], Praveen K V[1], Ajmal S[2] and Asha Devi[1]
[1]ICAR- Indian Agricultural Research Institute, New Delhi
[2]ICAR-Central Island Agricultural Research Institute, Port Blair
Email: renji608@gmail.com

Agriculture is far more energy-intensive than ever making it critical to shift toward climate-friendly practices as climate change poses a major global challenge. Currently, agriculture relies heavily on fossil fuels, causing significant environmental damage. Additionally, government subsidies in the agricultural power sector strain the economy and contribute to environmental degradation due to inefficient power use. This paper, using the DPSIR (Driving Forces-Pressures-State-Impacts-Responses) framework, examines the energy demands of Indian agriculture, the driving forces behind its energy strain, and potential policy responses to promote sustainability. Renewable energy, particularly solar, plays a key role due to its vast potential and widespread availability across the country. India's geographic location gives it a natural advantage in harnessing solar power, which can benefit all sectors of the economy, particularly agriculture. A literature search of the Scopus database (1991–2024) yielded 1,289 relevant studies after filtering for duplicates and relevance. Key drivers of agricultural energy demand include population growth, economic and technological advancement, industrialization, and urbanization. Population growth increases food and energy demands, while urbanisation reduces arable land. These drivers lead to higher energy costs for farmers and increased greenhouse gas emissions. India has a unique opportunity to improve energy efficiency in agriculture by increasing the use of solar energy, balancing environmental protection with economic growth. The government has been promoting solar energy in agriculture through initiatives like the PM KUSUM scheme, which helps farmers install solar pumps and rooftop PV systems. To meet India's target for reduction of emission intensity and to increase non-fossil power capacity by 2030—further investment in solar energy, supported by strong public sector initiatives, is essential.

Keywords Solar energy, DPSIR, renewable energy, sustainable agriculture, driver

A framework for assessing the output impact of crop-specific micronutrient formulations in spice crops

Lijo Thomas[1*], Sajesh V K[1] and V Srinivasan[1]
[1]ICAR-Indian Institute of Spices Research, Kozhikode 673012
Email: lijoiari@gmail.com

Soil micronutrient deficiency is a critical factor limiting productivity of spice crops in India. This production constraint can be mitigated through application of crop specific micronutrient formulations. This study evaluates the national-level output impact of crop-specific micronutrient formulations developed by ICAR-Indian Institute of Spices Research for black pepper, ginger, turmeric, and cardamom. By analysing data from technology licensees, crop area, and yield trials, the study estimates yield enhancement and economic benefits attributable to micronutrient application. Results indicate substantial yield gains and economic benefits, with conservative estimates suggesting national-level output increases for all four crops. We also establish that the cost of technology development was relatively low when compared to the magnitude of the benefits. The yield impact at the national level was estimated to be 1.96,130.2, 18.3 and 1.9 kg/ha for black pepper, ginger, turmeric and cardamom, respectively. The net economic gains for the primary producers from the use of micronutrient technology was highest in ginger (INR 667 million) followed by turmeric (INR 383 million), black pepper (INR 223 million) and cardamom (INR 113 million). The findings highlight the significant role of micronutrients in boosting spice output in the country. The study also implies that development of crop specific micronutrient dosage recommendations for other spice crops could yield similar economic benefits.

Keywords Output impact, micronutrients

Dynamics of agricultural advisory needs of farmers: a case study of farmer helpline service in Uttarakhand

Amit Thakur[1*], Kushagra Joshi[1], Janvi Kochar[1] and Lakshmi Kant[1]
[1]ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan
Email: amit.thakur@icar.gov.in

Utilizing a toll-free number for farmers' service is an effective way to access the hill region's agricultural information. From 2010-23, farmers accessed information on more than 16 different aspects of agricultural activities through the ICAR-VPKAS helpline. Information on crop protection (25.46%), seed availability (17.44%), and vegetable production (13.51%) are ranked as top priorities of the farmers. Investigating the effect of the season and monthly trends reveals that farmers made persistent phone calls during the Kharif season. A higher average number of phone calls are received during January, July, and September. Promoting digital mode of information is essential in reducing the knowledge gaps and enhancing the farmers' productivity and income levels.

Keywords Hill regions, sericulture, productivity

Sources of technical advice and effect of their adoption on dairy income of agricultural households in Karnataka

Udita Chaudhary[1], Vinita Kanwal[2] and Pradeep Terdal[1]*
[1]ICAR- National Dairy Research Institute, Karnal
[2]Punjab Agricultural University, Ludhiana
Email: PTerdal24@gmail.com

Secondary data from the National Sample Survey Office (NSSO) – Situation Assessment Survey (SAS) 77th Round for agricultural year 2018-19 was analyzed to estimate dairy income of farmers in Karnataka and to study the determinants of dairy income in the state. Of all the sources of technical advice adopted by dairy households in the state, the top three sources of veterinary department, dairy cooperative, and radio were considered among other relevant socio-economic variables for regression analysis. Education, adoption of technical advice given by dairy cooperatives, and herd-size are the key positive determinants of dairy income, while persistent disparities in income are noticed for households in the OBC group and the Coastal & Ghats region. Emerging digital sources of technical advice like smartphone apps can potentially benefit the dairy farmers if they are harnessed at the same scale as the dairy cooperatives in the state.

Keywords Dairy income, technical advice, determinants

Perceptions and barriers to empowerment among participants of women collectives in Kerala

Hadiya[1*], Venugopal[1], Navneeth[1], Krishna[1] and Vijesh V[1]
[1]International Maize and Wheat Improvement Center (CIMMYT) Hyderabad
Email: hadiyajazhaq@gmail.com

This study examines subjective differences in empowerment perceptions among women in Self-Help Groups (SHGs) in Malappuram, Kerala. SHGs engage women in income-generating activities, fostering their social, economic, and political empowerment. However, the perceived and subjective nature of empowerment is often overlooked. A household survey of 361 SHG participants, employing vignettes, found 42% believed in a case of "too much empowerment" for women, while others supported further empowerment. Barriers include family judgment, societal norms, and community expectations. While many women gain independence, financial stability, and confidence in decision-making, others struggle with limited family support and societal criticism. Insights from SHG activities show improved financial management and increased participation in household decisions, though social acceptance remains inconsistent. Regression models highlight factors influencing empowerment perceptions. Reshaping attitudes through community-centered initiatives is crucial for enhancing SHG engagement, suggesting a need for targeted interventions to address deep-seated perceptions and foster holistic empowerment.

Keywords Women empowerment, SHGs, financial stability, decision making

Interplay of institutions: an enquiry on formal and informal structures shaping women's collectives for food security in Kerala

Venugopa[l], Navneeth[1*], Hadiya[1], Jalal[l], Ameena[1], Joseph[1], Trisa Maria[2], Sathyan, Archana R[2], Krishna and Vijesh V.[1]

[1]International Maize and Wheat Improvement Center (CIMMYT) Hyderabad
[2]Kerala Agricultural University, College of Agriculture, Vellayani, Trivandrum
Email: navneethpvr2018@gmail.com

This study examines the roles of formal and informal institutions in shaping women-led self-help groups (SHGs) to advance food security in Kerala, India. Traditionally seen as custodians of food security, women now expand their roles through SHG-driven income generation. Despite recognition of their impact, limited research explores institutional factors influencing these collectives' efficacy. Based on 52 focus group discussions in Trivandrum and Malappuram, analyzed with NVivo, this study addresses accessibility, scalability, and sustainability under diverse climatic and market constraints, offering strategic insights to empower women-driven initiatives. The findings reveal that while formal institutions support capacity-building, challenges like administrative delays and cultural biases hinder progress. Informal networks boost resilience, but decontextualized policies and limited market access reduce growth potential. Digital tools empower women to navigate market and climate issues, yet socio-cultural and administrative barriers persist. Enhancing digital literacy and addressing these barriers could strengthen women's SHGs in sustainable food security.

Keywords Self-help groups, efficacy, digital literacy, food security

SHGs for social upliftment? exploring the caste dimensions of SHG participation in Bihar

Rosalin Geetha-Ingersal[2*]; Mahin Sharif[2]; Vijayalaxmi D.Khed[1]; Krishna[1], Vijesh V.[1]

[1]International Maize and Wheat Improvement Center (CIMMYT) Hyderabad
[2]University of Agricultural Economics (UAS) Bangalore
Email: rosalingeetha@gmail.com

Gender inequality and caste-based hierarchies affect power, resource access, and life opportunities in rural households across South Asia. In India, Self-Help Groups (SHGs) serve as a key strategy to reach marginalized women and potentially address these disparities. This study examines SHG participation among 1,200 rural women across ten districts in Bihar, India. Results indicate that women primarily join SHGs for better credit access, although activities centered on livestock and agricultural training gain prominence in certain districts. Employing regression models and machine learning (Random Forest), we find that farmer caste, landholding size, age, education, and wealth are key factors determining SHG participation in Bihar. While most SHG members belong to marginalized castes, regression results reveal important intersectionalities: landholding and wealth reduce membership likelihood for marginalized women but increase it for non-marginalized women. These findings suggest the need for caste-sensitive approaches to ensure SHGs equitably empower women from diverse socio-economic backgrounds.

Keywords Women, caste hierarchies, self help groups (SHGs), probit model, Bihar, India

Profiling of farmer producer companies (FPCs) in Rajasthan

Latika Sharma[1], Narendra Yadav[1] and Binoo P Bonny[2]
[1]Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313001
[2]College of Agriculture, Kerala Agricultural University Kerala
Email: ynarendra0988@gmail.com

This study examines the profiling of Farmer Producer Companies (FPCs) in Rajasthan, highlighting their significance in enhancing the well-being of smallholder farmers. The study was conducted during 2022-23 in Rajasthan with 30 sample sizes. 30 FPCs were selected in proportion based on their business activities. The analysis reveals that 95 percent of FPCs in Rajasthan have been established for 5 to 10 years. A significant proportion of these organizations, 77 percent, have an annual turnover of up to 50 lakh INR, while 70 percent possess share capital ranging between 5.1 to 9.9 lakh INR. Community engagement is evident, as 46.67 percent of FPCs have between 500 to 750 shareholders. Gender diversity within these organizations is notable, with 30% of board members being female, suggesting a need for increased promotion of women's participation. The profile of CEOs indicates that 70 percent have up to 7.5 years of experience and are over 35 years old, with most being full-time, paid executives earning up to 4 lakh INR annually. The study identifies garlic as the region's predominant product procured by FPCs. These findings underscore the pivotal role of FPCs in fostering agricultural development and community involvement in Rajasthan.

Key words FPC, small holder farmer, gender diversity

Determinants affecting the adoption of government schemes in Rajasthan

Nikita[1]* and Rajesh Sharma[2]
[1]Faculty of Agricultural Sciences, SGT University, Gurugram-122505, India
[2]Swami Keshwanand Rajasthan Agricultural University, Bikaner-334006
Email: inaniyanikky788@gmail.com

Using primary data from various farmers of Rajasthan, this paper examines the determinants affecting the adoption of various government schemes by farmers. A binary logistic regression model has used for the analyzing the results. Two government schemes were taken under consideration for the present study, viz., Prashan Mantri Fasal Bima Yojana (PMFBY) and Pradhan Mantri Krishi Sinchayee Yojana (PMKSY). The findings of study revealed that annual income, operational and education found positively significant for the participation of farmers in government schemes. The identification of the determinants affecting the adoption of government schemes would help the policy makers to make various government schemes accordingly for the maximizing the participation of farmers and improve the targets of the government.

Keywords Affecting, determinants, government schemes and participation

How direct benefit transfer (DBT) schemes (like PM KISAN) and financial inclusion can raise investment and farmer income- an overview

Neelam Sinha[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: itsneel12@gmail.com

Direct Benefit Transfer (DBT) schemes, such as PM KISAN, and financial inclusion initiatives play a pivotal role in enhancing investment and increasing farmer income in agrarian economies. DBT schemes facilitate timely and transparent cash transfers directly to farmers, reducing leakages and ensuring that benefits reach the intended recipients. This financial support enables farmers to invest in essential inputs like seeds, fertilizers, and equipment, thereby improving productivity and yields. Concurrently, financial inclusion initiatives broaden access to credit and financial services, empowering farmers to leverage loans for expanding operations and adopting modern agricultural practices. The synergy between DBT and financial inclusion fosters a more resilient agricultural sector, increases household incomes, and stimulates local economies. By providing both immediate financial relief and long-term investment opportunities, these strategies contribute to sustainable agricultural development and poverty alleviation, ultimately enhancing food security and economic stability.

Keywords PM KISAN, DBT, financial inclusion

Farm advisory services in Gujarat: multivariate insights into information access and adoption

U. Poojitha Ratnam[1], Vishal S. Thorat[2*], Yogesh Garde[1] and O. P. Sharma[1]
[1]N. M. College of Agriculture, Navsari Agricultural university, Navsari, Gujarat,396450
[2]ASPEE Agribusiness Management Institute, Navsari Agricultural University, Navsari, Gujarat, 396450
Email: vishal.lotus@gmail.com

Agriculture advisory services are important in enhancing farm household's everyday decision making by providing information about new technologies, inputs, and markets. This paper examines the various farm advisory services accessed by farm households of Gujarat using unit level data from NSSO 77th round. Access to various information sources was analysed using multivariate probit model, while the types of information accessed was studied by cross-tabulation and percentage analysis. Results show that progressive farmers, radio/TV, veterinary department, input dealers and print media were majorly accessed by farm households. Results of MVP model revealed that different socio-economic factors like gender, training in agriculture, household size, and registration in any farmer's organization, land holding, literacy, age, region and primary income source of the household were found to be significantly associated with the access of information. Under the cultivation enterprise information about improved seed/ variety, plant protection and fertilizer application, and under animal husbandry enterprise information regarding healthcare, feeding and breeding of livestock was accessed by majority of the households.

Keywords Advisory services, information access, progressive farmers, farm households

Utilization pattern of direct benefit transfers for agricultural and non-agricultural purposes: evidence from the rythu bandhu scheme

Mounika Akula[1*], Nirmala Bandumula[2] and Meghraj Chandrakar[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
[2]National Academy of Agricultural Research Management, Rajendranagar, Hyderabad, 500030, India
Email: mounika.akula13@gmail.com

The Rythu Bandhu Scheme (RBS), introduced by the Telangana government in 2018, provides financial support to farmers for timely investment in crop production. Its primary goal is to assist farmers in purchasing essential inputs such as seeds and fertilizers while protecting them from falling into debt. This study examines how beneficiaries utilized RBS funds during the Kharif and Rabi seasons, focusing on different farm size categories. Based on primary data collected, it quantifies the proportion of funds allocated to agricultural and non-agricultural purposes across farm sizes (marginal, small, medium, and large). The findings show that a significant share of the funds was used for agricultural investments, with large farmers allocating a higher percentage to agricultural activities. In Kharif, large farmers invested 89.67% of the funds in agriculture, while marginal farmers allocated 82.88%. A similar pattern emerged in Rabi, with large farmers dedicating 89.79% of their funds to agriculture. However, smaller farmers allocated a slightly higher share to non-agricultural needs such as household expenditure, medical expenses, and loan repayments. Fertilizers and labour wages were the primary agricultural expenses, while household expenditures dominated non-agricultural use. These findings underscore the effectiveness of RBS in supporting agricultural investment while highlighting the non-agricultural needs of smaller farmers. The study offers insights into farmers' financial behaviour, providing evidence for policymakers to optimize schemes that enhance agricultural productivity and rural livelihoods.

Keywords Rythu bandhu scheme, utilization, agricultural investment, farm size

Transforming rural agriculture: impact study of Kalaignarin all village integrated agriculture development programme (KAVIADP) in Tamil Nadu

Saravanakumar V.[1*], D. Sureshkumar[1], and S. Sakunthaladevi[1]
Tamil Nadu Agricultural University Coimbatore-641003
Email: saravanakumar.v@tnau.ac.in

This study assesses the impact of the KAVIADP program in Tamil Nadu, focusing on its effects on agricultural yield, implementation challenges, and necessary mid-course corrections. Conducted as a pilot in Coimbatore, 720 farmers were surveyed using a before-and-after approach during 2022-23. Key findings include the creation of additional water storage structures, boosting irrigation intensity by 22%, and increasing cropping intensity through crop diversification. Agricultural productivity improved significantly, with gains in maize, groundnut, and vegetable yields, while input costs dropped by 4-7% for vegetable farmers. Additional income from custom hiring of battery sprayers, and capacity-building programs further strengthened the impact. Recommendations include revising cluster formation guidelines and enhancing awareness programs for greater scheme effectiveness.

Keywords Irrigation intensity, crop diversification, Agricultural productivity

Implications of *krishak bandhu* direct benefit transfer scheme for small-holder farmers during covid19 pandemic in coastal West Bengal

Sagnik Samanta[1]*, Subhasis Mandal[2] and Suchitra Mohanty[3]
[1]Integrated Rural Development and Management, Ramakrishna Mission Vivekananda Educational and Research Institute, Narendrapur, West Bengal, PIN-700103
[2]ICAR-National Dairy Research Institute, Karnal, Haryana, PIN-132001
[3]Amity Research Center, Amity University, Kolkata, West Bengal, PIN - 700135
Email: sagniksamanta2050@gmail.com

The small and marginal group of farmers across the country, including West Bengal is facing multiple constraints such as high input prices but depressing output prices and inadequacy of capital to investment in production. In addition to this, pandemic situation due to COVID19 outbreak further challenged continuation and gainful engagement in the farming sector. It was increasingly felt that farmers needed direct cash benefit support to continue their farming business. This study was aimed to get detailed information about the implications of one such direct benefit transfer of cash through *Krishak Bandhu Scheme (KBS)* on farmers in West Bengal, particularly during pandemic times. The scheme targeted to provide Assured Financial Assistance to all farmers (72.4 lakh) having one or more than one acre of land holding. Farmers are entitled for ₹ 5000 per annum (in two equal instalments during *rabi* & *kharif* season) assistance with minimum of ₹ 2000 per annum on pro-rata basis. The study indicated that 58 percent of the farmers in study area have benefited under the scheme with at least one or more installments with an average amount of ₹ 1757 (average of 3 installment) per installment during January 2019 to till April 2020. The cash receipt contributed up to 16 percent of input cost that were incurred by the farmers for growing crops. Over half of the beneficiary farmers (66%) of had utilized the cash for agricultural activities such as buying seeds, payment to labour, buying fertilizer and pesticide etc. It was concluded that such direct cash benefit scheme helped farmers to continue their agricultural operation even during the pandemic and lockdown situation due to COVID19 by reducing the input cost burden and the government should continue such scheme.

Keywords *Krishak bandhu scheme*, COVID19, agricultural income, direct benefit transfer

Empowering agri-startups: digitalization of agriculture through virtual mentoring

Sandipamu Raahalya[1*] and Saravanan Raj[1]
[1]National Institute of Agricultural Extension Management (MANAGE), Rajendranagar, Hyderabad, Telangana
Email: sandipamuraahalya@gmail.com

Digital transformation in agriculture presents unprecedented opportunities for achieving sustainable and inclusive growth in the farming sector. This study examines MANAGE's innovative digital mentoring initiatives through three key programs: Agri Startup Saturday Webinars, Digital Marketing Skills Training and Pre-incubation Mentoring Programs. The research analyses comprehensive data from 240 participants (80 participants from each program) to evaluate the effectiveness of virtual mentoring in fostering agri-entrepreneurship. Through structured online learning modules, expert-led webinars, and personalized digital mentoring sessions, MANAGE has created a virtual ecosystem for aspiring entrepreneurs. The analysis focuses on three critical dimensions: awareness creation, knowledge management, and promotion of best practices in the agri-startup ecosystem. The findings demonstrate how virtual mentoring has democratized access to entrepreneurial resources by reducing geographical barriers. The study provides insights into scaling up digital mentoring models for fostering innovation and entrepreneurship in agriculture while addressing critical challenges in the agri-startup ecosystem.

Keywords Digital agriculture, virtual mentoring, agri-startups, knowledge management, entrepreneurship development

Impact of augmented kisan credit scheme on crop and livestock in Maharashtra

Vishwanath[1], Anbukkani Perumal[1*] and Pramod Kumar[1]
[1]ICAR-Indian Agricultural Research Institute, New Delhi
Email: anbueconomic@gmail.com

Credit plays a pivotal role in the advancement of agriculture within India. The Kisan Credit Card scheme represents a significant initiative within the banking sector aimed at fostering agricultural credit and facilitating financial inclusion. This research was conducted with specific objectives: To study the growth and performance of Kisan Credit Card in India and to analyze the impact of KCC on farm income. The study utilized secondary data concerning Kisan Credit Cards issued and the outstanding amounts collected from various sources, including NABARD, RBI, and indiastat.com, among others. Primary data were gathered from 180 farmers through personal interviews in the Latur district of Maharashtra, alongside insights from 30 key informants within the study region. Analytical methods employed included linear regression models, regression adjustment models, rank-based quotient, binary logit models, and NVivo software. The Kisan Credit Card (KCC) scheme in India has seen remarkable growth since its inception, evolving into a vital financial tool that enhances credit access for farmers engaged in both crop and livestock farming. By the end of 2022-23, the scheme had issued 7.35 crore KCCs, with an annual growth rate of 11.73 per cent, and an outstanding credit amount reaching ₹ 8.86 lakh crore, indicating a robust CAGR of 21.72 per cent. In Maharashtra, the scheme has demonstrated substantial growth across Cooperative Banks, RRBs, and Commercial Banks, with an overall CAGR of 12.85 per cent for card issuance and 22.11 per cent for the outstanding amount. KCC adoption positively impacts farm profitability, leading to higher yields, increased investment in productive areas, and improved net returns. In soybean cultivation and livestock farming, KCC beneficiaries show higher net income compared to non-beneficiaries, highlighting their role in financial stability and agricultural productivity. Key factors influencing farm income include labour, input costs, landholding, family size, and KCC adoption.

Keywords Agricultural credit, kisan credit card, utilization of credit, interest subvention scheme, regression adjustment model

Examining the role of cooperatives in improving market access for smallholder farmers

Dharni Sahu[1*], Avan Das Sahu[2] and Aashi Sarva[3]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: dharnisahu23@gmail.com

Agricultural cooperatives in India serve as a crucial tool for improving market access for smallholder farmers. By pooling resources, cooperatives enable farmers to secure better prices, reduce marketing costs, and access larger, more profitable markets. These cooperatives also offer vital services such as input supply, training, and financial assistance, all of which enhance productivity and long-term sustainability (Shah, 2014). Additionally, they help mitigate risks such as market volatility and climate change, while fostering collective decision-making. This study explores the role of cooperatives in improving market access in states of Kerala and Maharashtra (Kumar et al.,2017).

Keywords Cooperatives, smallholder farmers, market access, India, agricultural development, sustainability

Impact of rural self-help group women in the development of sustainable agriculture in Chhattisgarh

Amar Nath Taram[1*] and Devendra Kumar Kurrey[2]
[1]Kalinga University, Nawa Raipur
[2]LM College of Agriculture and Research Station, Narayanpur (IGKV Raipur)
Email: amarnathtaram.3003@gmail.com

Rural women Self-Help Groups (SHGs) in Chhattisgarh are driving substantial progress in sustainable agriculture, significantly impacting both local livelihoods and environmental sustainability. This study explores the influence of SHGs on shifting traditional agricultural practices towards more sustainable methods, using data gathered from 1,200 SHG members across five districts, supplemented by government records and SHG reports. Findings reveal that approximately 65% of SHG members have adopted organic farming techniques, resulting in a 35% decrease in the use of chemical fertilizers over five years. This transition supports soil health, reduces input costs, and stabilizes incomes, fostering long-term sustainability for smallholder farmers. Indigenous crop preservation also plays a key role, with 78% of SHGs engaged in seed conservation, cultivating over 15 resilient native crop varieties that are better adapted to local climatic conditions. This practice boosts biodiversity, enhances food security, and reduces reliance on external inputs. SHG-led water conservation practices, such as rainwater harvesting and drip irrigation, have also led to a 25% reduction in water use across 58% of SHG-managed farms, addressing water scarcity challenges and increasing agricultural resilience. Climate resilience strategies have also gained traction among SHGs, with 55% adopting agroforestry and crop rotation to counteract climate variability. SHGs have successfully leveraged government schemes such as the National Rural Livelihood Mission (NRLM) and Pradhan Mantri Fasal Bima Yojana, benefiting 70% of SHG households with financial aid and crop insurance. Nevertheless, challenges remain, including limited access to larger credit options, advanced technology, and strong market infrastructure, which could further amplify SHG contributions. In conclusion, women-led SHGs in Chhattisgarh serve as pivotal agents in advancing sustainable agriculture, contributing to ecological preservation, economic resilience, and improved food security in rural communities. Their collective initiatives position SHGs as vital players in building a sustainable agricultural future, meriting increased support to overcome existing barriers and maximize their impact. To enhance the impact of SHGs on sustainable agriculture, the government should increase access to affordable credit and technology for SHG women, enabling them to adopt advanced farming practices. Additionally, building rural market infrastructure and providing dedicated marketing channels for SHG produce would improve income stability and reduce dependence on intermediaries. Finally, expanding training and support programs focused on organic farming, water management, and climate resilience will empower SHGs to continue as leaders in sustainable rural development.

Keywords Sustainable, self-help groups, organic farming, NRLM, rural development, policy recommendations

Governance and institutional support: driving sustainable change

Sadhna Xalxo[1*] Anisha Ekka [1] and Anusha Toppo[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: xalxosunny99@gmail.com

Governance and institutional support are critical in transforming agricultural extension services to drive sustainable change. Effective governance ensures transparency, accountability, and participatory decision-making, fostering an enabling environment for innovation and knowledge dissemination. Strong institutional support enhances the capacity of extension systems to address farmers' needs, promote sustainable practices, and adapt to emerging challenges like climate change and resource scarcity. This paper examines the role of governance and institutions in strengthening agricultural extension services, emphasizing collaborative models, policy reforms, and technology integration. By bridging gaps and fostering resilience, effective governance can empower extension systems to sustainably enhance agricultural productivity and livelihoods.

Keywords Governance, institutional support, extension, technology

A study on the relevance and impact of KMAS on farmers' decision-making in agriculture

Chandra Kumar[1*], S.K. Joshi[1], Akash Tiwari[1] and Abhishek Jain[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: chandrakumarv054@gmail.com

The study on Kisan Mobile Advisory Services (KMAS) reveals that this innovative agricultural extension initiative has been successful in delivering valuable information to farmers in India. The majority of beneficiaries, who were predominantly middle-aged, educated, and engaged in agriculture as their main occupation, found messages on crop protection, particularly insect and disease management, to be most useful. However, despite the usefulness of KMAS, several constraints were identified, including the use of technical terminology, limited access to relevant information, risk aversion, poor connectivity, and difficulties in operating mobile devices. To overcome these challenges, beneficiaries suggested a range of improvements, including receiving messages in local languages, simple and understandable content, regular message delivery, consideration of local needs and preferences, and the provision of voice message facilities. By addressing these concerns and refining the service, KMAS can further enhance its impact on agricultural productivity, farmers' decision-making abilities, and ultimately, their livelihoods.

Keywords Kisan Mobile Advisory Services, decision making

The impact of farmer producers' organizations on resource use efficiency in vegetable crops of Jammu & Kashmir

Diksha Bali [1], Jyoti Kachroo[2], Sumit Sutradhar[3] and Parul Barwal[4]
[5]ICAR- National Institute of Agricultural Economics and Policy Research, New Delhi-110012
[2]Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu & Kashmir, India, 180009
[3]ICAR-Indian Agricultural Research Institute, 110012
[4]Khalsa College Amritsar, Punjab, 143002
Email: balidiksha7@gmail.com

This study investigates the impact of Farmer Producers Organizations (FPOs) on resource use efficiency in vegetable production in the Jammu region of Jammu & Kashmir. Data from 300 farmers, including 150 FPO members and an equal number of non-members from Udhampur, Reasi, and Doda districts, were analyzed using a Cobb-Douglas production function. The study examines the relationship between resource inputs (labor, manure, fertilizers, plant protection chemicals, irrigation, and seeds) and gross returns for key crops, including brinjal, potato, and radish. The findings show that FPO membership improves resource use efficiency, with members achieving higher returns and better resource allocation than non-members. Members underutilize inputs like manure and fertilizers while overusing plant protection chemicals, whereas non-members show a less optimal use of key resources. Stepwise regression models addressed multicollinearity, identifying significant factors such as seed, manure, and plant protection chemicals that affect returns. The study highlights the benefits of FPO membership in improving agricultural outcomes and recommends policies to support FPO formation, empower farmers, and promote sustainable agricultural growth in the region.

Keywords FPO, resource use efficiency, vegetable crops, impact, Jammu & Kashmir

Impact of government schemes on handloom weavers

Shraddha Nayak[1*]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: shraddhanayak27@gmail.com

The government of India offers a variety of schemes and programs to support the handloom industry, including National Handloom Development Programme (NHDP), a scheme to help handloom weavers become a self-managing, competitive, and sustainable socio-economic unit. The scheme supports weavers with raw materials, design inputs, marketing support, and technology up gradation. Comprehensive Handloom Cluster Development Scheme (CHCDS) is implemented for the development of Mega Handloom Clusters covering at least 15000 to 25,000 handlooms. The financial assistance was provided as a government contribution of between Rs 400 billion and Rs 700 billion will be provided over five years. Handlooms form the highest employment generating, labor-intensive and export-oriented industry especially in rural and semi-urban areas in India. Central and State government scheme. Cross-sectional descriptive research was adopted to determine the awareness of weavers against the various schemes like yarn supply scheme, integrated handlooms development scheme, Marketing & Export Promotion Scheme, Health Insurance Scheme, Mahatma Gandhi Bunkar Bima Yojana and assessing the extent to which core issues in weaving are addressed through these schemes. This study, thus, gives recommendations to tackle the bottlenecks of the schemes.

Keywords Handloom, government schemes

Unpacking the barriers: understanding low farmer engagement in farmer producer companies (FPCs) in India

Davis Augustine[1*] and Namrata Singha Roy[1]
[1]Christ (Deemed to Be University), Bangalore, India
Email: davis.augustine@res.christuniversity.in

Farmer Producer Organisations (FPOs) have emerged as a promising solution to address the challenges faced by small-scale farmers in India, with over 33,000 FPOs registered nationwide. This study delves into the issue of low farmer engagement with FPOs, focusing specifically on Farmer Producer Companies (FPCs). By analysing data from the Situation Assessment of Agricultural Households 2019 and the FPO dataset by the Tata Cornell Institute, this research highlights the limited impact of FPOs, with fewer than 1% of Indian farmers utilising their services. Despite their potential to enhance agricultural practices, provide access to inputs, streamline market linkages, and deliver technical support, FPCs have largely fallen short of expectations. Through a systematic evaluation, the study identifies three major barriers to member engagement: economic non-lucrativeness (44.9%), technical barriers (30%), and administrative displeasure (25.1%). Economic dissatisfaction arises from FPCs' inability to offer competitive prices, timely dividends, and input subsidies, while technical issues such as travel distances, fragmented services, and process inefficiencies exacerbate disengagement. Administrative concerns, including perceptions of corruption, lack of transparency, and inequitable practices, further alienate farmers. The findings emphasise the need for targeted interventions to address these challenges and enhance the effectiveness of FPCs. By rebuilding trust, improving operational efficiency, and aligning with farmers' expectations, FPCs can fulfil their foundational goal of empowering farmers and transforming rural livelihoods.

Keywords Farmers producer organisation, FPO penetration, ýnput supply, marginal farmers

Digital identity for farmers in India: An Aadhaar for financial inclusion

Vishalakshi Choubey* , Chayanika Hajong, Aparna Purohit
Department of Agricultural Extension Education, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh

*Email: choubeyvishalakshi@gmail.com

Indian agriculture has been fraught with exclusion with millions of farmers unable to avail credit, insurance and other formal financial services. The launching of Aadhaar, the singular identification vision of Indian authorities, arguably helps to address this divide. Recently, the government has envisioned unique digital ID's i.e "Kisaan Ki Pehchaan" for Indian farmers that will not only store a farmer's farming related information such as land records, livestock ownership, benefits received etc. but will also strengthen planning and extension services on the governments part. This study investigates the issues of governance and the role of institutional backing in the provision of digital identity to the farmers in the Indian context. Using a biographical approach, we examine the impact of this ID on the farmers' ability to receive loans, purchase financial insurance, utilize payment systems and engage in other economic activities. The investigation is also extended to understanding the governance and institutional mechanism necessary for the diffusion of digital identity such as privacy, security, and farmer-centric digital solutions.

Keywords Financial inclusion, services, governance

Climate Change and Resilience

Assessment of the agriculture sustainability index in Kumaun hills of Uttarakhand

Dhirendra Kumar and Hulas Pathak
Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh 492012
Email: dhiirenagrileco@gmail.com; hulaspathak@rediffmail.com

Climate change and vulnerable ecosystems provide serious sustainability issues for Uttarakhand's Kumaun Hills. Using a comprehensive index based on 28 agroecological variables spanning six dimensions—physical resources, financial resources, human resources, social resources, livelihood diversity, and information accessibility—this study assesses agricultural sustainability in the area. Significant variation in resource accessibility is found between elevations according to the research, with extremely high hills having the lowest sustainability (index score: 0.410) and low hills having the greatest (index score: 0.561). worse scores in the Physical Resources and Financial Resources Indices lead to worse sustainability in extremely high hills, whereas the Livelihood Diversity Index and Information Accessibility Index are critical for greater sustainability in low hills. The Agriculture Sustainability Index (ASI) and the Information Accessibility Index (IAI) (r = 0.92*), as well as the Physical Resource Sustainability Index (PRSI) (r = 0.85*) and Financial Resources Index (FRI) (r = 0.76*), exhibit strong positive correlations, indicating the significance of information access and financial and physical resources, according to the indices' validation. On the other hand, the Social Resources Index (SRI) primarily shows non-significant connections, suggesting a little direct influence on sustainability as a whole. These results highlight the necessity for focused interventions that are altitude-specific in order to improve sustainable development in the Kumaun Hills.

Keywords Kumaun Hills, agriculture sustainability index, accessibility index and altitude

An empirical evaluation of farmers' climate change awareness and adaptation strategies in Haryana

Manpreet Kaur[1], DP Malik[2], A. Amarender Reddy[3] and Monika Devi[2]
[1]ICAR- Central Institute for Arid Horticulture, Beechwal, Bikaner 334006, India
[2]CCS Haryana Agricultural University, Hisar, Haryana 125004 India
[3]ICAR- National Institute of Biotic Stress Management, Raipur, Chhattisgarh 493225
Email: manpreet.kaur1@icar.gov.in

Climate-smart agriculture (CSA) is an approach aimed at enhancing sustainable agricultural productivity, climate adaptation, and reducing greenhouse gas emissions. It comprises five major components: carbon and energy-smart, knowledge-smart, nutrient-smart, water-smart, and weather-smart technologies. A purposive multistage sampling technique was used to select cultivators from climate-smart villages (CSVs) and non-CSVs in Kurukshetra and Sirsa districts. Awareness levels were generally higher among CSV cultivators, with some variation in non-CSV cultivators' awareness, especially in Sirsa district. CSV cultivators exhibited higher adoption of CSA technologies, with improved varieties and laser land levelers being equally preferred, while other technologies were more widely adopted among CSV beneficiaries and less among non-CSV cultivators.

Keywords Adoption, adaptation, climate smart agriculture, climate smart villages, Heckman treatment effect model

Spatio-temporal dynamics and valuation of agricultural ecosystem services in Eastern India

Suvangi Rath[1], Kiran Kumara T. M.[2], Amarendra Das[3] and Khitish Kumar Sarangi[4]
[1]Indian Council for Research on International Economic Relations, New Delhi
[2]ICAR-NIAP, New Delhi
[3]School of Humanities and Social Sciences, NISER, Bhubaneswar, India, Homi Bhabha National Institute, Mumbai
[4]Department of Agricultural Economics, Odisha University of Agriculture and Technology, Bhubaneswar
Email: suvangi.rath@gmail.com

Demographic, economic, social, and climatic changes are exerting increasing pressure on natural resources due to growing global demands for energy, food, and water. This threatens the well-being of the ecosystems we rely upon. To shift towards sustainable development, strategic decisions on natural resources need to be better valued and responsibly managed. Given that ecosystems can provide mitigation and adaptation services, the policies and local initiatives related to ecosystem management should integrate both climate change strategies and avoid trade-offs between them. Our study aims to map and study the land use land cover (LULC) dynamics of ecosystem services in the rainfed and irrigated ecosystems of Eastern India using ArcGIS and the equivalent factor valuation method. The LULC change revealed that the agricultural ecosystem did not increase over the years rather in Bungapali village, there was a decrease in the agricultural ecosystem due to conversion into built-up areas. The absolute change in the values of different ecosystem services between 2005 and 2020 was $66431/ha/year. We also estimated the monetary values of irrigated and rainfed paddy ecosystems. It was concluded that the irrigated paddy ecosystem delivered higher net ecosystem services ($4107/ha/year) than rainfed paddy ecosystems. Our study suggests that policies should mainstream the valuation and preservation of ecosystem services into national development plans, promote sustainable agricultural practices, and enhance climate resilience through ecosystem-based approaches. Incentivizing farmers through payment for ecosystem services is necessary to enhance the supply of ecosystem services to society. Further, incorporating ecosystem service valuation into economic decisions, strengthening environmental governance, and increasing public awareness are critical steps. This integration will not only support specific SDGs related to poverty, hunger, health, and climate action but also foster a holistic approach to achieving all 17 SDGs, leading to a more resilient and sustainable development of agroecosystems.

Keywords Agriculture, Ecosystem Services, Land use/cover change, Valuation

Influence of Masculinity Norms on Adoption of Climate-Resilient Agriculture in Rural Punjab

Kala-Satheesh, Hari Krishnan[*], Krishna Vijesh V.[**]
[*]Uttar Banga Krishi Vishwavidyalaya, West Bengal
International Maize and Wheat Improvement Center (CIMMYT) Hyderabad

This study examines the impact of masculinity norms on the continued adoption of climate-resilient agricultural practices among smallholder farmers in rural Punjab, India. Qualitative interviews from 2022 and 2023 reveal that ideals of masculinity strongly influence farming success, with attributes like strength, resilience, and self-reliance driving technological decisions. For example, technology adoption is often cautious and selective; farmers tend to trial innovations, such as the conservation agriculture machinery "Happy Seeder", on a small scale before expanding, aligning with the notion of a "real man" who avoids unnecessary risks. Social respect and community reputation are key, as failure in technology adoption can lead to ridicule, particularly for smallholders, reinforcing hesitation. Traditional masculinity norms also marginalize women's roles in decision-making, further hindering sustainable farming efforts. This study highlights the need for policies that address gendered expectations in farming, fostering inclusive practices that encourage both climate resilience and equitable participation across genders.

Keywords Masculinity norms, climate resilient practices, community reputation

An assessment of the economic and social impacts of Climate Change Knowledge Networks in Agriculture (CCKN-IN)

Bhaskar[1], Anugu Arun Reddy[2*] K V Praveen[3] and A. A. Reddy[4]
[1]National Institute of Agricultural Extension Management (MANAGE), Hyderabad-30
[2]Indian Institute of Technology, Gandhinagar-382055
[3]ICAR-Indian Agricultural Research Institute, New Delhi, 110012
ICAR-National Institute of Biotic Stress Management, Raipur-493225

This study evaluates the economic and social impacts of the Climate Change Knowledge Network in Indian Agriculture project, which was implemented across three Indian states—Jharkhand, Maharashtra, and Odisha. The project aimed to bridge the gap between climate science and agricultural practices by disseminating climate-smart agricultural knowledge to farmers. A multistage random sampling approach was employed to collect data from 273 farmers, including both project beneficiaries and control farmers. Key indicators such as adoption rates of climate-smart practices, access to advisories, and economic outcomes were analyzed. The findings indicate that farmers in project villages reported significantly higher access to climate-adaptive advisories and demonstrated greater adoption of climate-smart agricultural practices compared to control villages. Furthermore, the project positively contributed to farmers' income, food security, and social capital. The financial benefits were calculated using the Partial Budgeting method, and simulation analyses projected potential economic gains based on different adoption and diffusion scenarios. Overall, the CCKN-IA project showed a notable impact on agricultural resilience, underscoring the importance of knowledge networks in supporting climate change adaptation in agriculture. The results suggest that expanding such initiatives could further enhance the adaptive capacity of vulnerable farming communities in India.

Keywords Climate change knowledge networks, economic impact, knowledge dissemination, rural development

Promote agritourism

Iba Thanwal and Pawan Kumar Sharma

Agritourism refers to visiting agricultural, horticultural, animal husbandry, or agri-enterprises for leisure, education, or active participation. Agritourism is gaining popularity among young Agripreneurs looking to convert a section of their farm into a tourist destination for visitors and learners. However, worldwide initiatives to bring eco-friendly agriculture into mainstream tourist are long overdue. Agri-tourism is a way of sustainable tourist development and multi-activity in rural areas through which the visitor has the opportunity to get close awareness with agricultural areas, agricultural occupations, local products, traditional food and the daily life of the rural people, as well as the cultural elements and traditions of the local communities. Upscaling agribusiness requires policy and research support to ensure long-term economic viability for small and medium farmers, particularly in India. Tourism can generate significant employment and income opportunities for both skilled and unskilled workers. Promoting tourism has several benefits, both direct and indirect. Agri-tourism may promote sustainable tourist growth and increase activity in rural regions. The establishment of such centres has increased income for farmers and created job opportunities for rural youth. However, there are some issues with the process. To support agricultural development and increase farmer income, the government and related authorities should support these activities in India. Farmers should also establish their own co-operative societies.

Keywords: Agritourism, Sustainable, Farm tourism, Employment, Eco – friendly, Agri-preneurs.

Redefining Agriculture: Community-Managed Natural Farming for a Sustainable Tomorrow

Praneeth Talam, Yash Srivastava, Debapriya Chanda, Saikumar C. Bharamappanavara, Biswaranjan Baraj, Aniruddha Brahmachari, Kishore Kumar illa , Vinuthna Patibandla
Sambodhi Research and Communications Pvt. Ltd.
Email: saikumar@sambodhi.co.in

India is battling the twin challenges of Land Degradation and Biodiversity Loss, which have long-term implications on soil productivity, leading to food insecurity, higher food prices, climate change, and biodiversity loss. One solution actively promoted is Sustainable agriculture systems. The Government of Andhra Pradesh launched the Andhra Pradesh Community Managed Natural Farming (APCNF) program in 2016. Based on Zero Budget Natural Farming (ZBNF) and agroecology, APCNF is implemented through the Rythu Sadhikara Samstha (RySS). The program promotes sustainable farming practices, participatory land use management, and an efficient supply chain. Sambodhi, commissioned by Rainforest Alliance- [Global Environment Facility (GEF) funded] evaluated the adoption of Community Natural Farming (CNF) practices among smallholder farmers in Andhra Pradesh. Using a quasi-experimental design and mixed methods approach, the study included 430 farmers practising CNF and a control group of 430 farmers practising conventional farming. The control group was selected using Propensity Score Matching to ensure similarity in socio-demographic characteristics. We found that CNF practices led to lower production costs and higher yields for crops like paddy, black gram, and cashew. However, CNF farmers often faced challenges with market access and fair pricing. Advisory services played a crucial role in CNF adoption, though access to digital advisory services remained limited. Farmers reported benefits of improved soil health, but some faced challenges with labour demand and initial learning. Stakeholders highlighted the importance of strengthening partnerships with government agencies for long-term success. Recommendations include improving market access, ensuring affordable organic inputs, and enhancing collaboration between government and local institutions to promote sustainable agriculture.

Keywords Land degradation, CNF practices, Sustainable Agriculture Practices (SAPs), Propensity Score matching

Organic farming in Una district: Addressing barriers to adoption and empowering women farmers

Vandana Thakur, Yashwant Singh and Pratiksha Rana
SKUAST-Jammu and Dr. YSPUHF, Nauni, Solan
Email: Vandnathakur5011@gmail.com

Organic farming is becoming a sustainable way of farming nowadays. Organic farming is proven to more a lifesaver. So, there is a need to study organic farming in Una District. Farming proves to be more productive especially in women empowerment as most of the women are engaged in farming. The organic industry is one of the most flourishing industries these days. Most of farmer knows about organic farming but they hesitate to adopt the technique due to reasons like high investment, cost-effectiveness, the low and late output of the produce, non-availability of a buyer, and lack of proper R & D all these problems contribute to non-adoption of organic farming. Major constraints faced by respondents in the cultivation of organic farming were lack of knowledge about organic plant protection management, high cost of organic manures and biofertilizers, lack of demand for organic produce in the local market, and lack of skill regarding preparation and usage of organic inputs. The other variables such as size of family, farm size, annual income and organic farming experience had no association with their attitude towards organic farming. The government must address these issues to make organic farming more fruitful for the nation and help employ more youth. So, awareness of farmers towards organic farming is necessary to convert chemical farming into organic farming.

Keywords Organic farming, Adoption barriers, Women empowerment, Sustainable agriculture

Beyond prescription: Gendered analysis of farmer preferences for climate-resilient cropping systems in Bihar

Babita Kathayat[1], A.G. Adeeth Cariappa[2], R.K. Jat[3], Vijesh V. Krishnat
[1]ICAR-Indian Agricultural Research Institute, New Delhi
[2]Tamil Nadu Agricultural University, Coimbatore
[3]International Maize and Wheat Improvement Center (CIMMYT), Hyderabad
[4]ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi
Email: babita.kathayat@example.com

Diversification is crucial for maintaining farming system productivity and ensuring food security in the Eastern Gangetic Plains of India. The public sector agricultural research and development (R&D) system is actively developing and promoting new cropping systems tailored to different agroecological conditions to enhance system resilience against climate change. However, the new farming systems are not always accepted, and the reasons behind them are poorly understood. We evaluated farmers' preference for fourteen proposed cropping systems using data from 751 gender-disaggregated FGDs conducted across 380 villages in Bihar. Farmers' preferences showed significant divergence from prescribed systems, with significant gender-specific preference heterogeneity. Men were more likely to prefer diversified cropping systems, while women consistently opted for conventional rice-wheat based rotations. Understanding the gendered reasons behind resistance and scepticism toward the new cropping systems, and creating awareness around those underlying factors, is crucial to ensure inclusive and effective dissemination of climate-resilient cropping systems.

Keywords: Farmer preference, gender, cropping systems, climate-resilient agriculture

Effects of crop Residue Burning on Biodiversity: An Exploratory Review

Parambil Peedika, Ashiq Krishna, Vijesh V.
International Maize and Wheat Improvement Center (CIMMYT), Hyderabad

Residue burning is known to harm human health, yet its impact on agrobiodiversity is less understood. Compiling findings from 36 global studies, we assess the effects of residue burning compared to non-burning residue management practices to evaluate biodiversity responses. Beneficial organisms such as natural predators, parasitoids, and decomposers responded negatively to residue burning. Conversely, parasitic nematodes and plant pathogenic fungi displayed increased abundance following residue burning. While most studies recorded the population and community traits of organisms, other life history traits were mostly ignored. Additionally, pollinator arthropods and higher trophic level organisms were greatly ignored from the studies. Nonetheless, these findings underscore the ecological trade-offs associated with residue burning and emphasize the ecosystem-friendly alternative management practices, particularly in mitigating agriculture's contributions to air pollution and climate change. Importantly, the review highlights that adopting non-burning residue management practices could enhance beneficial soil biodiversity, potentially improving soil health and crop productivity.

Keywords Crop residue, community traits, air pollution

Impact of climate change on garlic, ginger, and potato crops in Himachal Pradesh: Vulnerability and adaptation strategies

Pardeep Singh[1*] and Manoj Kumar Vaidya[2]
[1]ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi
[2]Department of Social Sciences, Dr. YSP UHF, Nauni, Solan, Himachal Pradesh
Email: pardeepmahal1994@gmail.com

The production of root crops in the low and mid hills was highly vulnerable to the climatic vulnerability. The study evaluated the Agricultural climatic vulnerability index (ACVI) for the 51 blocks in the regions using a conceptual framework of IPCC AR4. The developmental blocks were categorised into three strata (Low, Moderate and high vulnerable strata) to collect the primary data. A multistage stratified random sampling technique was employed for collect of the data with pre-tested questionnaire. The ACVI findings reveal that the Balh Valley is the most climate-vulnerable block, while Paonta Sahib is the least. Vulnerability mainly caused by the temperature in the Kharif and Rabi season of exposure dimension. The farm income measure revealed that crop feasibility was decreased from low to high vulnerable strata. Maximum temperature and rainfall significantly negatively impacts the crop net returns of garlic and potato crop. Increase in the minimum temperature significantly rises the crop profitability. A The non-linear relation observed between maximum and minimum temperature. The balanced use of fertilizer application, NK ratio, pesticide, crop diversification and percent of irrigated land were significantly mitigating the climate change impact in all the vulnerable strata. A significant difference was observed in the carbon sequestration level among the vulnerable strata which affects the crop sustainability. Farmers in these areas adopt various adaptation strategies, including crop diversification, nutrient management, varietal changes, and water conservation. To enhance resilience, the study highlights the need for improved technical understanding, capacity building, better agronomic practices, financial support, and comprehensive consultation within the agriculture and allied sector.

Keywords Adaptation, crop feasibility, carbon footprint, Impact, sustainability

Do climate variables influence fish production in top fishery economies? Evidence from the ARDL Approach

Jaganathan Maniselvam, Swadesh Prakash, Arpita Sharma, Radhakrishnan Kalidoss
Fisheries Economics, Extension and Statistics Division, ICAR – Central Institute of Fisheries Education (CIFE), Mumbai – 400 061, Maharashtra
Email**:** swadeshprakash@cife.edu.in

Climate change poses significant challenges to global food security, particularly within the fisheries sector, where fish production is highly sensitive to climatic variables. This study investigates the long-run and short-run impacts of climate change on fish production in four major fish-producing countries, China, India, Vietnam, and Bangladesh, using annual time series data from 1990 to 2020. Here, an Autoregressive Distributed Lag (ARDL) model was employed to explore the long-run equilibrium relationships between climate factors (precipitation, minimum, mean, and maximum temperatures, CO2 emissions) and total fish production, as well as their adjustments to short-run deviations. The findings reveal distinct patterns across countries: CO2 emissions positively influence long-term fish production in China, India, and Bangladesh, while precipitation boosts fish production in China and Bangladesh. In contrast, Vietnam shows no long-run equilibrium, indicating a higher sensitivity to short-term climatic fluctuations. In the short run, CO2 emissions significantly enhance fish production in Bangladesh, with regional temperature effects varying. Minimum temperature positively impacts long-term fish production in China but negatively affects it in Bangladesh. In Vietnam, increased maximum temperature enhance short-run production, while minimum temperature reduces it. This study examines the critical role of CO2 emissions, precipitation, and temperature in influencing fish production, offering key insights for policymakers to develop adaptive strategies for sustainable fish production amid climate change.

Keywords Climate change; fish production; ARDL model; Asian Countries

Climate change and food security: A vulnerability assessment for South Asia

Kota Karuna Sri[1], Vedamurthy K B[2], Kalidoss Radha Krishnan[3]
[1]Department of Agricultural Economics, University of Agricultural Sciences GKVK, 560065
[2]Department of Dairy Business Management, Dairy Science College, Hebbal, Bengaluru [3]Central Institute of Fisheries Education, Mumbai, 400061

Food security is vital for global development, yet over 800 million remain undernourished, with projections worsening due to climate change. This paper assesses food security vulnerability in South Asia using the Composite Vulnerability Index (CVI) for Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. Results show Afghanistan (Exposure Index: 0.5796) and Pakistan (Sensitivity Index: 0.599) as highly vulnerable, while the Maldives (Adaptive Capacity Index: 0.7298) exhibits strong resilience. These findings highlight the urgent need for region-specific strategies to mitigate climate change impacts and enhance adaptive capacity, ensuring food security and safeguarding livelihoods.

Keywords: Food Security, Climate Change, South Asian Countries, Vulnerability and livelihood

Unlocking agricultural growth in India: Climate resilience and productivity insights

Aamir Ahmad Teeli
Senior Research Fellow, Department of Economics, Central University of Tamil Nadu
Email: Imamireconomics@gmail.com

Productivity in agriculture sector has a direct impact on the per capita income (PCI) of agricultural employees. In India, where agriculture employs over half of the workforce, increasing productivity is of paramount importance. Furthermore, agriculture is crucial in providing food security to a large country with a sizable population like India. Climate change a common phenomenon in recent times has a potential to effect productivity of agriculture sector. To this end utilizing an ARDL bounds test approach this study attempts to examine long-term impact of climate change on agricultural productivity in India. The results show a strong positive relationship between rainfall and Agricultural total factor productivity in agriculture, and a negative impact of temperature and agricultural employment growth on productivity in agricultural sector. Moreover, agricultural productivity is positively impacted by overall economic growth. Findings from the long term are supported by the short term, and a strong equilibrating relationship is shown by an error correction term. This research highlights the significance of adopting climate-resilient agricultural practices and policies that encourage innovation, technology uptake, in order to improve agricultural productivity in India.

Keywords: Agriculture productivity, Climate change, Economic growth, ARDL, India.

Biodegradable plastic mulch: An eco-friendly solution for sustainable agriculture

Kriti Bais
Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya (IGKVV), Raipur
Email: kritibais@gmail.com

Biodegradable plastic mulch (BDM) offers an environmentally sustainable alternative to conventional plastic mulch by breaking down naturally in the soil. At the season's end, BDM can be tilled into the ground, where soil microorganisms decompose it into water, carbon dioxide, and biomass. This reduces plastic waste and eliminates the need for removal and disposal, promoting more efficient, eco-friendly farming. Additionally, BDM maintains essential agricultural benefits like weed control, soil moisture retention, and temperature regulation, aligning with sustainable agricultural practices.

Keywords: Biodegradable plastic mulch, sustainable agriculture, soil decomposition

Enhancing sustainable practices in regional vegetable farming: Insights from Jammu and Kashmir and Himachal Pradesh

Nikhil[1*], S A Wani[1], K Gautam[1], F A Shaheen[1], S Sarkar[2], Shubham[3]
[1]School of Agricultural Economics and Horti-Business Management, SKUAST Kashmir, Jammu & Kashmir-190025
[2]Senior Scientist, ICAR-IASRI, New Delhi-110012
[3]Department of Social Science, Dr. Yashwant Singh Parmar, University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh-173230
Email: nikhilchandel1994@gmail.com

India, the world's second-largest producer of fruits and vegetables, has significantly advanced its horticulture sector, establishing global agricultural prominence. This study compared the vegetable farming practices of tomato, cauliflower, and capsicum in Jammu & Kashmir (J&K) and Himachal Pradesh (H.P.), focusing on resource use efficiency and key constraints. Data were collected from 300 respondents, 150 from each state, selected from Srinagar and Budgam districts in J&K and Solan and Sirmaur districts in H.P. The Cobb-Douglas production function analysis revealed that J&K underutilized essential inputs like manure, pesticides, and fertilizers, particularly in capsicum and cauliflower production, leading to lower yields. In contrast, H.P. showed higher yields but faced issues of input overuse and underuse. For example, the net income per kilogram of tomatoes was ₹ 9.09 in J&K compared to ₹ 6.16 in H.P., and for cauliflower, it was ₹ 2.52 in J&K versus ₹ 4.29 in H.P. Capsicum production in H.P. achieved higher net income per kilogram at ₹ 17.90 compared to ₹ 9.43 in J&K. J&K demonstrated significant underuse of inputs in capsicum production, while H.P. showed overuse of seeds in cauliflower production. The Garrett ranking method identified major constraints such as the unavailability of high-yielding variety (HYV) seeds in J&K and high transportation costs in H.P. The findings indicate a need for smart agricultural technology (Agri-tech) solutions tailored to the unique constraints of each region, such as high-yielding seeds, real-time resource management systems, and smart logistics. This study underscores the importance of integrating Agri-tech innovations to improve productivity, profitability, and sustainability in vegetable farming across both states.

Keywords Resource use efficiency, net income, optimization, sustainability

Gender-based occupational segregation in India's green transition in agriculture

Ananya Chakraborty and Anjana Rajagopalan
Climate Resilience Practice, World Resources Institute

Across the world, efforts are being made to reduce the effects of climate change and limit the impacts of global warming. Achieving sustainability implies changing the ways in which economies and production processes are structured and changing them towards energy sources that reduce GHG emissions. This will imply the methods in which jobs and businesses are structured. Jobs and businesses that contribute to low-carbon pathways are included within the spectrum of 'green jobs.' The concept of green jobs was introduced by the International Labor Organization (ILO) in 2008 to address multi-dimensional threats of mitigating negative impacts of climate change through a low-carbon production pathway, while providing employment, addressing poverty, and reducing environmental degradation. Since then, the concept of 'green' jobs has been defined and explored in multiple ways to indicate processes and practices that contribute towards sustainable development, improve resource efficiency, and harmonize economic growth. In the Indian context, engages about 42 percent of the total labor force in the country, contributing to nearly one-fifth of national GDP. The agriculture sector is also the second-largest contributor of greenhouse gases (GHG) in India. In order to meet climate ambitions, India has taken several steps to fulfil global commitments and contribute to actions that limit GHG emissions from agriculture. Efforts like climate-smart agriculture, precision agriculture, and regenerative agriculture are some of the low-carbon pathways in agriculture that India is embarking on. We applied a mixed methods approach. At the national level, we draw from education, occupation, and wage data to map gender intersectional gaps in women and men's participation in agriculture, skilling, and training. We contextualize this against the persistent discrimination in ownership rights, accessing knowledge and technology, and decision-making and bargaining power due to structural and socio-cultural inequalities that women in Indian agriculture have faced. We also complement this with key informant interviews (10-15) with policymakers, practitioners, and researchers to understand how greening of the agricultural sector could exacerbate entrenched gender inequalities.

Keywords: Gender equity, green transition, climate-smart agriculture, sustainable practices, occupational segregation

The Indian carbon market: A win-win for farmers and the environment

Cheela Soumya[1], Akrithi Sharma[1], Asha Devi[1], K. V. Praveen[1], Nalini Ranjan Kumar[2]
[1]ICAR-Indian Agricultural Research Institute, New Delhi.
[2]ICAR- National Institute of Agricultural Economics and Policy research (NIAP), New Delhi
Email: soumyacheela141@gmail.com

Carbon farming, a pathway to sustainable agriculture, is increasingly promoted as a tool to combat climate change. However, farmers need incentives to adopt carbon farming practices, as these methods are costly, time-consuming, and unremunerative in short-run. The mechanism of carbon trading can be harnessed to support farmers in this transition and to incentivize them for their efforts in generating carbon credits. This study aims to provide an overview of carbon pricing and examine how farmers can be integrated into carbon trading under the framework of the Indian Carbon Market, established under the Energy Conservation (Amendment) Bill, 2022.

Keywords: Carbon trading, carbon farming, Indian Carbon Market, climate resilience and sustainable agriculture

Digital management for climate-resilient agriculture

Manoj Kumar Dara, Praveen Kumar Verma, Lalenpuii, M.J.S.L. Naga Durga
Department of Agricultural Economics, IGKV, Raipur, 492012
Email: manojkumar123@gmail.com

Climate-resilient agriculture (CRA) is increasingly vital in addressing the multifaceted challenges posed by climate change, which threaten global food security and sustainability. Digital management tools, such as data analytics, remote sensing, and the Internet of Things (IoT), have emerged as crucial enablers for enhancing CRA practices. These tools provide advanced capabilities for real-time monitoring, predictive analytics, and decision support, thus assisting farmers in adapting to fluctuating climatic conditions. This paper explores the integration of digital management in CRA by reviewing recent advancements, assessing their impacts on agricultural sustainability, and identifying both opportunities and challenges in implementing these technologies. The study aims to highlight how digital management can drive the evolution of more resilient agricultural systems in response to climate change.

Keywords Climate-resilient agriculture, Internet of Things

Mitigating greenhouse gas emissions from agriculture in Uttar Pradesh: Assessing the potential impact of climate smart agriculture

Saumya
Centre for the Study of Regional Development, Jawaharlal Nehru University, New Delhi 110067
Email: pandeyasaumya@gmail.com

Uttar Pradesh, located in Northern India, has immense potential to mitigate emissions provided improved agricultural practices are adopted by the farmers. In the present research, we have analyzed baseline estimates on crop output and associated emissions for three resource-intensive crops viz. paddy, wheat, and sugarcane grown across predefined zones in 75 districts in the state. The analysis is based on the activity data (a product of area under cultivation and estimated input-use intensities), which prompt a need to assess the existing technological interventions aimed at improving water, nutrient, and energy efficiency. We project the minimum extent to which recommended Climate Smart Agriculture (CSA) practices could mitigate baseline emissions from the chosen three crops. The CSA technologies that could improve input-use efficiencies in crop cultivation include laser land levelling (LLL), integrated nutrient management (INM), direct seeded rice (DSR), irrigation scheduling, and drip irrigation. These technologies are mapped across the predefined zones and crops based on their input-use intensity values. We develop a mitigation scenario following the adoption of these technologies, to estimate the extent to which emissions could be reduced and the potential increase in output. Reference estimates on the magnitude of yield improvements and input-use efficiencies were derived from the results of experimental studies. Assuming that only a fraction of cropland would adopt these technological interventions starting from 2020-21, results show that post-adoption supply estimates would exceed baseline counterparts due to improved yields. As the scaling-up of practices progresses, emissions are expected to decline during the adoption period, except in a few zones. For instance, post-adoption emissions from paddy in Zones 2 and 3 (high yield with low area and low yield with high area, respectively) are expected to increase until 2022-23, followed by a decline. Similarly, in case of wheat, emissions are projected to rise during the first three years of adoption and then decline in Zone 2. However, for sugarcane, emissions are expected to increase over the entire period through 2034-35 in Zone 2. During these years of rising emissions, the area under cultivation also may expand.

Keywords: Mitigation, climate-smart agriculture, input-use intensity, emissions

Promoting sustainable agriculture through maize diversification in Punjab: An economic and environmental perspective

Arshdeep Singh and Poonam Kataria

This paper evaluates the potential of maize as a diversification option for the agricultural system of Punjab, India, from both economic and environmental perspectives. The Green Revolution led to a paddy-wheat mono-cropping system, causing water depletion and environmental degradation. Our study, conducted across four major maize-producing districts in Punjab, utilized primary data collected from 240 farmers to analyze economic (cost concept) and environmental metrics (carbon and water footprints). The findings indicate that maize incurs costs comparable to paddy but offers a lower net return (¹ 9038/acre) due to prevailing market conditions. However, linking small-scale processors with maize farmers can significantly increase their profitability, reducing the net return gap with paddy to ¹ 5,232 per acre. Environmental assessments show maize has a 43% lower water footprint and a farm carbon footprint four times lower than paddy (958.1 kg CO2e/acre), primarily due to methane emissions from rice cultivation and crop residue burning. Shifting to maize can mitigate these emissions by more than 2.5 times, offering significant environmental benefits. The carbon sustainability index for maize stood at 2.0, compared to 1.5 for paddy, highlighting its potential to alleviate environmental burdens. Policy recommendations aim to enhance the maize value chain, boost farmer incomes, and sustainability by supporting high-yielding varieties, stabilizing prices, improving market access, and strengthening linkages with small-scale processors.

Keywords Agricultural Diversification, Agricultural Policy, Economic Feasibility, Environmental Sustainability, Value Chain

Climate change vulnerability: An assessment of extent of vulnerability on cropping intensity, irrigation intensity, and crop yields of major crops in Telangana, India

Ch. Ramya Sri[1], Kalla Ashok[2], K. Suhasini[3], B. Mohan Uday Raj, S. Shrine*

[1345]Department of Agricultural Economics, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, 500030

[2]Department of Agricultural Extension, Teaching Associate, College of Horticulture, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Rajendranagar, Hyderabad, Telangana, 500030

Email**:**ramyaayaansh8824@gmail.com

This research paper aims to present an integrated analysis of the agricultural, climatic, and demographic dimensions of climate change vulnerability to identify districts of Telangana at highest risk and to ascertain the influence of cropping intensity, irrigation intensity, and crop yields on climate change vulnerability. To achieve this, a climate change vulnerability index was formulated, considering 17 indicators with unequal weights assigned by domain experts following the Delphi technique. The study utilized 30 years of secondary data related to all the indicators mentioned in the study. The findings of the climate change vulnerability index identified Adilabad and Medak as the most vulnerable districts, while Warangal and Karimnagar were the least vulnerable. The study further established an inverse relationship between climate change vulnerability, cropping intensity, and mean paddy yield, implying that paddy is the most vulnerable crop to climate change. Therefore, advocating a shift from paddy to less climate-affected crops such as cotton is recommended.

Keywords Vulnerability index, demographic factors, agricultural factors, climatic factors, cropping intensity, irrigation intensity

Enhancing governance and institutional framework for sustainable agriculture: A pathway to resilient food systems

Shubham Kumar Thakur[1*], Hulas Pathak[2], Shubhi Singh[3], Vaibhav Laxmi Tiwari[4], Navinkumar[1]

[1]Mahant Bisahu Das College of Horticulture and Research Station, GPM, Chhattisgarh 495117
[2]Department of Agricultural Economic, IGKV Raipur, Chhattisgarh 492012
[3]College of Horticulture and Research Station, Kunkuri, Chhattisgarh 496225
[4]ICAR-National Institute of Biotic Stress Management, Baronda, Chhattisgarh 493225
Email: shubhamcks@gmail.com

Effective governance and robust institutional frameworks are vital for sustainable agriculture, tackling issues like climate change, resource degradation, and food insecurity. With 40% of the global population unable to afford a healthy diet and agricultural greenhouse gas emissions rising by 6% in 2023, innovative governance models are urgently needed. Global investment in agricultural R&D remains critically low, with many nations allocating less than 1% of agricultural GDP, far below the 2% recommended threshold. India's Pradhan Mantri Krishi Sinchayee Yojana improved water use efficiency by 20%, while Ethiopia's ultra-poor graduation program reduced climate vulnerabilities by 50%, showcasing the potential of targeted policies. Key findings highlight the importance of decentralized governance, increased R&D investment, and inclusive policies for marginalized groups. Collaborative efforts among governments, private sectors, and civil society are essential to achieve SDGs, combat climate change, and ensure global food security.

Keywords: Sustainable Agriculture, Governance, Climate Resilience.

Enhancing climate resilience through digital agriculture

Rishabh Kumar

Department of Agricultural Economics, Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, 492012
Email: mailforishabh@gmail.com

The impacts of climate change necessitate revolutionary agricultural strategies. This research investigates how digital solutions, including precision farming, satellite imaging, and mobile technology, can bolster climate-resilient agriculture. By optimizing resource allocation and predicting disease outbreaks, digital management yields substantial benefits: 20-30% yield increases, 30-50% water conservation, and 10-20% income growth for farmers. This study highlights digital management's pivotal role in safeguarding global food security in the face of climate uncertainty.

Keywords: Climate-Resilient Agriculture, Digital Agriculture, Precision Farming, Sustainable Practices

Framework for climate-smart rice cultivation: Policy and governance solutions

Vaibhav Laxmi Tiwari[1*], Shubham Kumar Thakur[2], Vivek Kumar Singhal[3] & Shubhi Singh[4]
[1]ICAR-National Institute of Biotic Stress Management Baronda, Chhattisgarh 493225
[2]Mahant Bisahu Das College of Horticulture and Research Station GPM, Chhattisgarh-17
[3]College of Agriculture and Research Station Mahasamund, Chhattisgarh 493445
[4]College of Horticulture and Research Station Kunkuri, Chhattisgarh 496225
Email: vibhatiwari131998@gmail.com

Rice farming, essential for global food security, significantly contributes to methane emissions due to waterlogged conditions. This study examines governance's role in mitigating these emissions, comparing Chhattisgarh and India from 2001 to 2022. Methane emissions rose by 15.34% in Chhattisgarh (155.88 to 179.80 thousand tonnes/year) and 3.51% in India (1,848.76 to 1,913.68 thousand tonnes/year), with an average emission rate of 41.35 kg/ha/season. Agriculture accounts for 54% of anthropogenic methane emissions, highlighting the urgent need for sustainable practices. The study emphasizes institutional support, effective water management, and robust policies as key to reducing emissions. Recommendations include farmer training, cross-sectoral collaboration, and governance reforms to encourage eco-friendly farming. Mitigating methane emissions is critical for addressing climate change while sustaining agricultural productivity. This research underscores governance as a cornerstone for achieving systemic change in sustainable agriculture.

Keywords Governance, Institutional Support, Methane Emissions, Sustainable Agriculture, Climate Change Mitigation

Linking economic, environmental and social factors to agricultural sustainability: A state-level study in India

Simarjot kaur, Jitender Mohan Singh and Sunny Kumar
Department of Economics & Sociology, Punjab Agriculture University Ludhiana-141004
Email: Simarjotkaur755@gmail.com

The present study assesses agricultural sustainability using economic, environmental, and social factors. Agricultural Sustainability Index was developed mainly based on 17 indicators. Data were collected from various secondary sources and standardized through the indicator approach. The results revealed Kerala (0.56) as the most sustainable state, followed by Uttarakhand (0.54) and Punjab having index value of 0.5. Bihar (0.26), Odisha (0.3), and Uttar Pradesh (0.32) ranked the lowest in agricultural sustainability index. Further the study constructed model using regression approach to strengthen the argument of significant. Forest area, livestock density, household monthly income, irrigation intensity and literacy rate are positively associated ($p<0.1$) with improved agricultural sustainability. Whereas agriculture land use intensity, chemical use intensity, population density, IMR, area under small & marginal land holding and population under poverty line have negative relationship with agricultural sustainability. The study suggested that a regular assessment of agricultural sustainability is required and this index can be useful for effective state-specific policy decision making.

Keywords Agriculture, Index, India, Indicators, Sustainability

Valuation of carbon sequestration potential of stabilized sand dune in the Thar desert

R S Shekhawat, Dinesh Kumar, V S Rathore, and N R Panwar
ICAR-Central Arid Zone Research Institute, Regional Research Station, Bikaner-334004
Email: ravindra.shekhawat@icar.gov.in

The Thar Desert, located in the arid western part of Rajasthan and extending into Gujarat, Punjab, and Haryana, is characterized by extensive sand dunes that pose serious threats to transportation, communication, agriculture, industry, and settlements. The mobility of these dunes disrupts infrastructure and diminishes land productivity. In response, the Central Arid Zone Research Institute (CAZRI) developed Sand Dune Stabilization (SDS) techniques, which have been widely adopted by the government of Rajasthan and neighboring states. These techniques involve planting native grasses, shrubs, and trees that anchor the sand and reduce dune mobility. This study assesses the impact of SDS on carbon sequestration across key districts of the Thar Desert—Bikaner, Jaisalmer, and Churu, which have the largest areas of sand dunes. Data was collected from stabilized and unstabilized dunes to evaluate carbon sequestration in soil and plant biomass. Plant samples (roots, trunks, height) were collected and carbon sequestration was estimated using allometric equations. The results reveal that stabilized sand dunes sequester more carbon than unstabilized ones, with an average of 60.6 Mg C ha{ ¹ for stabilized dunes compared to 49 Mg C ha{ ¹ for unstabilized dunes—a 24% increase in carbon accumulation. This increase amounts to 11.7 Mg ha{ ¹ more carbon in stabilized dunes across the region. Soil organic carbon stocks varied by district, following a rainfall gradient, with Churu showing the highest levels, followed by Bikaner, and Jaisalmer. However, Jaisalmer had higher inorganic carbon and total carbon stocks compared to the other districts. The monetary value of this additional carbon sequestration was calculated for an area of approximately 4.35 lakh hectares. Using a value of US$ 80 per ton of CO, and an exchange rate of Rs. 83 per US dollar, the total value of carbon sequestered was estimated at Rs. 12,409 crores—Rs. 5,847 crores from soil carbon and Rs. 6,562 crores from plant biomass.

Keywords Sand dune stabilizations, Carbon Sequestration, Thar Desert

Sustainable agricultural development priorities of Indian states

Prem Chand, Kiran Kumara TM, Suresh Pal and Kalu Naik
ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi-12

Stakeholders including development experts, policymakers and agri-food entrepreneurs rely on reliable data to make informed decisions that enhance the sustainability of agricultural production systems. This study identifies sustainable agricultural development for major Indian states. The study uses secondary data available in the public domain and employ composite indicator framework encompassing natural resource (soil, water and biodiversity) and socio-economic dimensions. The findings revealed that, at national level, improving socio-economic dimension should be the top priority followed by water resource dimension. Among the 24 major states, Rajasthan immediate attention followed by Telangana, Jharkhand and states falling under Indo-Gangetic Plains. The study further identifies specific areas for improvement and providing a solid foundation for policy recommendations.

Keywords Sustainable agricultural development, socio-economic dimensions

Climate change and livelihood vulnerability of rural mountain communities in West Bengal and Sikkim

Pranay Sharma and Govinda Choudhury
Department of Economics, University of North Bengal
Email: spranay81@gmail.com

Rural mountain communities are particularly at risk from climate change due to their high exposure to multiple hazards and heavy reliance on natural resources. This research aimed to assess the livelihood vulnerability of mountain communities in the Eastern Himalayas, specifically in West Bengal and Sikkim. It sought to understand the factors contributing to their vulnerability and identify the adaptive strategies used by households. A total of 320 household samples were collected across four villages: two from Darjeeling district, one from Kalimpong district, and one from West Sikkim district. The Livelihood Vulnerability Index (LVI) and the IPCC-Livelihood Vulnerability Index were employed to assess the levels of vulnerability in the region. The findings revealed that different villages exhibit varying degrees of vulnerability based on their altitude and local conditions. High climatic exposure, increased crop loss, intervention of alien species, low market value of the agricultural product and limited job opportunities were the factors responsible for high vulnerability. The study highlights the need for better-improved agriculture support, livestock expansion, better irrigation facilities, establishment of organic certification and a robust market system to enhance farmers' resilience.

Keywords Adaptive strategies, livelihood vulnerability index, IPCC-livelihood vulnerability index, climatic exposure

Building climate resilience and adaptive capacity among smallholder farmer: A global systematic review of strategies and insights

Perka Shiva Kumar, Praveen KV and Alka Singh
Division of Agricultural Economics, ICAR-Indian Agricultural Research Institute (IARI), New Delhi.
Email: asingh.eco@gmail.com

This study provided a comprehensive review of global literature on climate resilience and adaptive capacity among smallholder farmers. From an initial pool of 2,063 publications, 183 were selected for in-depth analysis. The review identified key adaptation strategies, including sustainable practices such as conservation agriculture, crop diversification, agroforestry, organic farming, and integrated farming systems *etc*. These approaches were found to enhance productivity, income, and food security. However, barriers such as high vulnerability, limited adaptive capacity, low awareness of climate change, and inadequate access to information and infrastructure persisted. Additionally, gender disparities, crop-specific challenges, socio-economic constraints, financial limitations, and insufficient policy support were recognized as significant factors affecting resilience. The study highlighted the need for inclusive, locally tailored interventions to strengthen climate adaptation efforts among smallholder farmers.

Keywords Climate resilience. Adaptive capacity. Smallholder farmers. Systematic Literature Review

Harnessing solar power for sustainable agriculture in India: A DPSIR framework

Surya Pratap Singh Nagdali[1], Renjini V R[1*], Praveen K V[1], Ajmal S[2] and Asha Devi[1]
[1]Division of Agricultural Economics, ICAR-IARI, New Delhi
[2] ICAR-Central Island Agricultural Research Institute, Port Blair
Email: renji608@gmail.com

Agriculture has become far more energy-intensive than in the past, making it critical to shift toward climate-friendly practices, especially as climate change poses a major global challenge. Currently, agriculture relies heavily on fossil fuels, causing significant environmental damage. Additionally, government subsidies in the agricultural power sector strain the economy and contribute to environmental degradation due to inefficient power use. This paper, using the DPSIR framework, examines the energy demands of Indian agriculture, the driving forces behind its energy strain, and potential policy responses to promote sustainability. Renewable energy, particularly solar, plays a key role due to its vast potential and widespread availability across the country. India's geographic location gives it a natural advantage in harnessing solar power, which can benefit all sectors of the economy, particularly agriculture. A literature search of the Scopus database (1991–2024) yielded 1,289 relevant studies after filtering for duplicates and relevance. Key drivers of agricultural energy demand include population growth, economic and technological advancement, industrialization, and urbanization. Population growth increases food and energy demands, while urbanization reduces arable land. These drivers lead to higher energy costs for farmers and increased greenhouse gas emissions. India has a unique opportunity to improve energy efficiency in agriculture by increasing the use of solar energy, balancing environmental protection with economic growth. The government has been promoting solar energy in agriculture through initiatives like the PM KUSUM scheme, which helps farmers install solar pumps and rooftop PV systems. The paper highlights that, to meet India's target for reduction of emission intensity and to increase non-fossil power capacity by 2030—further investment in solar energy, supported by strong public sector initiatives, is essential.

Keywords Solar energy, DPSIR, Renewable energy, Sustainable agriculture, Driver

Comparative analysis of hi- tech farming for sustainable horticulture in Chhattisgarh, India

Praveen Kumar Verma[1*], V.K. Choudhry[1] and Ashish Verma[1]
[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur, 492012
Email: praveen250480@gmail.com

This study examines the comparative economic benefits of hi tech Protected Cultivation and Precision Farming (PCPF) compared to open cultivation for various vegetables in the cropping year 2022-23 in Chhattisgarh state. The analysis reveals that PCPF demonstrates higher productivity due to improved labor-to-capital ratios, as indicated by the AM-GM inequality. Indeterminate tomato varieties exhibit superior yields and longer shelf lives under PCPF conditions. Cost analysis shows PCPF reduces operational expenses through efficient drip irrigation and lower plant protection costs, despite higher initial fixed costs. Government subsidies and insurance further support PCPF's economic viability. The Benefit-Cost (B:C) ratio analysis indicates significant growth for cabbage, cauliflower, and tomatoes due to higher off-season prices, while knol-khol and brinjal show less change. Overall, PCPF enhances productivity, cost efficiency, and economic returns, underscoring the importance of modern agricultural practices and targeted policies to promote sustainable vegetable cultivation and improve food security and economic resilience.

Keywords Protected cultivation, precision farming, productivity, cost efficiency, economic returns

Assessing sugarcane expansion to ethanol production under climate change scenarios in India

Naresha N, Bilavat Swami Nayak and Balaji SJ
ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi-12
Email: balaji.sj@icar.gov.in

India has pledged to achieve net zero by 2070 at the 26th Conference of Parties to the UNFCCC, driven by the goal of pursuing low-carbon development strategy. To reduce its dependence on fossil fuels and assist in carbon sequestration, the country has enhanced its capacity to manufacture ethanol for blending with petrol, primarily using sugarcane as feedstock. However, the vulnerability of sugarcane to climate change poses a potential threat to this long-term development strategy. This study examines potential impact of climate change on sugarcane production and subsequently on ethanol production, utilizing projected changes in both area and yield in response to climate variations until 2050. Projections for area and yield are derived from GFDL, HGEM, IPSL, and MIROC simulation models under SSP2, as well as SSP1 and SSP3 scenarios. Linear and non-linear econometric models are employed for validation. Findings indicate that climate change could lead to a 26-33 million tonne reduction in sugarcane production by 2050. Further analysis indicates that this would cause a 5% to 12% reduction in ethanol production, impeding the country's advancement toward a green energy transition.

Keywords Ethanol production, climate change, green energy