49th Vice-Chancellors' Convention

Indian Agricultural Universities Association (IAUA)

From Field to Future: Navigating New Frontiers in Agriculture

(05-06 January, 2026)

PROCEEDINGS



Organized By

Chaudhary Charan Singh
Haryana Agricultural University, Hisar-125004, Haryana

Proceedings
49th Vice-Chancellors' Convention on "From Field to Future: Navigating New Frontiers in Agriculture" Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana

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Contents

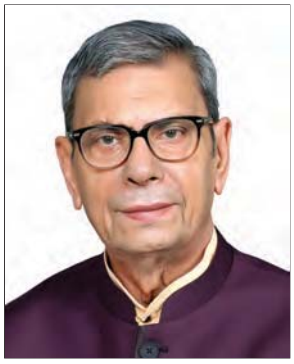
Messages	1-3
Forward	4
About Convention	5
Inaugural Session	6-8
Technical Sessions	9-18
Keynote Lectures	19-55
Technical Programme	56-59
List of Participants	60-61
List of Committee members from CCS HAU, Hisar	62-64
List of CCS HAU, Hisar liaisoning officers associated with Hon'ble Vice-Chancellors	65

Prof. Ashim Kumar Ghosh
Governor, Haryana

सत्यमेव जयते

प्रो0 असीम कुमार घोष
राज्यपाल, हरियाणा

HRB/PRO-MSG/2026-183
Dated: 05-01-2026



Message

It is a matter of immense pleasure and pride to learn that the 49th Vice-Chancellors' Convention is being organized by Chaudhary Charan Singh Agricultural University, Hisar, in collaboration with the Indian Agricultural Universities Association (IAUA), on January 5-6, 2026. The choice of the theme, "From Field to Future: Navigating New Frontiers in Agriculture," is both timely and forward-looking, reflecting the evolving challenges and opportunities confronting Indian agriculture today.

At a time when the agricultural sector is undergoing rapid transformation driven by technological innovation, climate change concerns, resource constraints and changing socio-economic realities, such a convention provides an invaluable platform for meaningful dialogue and knowledge exchange. The gathering of Vice-Chancellors, eminent academicians, scientists, policymakers and experts from across the country will facilitate deep deliberations on strengthening agricultural education, research and extension systems in line with national priorities.

Chaudhary Charan Singh Haryana Agricultural University, with its distinguished legacy in agricultural education and research, provides an ideal platform for hosting such a significant national-level academic congregation. The convention is expected to generate valuable insights, policy recommendations, and collaborative pathways that will strengthen the role of agricultural universities in shaping India's agrarian future.

Congratulations and best wishes!

(Prof Ashim Kumar Ghosh)
Governor, Haryana

सत्यमेव जयते

डॉ. एम.एल.जाट
DR. M.L.JAT
सचिव (डेयर) एवं महानिदेशक (आईसीएआर)
Secretary (DARE) & Director General (ICAR)

भारत सरकार
कृषि अनुसंधान और शिक्षा विभाग एवं
भारतीय कृषि अनुसंवाद परिषद
कृषि एवं किसान कल्याण मंत्रालय, कृषि भवन, नई दिल्ली-110 001

GOVERNMENT OF INDIA
DEPARTMENT OF AGRICULTURAL RESEARCH AND EDUCATION (DARE)
AND
INDIAN COUNCIL OF AGRICULTURAL RESEARCH (ICAR)
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Message



The 49th Vice-Chancellors' Convention of the Indian Agricultural Universities Association is being organized with a theme, "From Field to Future: Navigating New Frontiers in Agriculture", which highlights the need for forward-looking approaches in agricultural education, research and innovation.

The Indian Council of Agricultural Research (ICAR) has consistently emphasized the strong linkage between education, research and extension as the foundation of sustainable agricultural development. Vice-Chancellor play a pivotal role in strengthening this continuum and in preparing competent, future-ready human capital aligned with national priorities, including Viksit Bharat@2047.

I am happy to note that CCS Haryana Agriculture University, Hisar is hosting this Convention. With its distinguished legacy in agricultural education, research and extension, CCS Haryana Agricultural University, Hisar, provides an ideal platform for meaningful deliberations.

I extend my warm greetings to all the participating Vice-Chancellors, delegates and the entire team of CCS Haryana Agricultural University, Hisar for organizing this important Convention and look forward for successful outcome of the deliberations so as to strengthen agricultural education, research and extension.

(M.L. Jat)

Dated the 19th December, 2025
New Delhi

Dr. Manmohan Singh Chauhan
President
Indian Agricultural Universities
Association (IAUA)
New Delhi



Message

The Indian Agricultural Universities Association is proud to partner with CCS Haryana Agricultural University for the 49th Vice Chancellors' Convention of IAUA.

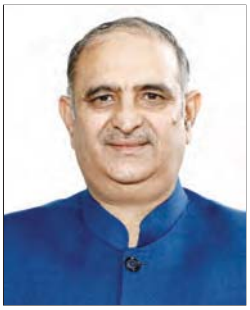
As we discuss the theme 'From Field to Future: Navigating New Frontiers in Agriculture', We must re-imagine our universities not just as centres of learning, but as dynamic hubs of innovation, knowledge dissemination and rural transformation.

The challenge before us is to bridge the gap between use of high-end technology and the time-tested traditional farming practices. I am confident that the collective wisdom and experience of the Vice-Chancellors present here will chart a clear roadmap for a more inclusive, resilient and technologically empowered system of agricultural education, research and extension.

I thank Prof. B.R. Kamboj and his dedicated team for graciously accepting the responsibility of hosting this Convocation and for making all arrangements to ensure its success.

(Dr. Manmohan Singh Chauhan)
Vice-Chancellor, GBPUAT, Pantnagar
&
President, IAUA

Prof. B.R. Kamboj
Vice-Chancellor
CCS Haryana Agricultural
University, Hisar



Foreword

It is a matter of great honour and privilege for us at Chaudhary Charan Singh Haryana Agricultural University to host the 49th Vice-Chancellors' Convention on January 5-6, 2026. We are also delighted to welcome the academic leaders of the country to our campus.

Our chosen themes 'From Field to Future: Navigating New Frontiers in Agriculture' is not just a topic for discussion but it is a pillar upon which the future of humanity rests. At CCS HAU, Hisar we have always strived to take the lab to the land, ensuring that our research translates into prosperity for the farmer.

This convention represents a convergence of minds committed to the cause of Indian Agriculture. I am confident that our deliberations will produce a blueprint for sustainable agricultural futures, blending the wisdom of our heritage with the precision of modern science.

I welcome all my esteemed colleagues and dignitaries to Hisar and look forward to a convention that is intellectually stimulating and historically significant. I also wish my team all the very best for the convention.

(Prof. B.R. Kamboj)
Vice-Chancellor

About Convention

The Chaudhary Charan Singh Haryana Agricultural University, Hisar in collaboration with the Indian Agricultural Universities Association organized the *49th Vice-Chancellors' Convention* on 5–6 January 2026 at CCS HAU, Hisar. The Convention marked an important milestone in re-envisioning the role of India's higher agricultural education system in national development, bringing together academic leaders, policymakers, researchers, and innovators. It served as a vibrant platform to deliberate on emerging challenges and transformative opportunities in agriculture.

Aligned with the vision of Viksit Bharat 2047, the Convention was anchored around the central theme, *"From Field to Future: Navigating New Frontiers in Agriculture."* The theme highlighted the transition from traditional agricultural practices to future-ready systems driven by innovation, sustainability, and technology. It emphasized the integration of advanced tools, data-driven decision making, improved crop varieties, digital extension and resilient farming approaches to address contemporary challenges.

This compendium captures the key insights and recommendations emerging from the deliberations, providing a guiding framework for agricultural institutions to build a resilient, sustainable and prosperous agricultural future, with focus on the following sub-themes:

1. **Viksit Bharat 2047: Role and Contribution of Agricultural Institutions:** The sub-theme underscored the expanding role of agricultural universities as engines of innovation and entrepreneurship. Beyond teaching and research, these institutions are pivotal in strengthening extension systems, promoting agri-startups, and advancing food security, farmers' income, climate resilience and inclusive rural development.

2. **Bridging Tradition and Technology for Sustainable Agricultural Futures:** This sub-theme highlighted the synergy between indigenous knowledge and modern technologies such as precision agriculture, remote sensing, bioinformatics, and artificial intelligence. Such integration is vital for developing sustainable, climate-smartand economically viable farming systems for both smallholder and commercial agriculture.





The Convention featured three technical sessions, each with two distinguished keynote speakers, alongside a panel discussion led by Hon'ble Vice-Chancellors. The deliberations offered diverse perspectives, culminating in actionable recommendations and strategic pathways to strengthen innovation, sustainability, and institutional impact in agriculture.

Inaugural Session

The convention was inaugurated by chief guest Dr. Krishan Lal Midha, Deputy Speaker, Haryana Legislative Assembly by lighting the lamp.





Prof. B.R. Kamboj, Vice-Chancellor, Chaudhary Charan Singh Haryana Agricultural University, Hisar, extended a warm and cordial welcome to all in this prestigious Vice-Chancellors' Convention. He said this august gathering represents the collective wisdom, leadership and vision of India's higher education system. The presence of such eminent Vice-Chancellors from across the country reflects our shared commitment towards academic excellence, innovation and nation-building. Vice-Chancellors are not merely administrators; they are thought leaders, institution builders and torchbearers of change. Your contributions continue to shape the future of our universities and, in turn, the future of our nation. The recommendations of the conference would prove to be a milestone in advancing agricultural education, research and extension.



Addressing the gathering, The IAUA President and Vice-Chancellor of GBPUA&T, Pantnagar Dr. Manmohan Singh said it is a platform to give new directions to agricultural education, research and innovation in the country, ultimately strengthening farmers, students and the national economy. He said there are 74 agricultural universities in the country which are playing a key role in developing latest technologies and improved varieties in agriculture, enhancing horticultural production and evolving advance practices in animal husbandry and fisheries. Dr. Singh said making agriculture profitable, increase in production, ensuring nutritional security and promoting innovations have now become major responsibilities of agricultural universities. He added that the primary objective of IAUA is to share the excellent work being done by different universities and to ensure solutions to challenges by establishing coordination with the government so that universities can perform their roles effectively.



Chief Guest, Dr. Krishan Lal Midha emphasised the role of Chaudhary Charan Singh, Haryana Agricultural University, Hisar, in India's Green Revolution and White Revolution, the transformative movements that helped India achieve food security and dairy self-reliance, respectively. He also mentioned that the university has developed a total of 305 field and horticultural (including vegetable) crops varieties since its inception. The varieties developed by this university have been cultivated in various zones of India, particularly the North-West Plain Zone constituting the



states of Punjab, Haryana, Rajasthan and Western UP. During the last five years the university has developed and released 44 varieties of cereals, pulses, oilseed, fodder crops and sixteen varieties/hybrids have been identified for release.

This Vice-Chancellors' Convention brings together academic leaders to deliberate on critical themes that are at the core of agricultural transformation. The theme "From Field to Future: Navigating New Frontiers in Agriculture" encapsulates the journey from traditional agricultural practices to future-ready paradigms i.e. integrating technology, data-driven decision making, high-performance crop varieties, digital extension and sustainability models across farming systems. Similarly in, "Viksit Bharat 2047: Role and Contribution of Agricultural Institutions", it is imperative that agricultural institutions expand their role beyond education and research to become incubators of innovative solutions that align with national goals of food security, rural prosperity, climate resilience, and socio-economic equity. The most impressive and important being "Bridging Tradition and Technology for Sustainable Agricultural Futures" which means we must honor traditional knowledge systems, while embracing advanced technologies, from precision farming and bioinformatics to remote sensing and AI to build agricultural systems that are sustainable, inclusive and profitable for small holders and commercial farmers alike. The objective of this convention, therefore, is not merely academic discourse but it is to shape actionable frameworks that empower universities to deliver impact at scale, influence policy and strengthen agriculture's role in India's growth narrative.

Former IAUA President Dr. Parvender Kaushal, Secretary Dr. Dinesh Kumar also participated in the convention. Vice-Chancellors from various universities, Registrar, Dean's, Directors', officers and scientists of CCSHAU, Hisar were also present on the occasion. Organising Secretary and DHRM, Dr. Ramesh Kumar proposed the formal vote of thanks.



TECHNICAL SESSION - I

FROM FIELD TO FUTURE: NAVIGATING NEW FRONTIERS IN AGRICULTURE

Chairperson:	Dr. Parvinder Kaushal Vice-Chancellor, Veer Chandra Singh Garhwali Uttarakhand University of Horticulture & Forestry, Bharsar	**Rapporteurs:**	Dr. Rajbir Garg Director of Research CCSHAU, Hisar
Co-Chairperson:	Dr. Bidyut Chandan Deka Vice-Chancellor Assam Agricultural University, Jorhat		Dr. Suresh Joint Director Crops CCSHAU, Hisar

In this theme, There were two keynote speakers Dr. Sharad Ramrao Gadakh, Vice-Chancellor, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola and Prof. (Dr) Indra Mani Vice Chancellor, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani and 09 panelists.

At the outset, Chairperson Dr. Parvinder Kaushal welcomed the speakers, panelists and all the participating Vice-Chancellors and highlighted the significance of navigating new frontiers in agriculture.



The First key note lecture on 'Sustainable & Scalable Model for Doubling Farmers' Income' was delivered by Dr. Sharad Ramrao Gadakh, Vice-Chancellor, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. He presented 'Model Village Initiative' implemented by *Dr. Panjabrao Deshmukh Krishi Vidyapeeth (PDKV),* Akola, as a university-led, science-driven approach to address persistent challenges in the rainfed agriculture of Vidarbha region of Maharashtra in which eleven villages, one from each district, were adopted as "living laboratories" to demonstrate sustainable pathways for enhancing farm income and rural livelihoods.

The initiative was structured around a four-component income enhancement model, with each component contributing approximately 33% to overall income growth, collectively enabling the doubling of farmers' income. The first component focuses on doubling crop productivity through location-specific technologies, improved varieties, scientific crop management, and extensive on-farm demonstrations across seasons. The second component emphasized reducing the cost of cultivation via mechanization, custom hiring centres, micro-irrigation and efficient input use, leading to substantial savings in labour and operational costs.

The third component addressed value addition and market linkages, enabling farmers to move beyond raw produce sales by adopting processing, grading, packaging, branding, and village-level entrepreneurship, with strong participation from women, self-help groups, and rural youth. The fourth component,

Integrated Farming Systems (IFS), provided sustainability and income stability through diversification into allied activities such as dairy, goatery, poultry, fisheries, vermicomposting, beekeeping, and fodder production.

The initiative demonstrated significant impacts, including substantial yield improvements in major crops, rapid adoption of improved technologies, expansion of cash crops like turmeric, increased engagement of rural youth in allied enterprises, and measurable village-level income gains. Encouraged by these outcomes, the Government of Maharashtra has adopted this model for large-scale replication under the *Nanaji Deshmukh Krushi Sanjivani Prakalp (POKRA),* covering 118 villages across Vidarbha.



The Second key note lecture on 'Climate-Smart Farming for a Resilient Tomorrow' was delivered online by Prof. (Dr) Indra Mani Vice-Chancellor, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani in which he highlighted that Indian agriculture is increasingly exposed to the adverse impacts of climate change, including rising temperatures, erratic rainfall, droughts, floods, and extreme weather events, posing serious threats to food security, natural resources, and farmer livelihoods, particularly for small and marginal farmers. In this context, Climate-Smart Farming (CSF) and Climate-Resilient Agriculture (CRA) emerge as essential approaches for sustaining productivity while enhancing resilience and reducing environmental vulnerability.

Climate-smart farming integrates adaptation, mitigation, and sustainability through practices such as crop diversification, climate-resilient varieties, conservation agriculture, precision resource management, integrated farming systems, mechanization, renewable energy use, and digital technologies. Efficient water and nutrient management, soil and water conservation, agroforestry, and carbon-sequestering practices contribute not only to productivity and income stability but also to climate change mitigation.

He told that, at the national level, initiatives such as the ICAR-led National Innovations on Climate Resilient Agriculture (NICRA) have strengthened adaptive capacity through research, technology demonstration, and capacity building while at State level, Maharashtra's Project on Climate Resilient Agriculture (PoCRA)—now the *Nanaji Deshmukh Krushi Sanjivani Prakalp* has demonstrated large-scale, community-driven climate resilience through watershed management, crop diversification, institutional strengthening, and technology adoption, supported by digital and AI-driven platforms. *Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani* has played a pivotal role in developing and disseminating region-specific climate-resilient technologies. Its contributions include climate-tolerant and biofortified crop varieties, water- and energy-smart interventions, innovative farm mechanization, integrated farming systems, and advanced digital and drone-based solutions. Climate-smart and climate-resilient farming is essential to safeguard Indian agriculture against growing climatic uncertainties.

The integration of resilient crop varieties, efficient resource management, mechanization, renewable energy, and digital technologies has demonstrated strong potential to enhance productivity, stabilize farm incomes, and conserve natural resources. Experiences from national and state initiatives, along with institutional contributions such as those of VNMKV, highlight that science-led and participatory approaches can effectively build resilience in rainfed and vulnerable regions. Scaling up these innovations

through strong collaboration, policy support, and capacity building will be critical for achieving sustainable, resilient, and future-ready agriculture.

The following points came out of the panel discussion:

- ❒ Increasing on-farm mechanization for small holder to reduce the cost of production and productivity gains.
- ❒ Establishment of Custom Hiring Centres at village levels as an effective tool in the mechanization of agriculture.
- ❒ Attracting rural youth and agriculture graduates in agriculture as agri-entrepreneurs.
- ❒ Development of replicable IFS model for increasing the sustainability and profitability per unit area.
- ❒ Artificial intelligence/digital platform to support agriculture with least human resource involvement.
- ❒ Reducing post harvest losses and increasing proportion of processing.
- ❒ Scientific validation of natural farming practices for their wide scale adoption.

The session ended with felicitation of Chair, Co-chair and keynote speakers with a memento and vote of thanks to Chair, Co-chair, keynote speakers, panellist and the house.

TECHNICAL SESSION - II

VIKSIT BHARAT 2047: ROLE AND CONTRIBUTION OF AGRICULTURAL INSTITUTIONS

Chairperson:	Prof. Parvat Kumar Roul Vice-Chancellor OUAT, Bhubaneswar	**Rapporteurs:**	Dr. K.D. Sharma Dean, College of Biotechnology CCSHAU, Hisar
Co-Chairperson:	Dr. Dheer Singh Director & Vice-Chancellor ICAR–NDRI, Karnal		Dr. Anil Kumar Sr. Scientist CCSHAU, Hisar

In this theme, there were two keynote speakers Prof. Baldev Raj Kamboj, Vice Chancellor, CCS Haryana Agricultural University, Hisar, Dr. Manmohan Singh Chauhan, Vice Chancellor, GB Pant University of Agriculture & Technology, Pantnagar and 09 panelist.



The first keynote address was delivered by Prof. Baldev Raj Kamboj, Vice-Chancellor, CCS Haryana Agricultural University, Hisar, on "Strengthening Agricultural Research, Education and Extension."

He highlighted that India possesses one of the world's largest National Agricultural Research and Education Systems

(NARES) and emphasized the need for agricultural universities to evolve from knowledge centers into innovation ecosystems. He underscored that strengthening research, education, and extension is a national imperative for food security, farmer prosperity, and sustainable development. Prof. Kamboj aligned his views with NEP 2020, advocating for flexible, multidisciplinary, research-oriented, and inclusive agricultural education, technology-driven research, sustained investment, and a farmer-centric, market-linked, and digitally enabled extension system. He stressed continuity between traditional wisdom, institutional science, and modern innovation, and called for royalty mechanisms for varieties and breeds to incentivize research.

The second keynote address was delivered by Dr. Manmohan Singh Chauhan, Vice-Chancellor, GB Pant University of Agriculture & Technology, Pantnagar, on "Genome Editing and Cloning in Animals for 2047."



He highlighted the transformative role of reproductive biotechnology in enhancing livestock productivity and disease resistance. He emphasized the potential of genome editing tools such as CRISPR-Cas systems, citing examples like myostatin (MSTN) knockout cattle for higher muscle growth and BLG-free dairy animals for hypoallergenic milk, noting that these technologies could be game changers in meeting future dairy demand.

The panel discussion was highly engaging and all the participant Vice-Chancellors proposed forward looking interventions given as under:

- Importance of inter-institutional collaboration and the responsibility of institutions to support each other through knowledge sharing and innovation.
- Keeping in view, the challenge of climate change there is a need to strengthen agricultural education, research and extension as key priorities to ensure profitability and sustainability.
- Need for export-oriented agriculture producing high-quality products meeting international standards. Strengthening agricultural universities and micro-level interventions, supported by trained manpower and CSR funding.
- Reforms in teaching methods are required to attract youth toward agriculture, as most educators follow traditional approaches and importance of women empowerment through involvement in value-added agricultural products, contributing significantly to food security and national development.
- Importance of custom hiring for timely sowing, residue management, and reducing diesel dependence.
- Empowering farmers by reducing cultivation costs, strengthening market linkages, organizing FPOs, and revising curricula toward skill development and entrepreneurship.
- Mandating at least one hour of field work in curricula to improve engagement with farming.

In his concluding remarks, the Co-Chairman emphasized the growing importance of nutritional security, while the Chairman concluded that the goal of *Viksit Bharat* can be achieved through *Viksit Krishi*, with

strengthened agricultural universities playing a central role. He observed that genome editing, though debated, holds significant promise for the future.

The session concluded with the felicitation of Chair, Co-chair and keynote speakers with a memento and vote of thanks by the Session Coordinator, Dr. Renu Munjal.

IAUA General Body Meeting

The Annual General Body Meeting (AGBM-2025) of IAUA was held on January 5, 2026, under the chairmanship of Dr. Manmohan Singh Chauhan, Vice-Chancellor, GBPUAT, Pantnagar, and co-chairmanship of Prof. B.R. Kamboj, Vice-Chancellor, CCSHAU, Hisar. The agenda items listed for the meeting and presented by Dr Dinesh Kumar, Executive Secretary, were duly deliberated upon, and appropriate decisions were taken. The proceedings of the meeting have been duly documented and circulated among the Executive Committee and member universities of IAUA. Dr. M.S. Chauhan shall continue to serve as the President of IAUA.





TECHNICAL SESSION - III

BRIDGING TRADITION AND TECHNOLOGY FOR SUSTAINABLE AGRICULTURAL FUTURES

Chairperson:	Dr. Manmohan Singh Chauhan Vice-Chancellor GBPUA&T, Pantnagar	**Rapporteurs:**	Dr. Pawan Kumar Registrar CCSHAU, Hisar
Co-Chairperson:	Prof. Baldev Raj Kamboj Vice-Chancellor CCSHAU, Hisar		Dr. Rachna Gulati Principal Scientist CCSHAU, Hisar

In this theme, there were two keynote speakers Prof. Vinod Kumar Verma, Vice-Chancellor, LUVAS, Hisar, Prof. Parvat Kumar Roul, Vice-Chancellor, OUA&T, Bhubaneswar and 11 panelist.



The first keynote address was delivered by Prof. Vinod Kumar Verma, Vice-Chancellor, LUVAS, Hisar, on "Traditional Livestock Management with Smart Health Monitoring". He highlighted that the traditional livestock management systems have played a vital role in sustaining rural livelihoods through age-old practices of animal rearing and healthcare. These systems rely largely on indigenous knowledge, farmer experience and manual management practices. However, increasing herd sizes, commercialization of livestock farming and rising expectations related to productivity, food safety and animal welfare necessitate a transition towards smart, technology-enabled health monitoring systems.

He concluded that smart livestock health monitoring represents a paradigm shift from experience-based practices to data-driven, analytics-based decision-making. By integrating traditional knowledge with advanced digital technologies, the system improves precision, accuracy and efficiency in animal health management, paving the way for sustainable and resilient livestock production systems.



The Second keynote address was delivered by Dr. Pravat Kumar Roul, Vice-Chancellor, Odisha University of Agriculture and Technology (OUAT), Bhubaneswar, on "Roadmap for Atmanirbhar Krishi: Policies, Institutions and Innovations for 2047".

He concluded that the roadmap emphasizes that successful agricultural transformation hinges on the integration of advanced technologies with sustainable practices and strong policy support. He emphasised that a coordinated approach of capacity building and human resource development, academic reforms and institute policy reforms are essential to achieve long-term resilience, productivity and inclusiveness in Indian agriculture.

The take away from the Session were as under:

- There is a need for technological intervention to address traceability, productivity losses and disease outbreaks in Veterinary and Animal Health Sector. Smart Health monitoring technologies can complement traditional technologies for real time monitoring and forecasting of diseases.
- There is need to strengthen the R&D infrastructure, Public-Private partnership, Agri-Nutri linkages and quality control in Agriculture and allied sectors.
- Universities should strengthen skill development and internship for Undergraduates and Postgraduates students. If needed, a separate cell may be formed in each University.
- To implement digital and futuristic technologies, there is need to have sufficient qualified manpower in each University/Climatic zones.
- Emphasis should be made to conserve and upgrade local breeds of animals. Diagnostic techniques, processing and slaughter houses be improved to sustain and improve livestock farming.
- In Fisheries sector, field and industry-oriented research is required. Cold- chain, market-chain, aquaponics, processing and value addition should be strengthened and integrated with digital technology.

PLENARY SESSION

Chairperson:	Dr. Manmohan Singh Chauhan Vice-Chancellor, GBPUA&T Pantnagar	**Rapporteurs:**	Dr. Ramesh Kumar DHRM CCSHAU, Hisar
Co-Chairperson:	Prof. Baldev Raj Kamboj Vice-Chancellor CCSHAU, Hisar		Dr. Anil Yadav Principal Scientist CCSHAU, Hisar

The plenary session commenced with summarisation of Technical Session–I by Dr. Suresh, Joint Director (Crops), CCSHAU, conducted under the theme "From Field to Future: Navigating New Frontiers in Agriculture," highlighting the key strategies for advancing sustainable and inclusive agricultural development. The session emphasized accelerating mechanisation for small and marginal farmers to reduce cultivation costs, establishing village-level Custom Hiring Centres as an effective mechanisation model, and promoting rural youth and agriculture graduates as agri-entrepreneurs. The discussions also underscored the adoption of sustainable and integrated farming systems, the use of digital platforms to support agriculture with minimal human resource involvement, the need to reduce post-harvest losses through enhanced processing and the wider promotion of natural farming practices for long-term sustainability.

Technical Session–II, concise by Dr. K. D. Sharma, Dean, College of Biotechnology, focused on reorienting agricultural education and research in alignment with NEP 2020, advocating for flexible, multidisciplinary, research-driven and inclusive systems supported by sustained investment and digitally enabled, farmer-centric extension. The session emphasized continuity between traditional knowledge, institutional science, and modern innovation, along with the need for royalty mechanisms to incentivize varietal and breed development. Significant attention was given to the transformative role of reproductive biotechnologies and advanced genome-editing tools such as CRISPR-Cas, citing examples like MSTN knockout cattle for enhanced muscle growth and BLG-free dairy animals for hypoallergenic milk to meet future livestock and dairy demands.

Panel discussions further highlighted strengthening institutional linkages, promoting export-oriented agricultural diversification, empowering women, advancing conservation agriculture to support natural farming, and reducing input costs as key strategies for sustainable development and poverty eradication. New-generation gene-editing tools were suggested as prime-facia inculcation to offer a precise, rapid, and sustainable approach to developing climate-resilient crop varieties capable of withstanding multiple abiotic stresses while ensuring yield stability and food security.

Technical Session–III, themed "Bridging Tradition and Technology for Sustainable Agricultural Futures," was summarised by Dr. Pawan Kumar, Registrar. The session emphasized the need for advanced technological interventions to improve traceability, reduce productivity losses, and manage disease outbreaks in the veterinary and animal health sectors through smart health monitoring and real-time disease forecasting. It highlighted strengthening R&D infrastructure, public–private partnerships, and agri-nutri value chains with robust quality control across agriculture and allied sectors. The discussions stressed enhancing skill development and structured internships for undergraduate and postgraduate students, supported by dedicated skill cells in universities and adequate qualified manpower across climatic zones to implement digital and futuristic technologies. Further recommendations included establishing small-scale processing units at village and district levels, generating scientific data and increasing research funding for natural farming, and aligning NCC/NSS programs with three-year certificate systems to strengthen youth engagement and capacity building.



Dr. Ajit Singh Yadav, Assistant Director General (EQA&R), ICAR, in his address as the Chief Guest, emphasized the need to embrace new dimensions of agriculture through transformational changes and the rapid adoption of futuristic approaches to meet emerging challenges within a shorter time span. He stressed that nodal officers must thoroughly understand the National Education Policy (NEP) to effectively inculcate contemporary and need-based courses into the agricultural curriculum. Highlighting well-documented case studies for effective implementation, he noted that while 30% of the curriculum should remain under university control, it must be balanced with uniform weightage across all agricultural universities to ensure parity and quality. He also referred to discussions with the UGC to enhance global academic standards by revising the eligibility criteria for Master's programmes in agriculture from 6.5 to 7.0 grade points. Dr. Yadav further underscored the importance of multiple entry–exit options at various academic levels to provide flexibility and make education more student-centric, advocating the removal of rigid structures. He concluded by stating that curriculum development is a dynamic process, recommending the periodic inclusion of at least 5% new and emerging topics to keep agricultural education relevant and responsive to the needs of the hour.

Dr. Manmohan Singh Chauhan, President of the Vice-Chancellors' Association (IAUA), while expressing gratitude to Dr. Ajit Singh Yadav, ADG (EQA&R), ICAR, emphasized that achieving the vision of Viksit Bharat by 2047 would require agricultural universities to play a decisive role in shaping a resilient and progressive India. He highlighted the need to enhance global competitiveness and strengthen accreditation mechanisms, suggesting that greater weightage be accorded to extension activities, technology commercialization, and outreach in NIRF rankings, alongside academics and research. Stressing the

importance of policy engagement as a critical priority, he underlined the collective responsibility of all 74 agricultural universities under IAUA in national development. Dr. Chauhan conveyed special appreciation to Dr. B. R. Kamboj for hosting one of the finest VC conventions, lauding his gracious leadership, meticulous planning, excellent management, and warm hospitality, which fostered an academically rich and congenial environment for meaningful deliberations. Reaffirming the unwavering commitment of agricultural universities to farmers and the nation, he called for strengthening extension systems to global benchmarks in alignment with national aspirations, concluding with the inspiring message: "Sky is the limit – Jai Jawan, Jai Kisan, Jai Anusandhan."

Dr. B. R. Kamboj, Hon'ble Vice-Chancellor, CCSHAU, in his concluding remarks, emphasized the values of integrity, strong work culture, and the invaluable contributions of all dignitaries whose insightful inputs collectively made the convention a resounding success. He highlighted the initiative to draft a comprehensive water policy within the next six months, underscoring the urgency of sustainable resource management. Dr. Kamboj further proposed MOUs and inter-university collaborations to promote active participation in nation-building through agriculture and to encourage interdisciplinary exchange of ideas among institutions. He concluded the ceremony by extending a heartfelt vote of thanks to all participants, reaffirming the collective commitment toward strengthening agricultural education, research and extension for national development. He also warmly praised the dedicated team of CCSHAU, acknowledging their tireless efforts, coordinated teamwork, and unwavering commitment that ensured the smooth organization and overall success of the convention, and expressed his appreciation for their exemplary planning, execution, and support throughout the event.

Dr. Dinesh Kumar formally concluded the plenary session with the vote of thanks, expressing sincere gratitude to the Chief Guest, Dr. Krishan Lal Midha, and highlighted the evolving responsibilities of stakeholders in shaping the future of agriculture. He underscored the collective need to address emerging challenges with foresight, while emphasizing the growing importance of market dynamics and the adoption of sustainable, innovative solutions to ensure resilient and inclusive agricultural development.



Recommendations

- There is a need to create scientific data on validation of natural farming practices and funding in research area should be increased in this direction.
- NCC/NSS Program should be in line with the 3 years certificate system.
- Small scale processing units for agriculture and allied sectors may be established at village/district level.
- There is need to integrate digital technologies with Indigenous technical knowledge (ITK) to improve productivity gains and adaptive capacity at grass root level.
- Emphasis on mechanization, natural farming and climate resilient production system needs to be given which may help farmers to cope with climate variability while maintaining productivity.
- Need to enhance skill development and structured internships for UG and PG students, supported by dedicated skill cells in the universities and adequate qualified manpower across climatic zone to implement futuristic technologies.
- There is a need to develop Policy Paper highlighting past achievements and future demand to make strong University system. The committee members appreciated and agreed for this demand. A

Committee under the Chairmanship of Prof. B.R. Kamboj, Vice-Chancellor, CCS HAU, Hisar is constituted to prepare the Policy Paper. The constitution of Committee is as :

1.	Prof. B. R. Kamboj, Vice-Chancellor, CCSHAU, Hisar	Chairperson
2.	Dr. Rajeshwar Singh Chandel, Vice-Chancellor, Dr. YSPUHF, Nauni	Member
3.	Dr. S.K. Malhotra, Vice-Chancellor, MHU, Karnal	Member
4.	Dr. Dheer Singh, Vice-Chancellor, NDRI, Karnal	Member
5.	Dr. P.H. Tank, Vice-Chancellor, KU, Gandhinagar	Member
6.	Dr. S.C. Dubey, Vice-Chancellor, BAU, Ranchi	Member
7.	Dr. Vimla Dunkwal, Vice-Chancellor, AU, Kota	Member
8.	Prof. Pushpendra Singh Chauhan, Vice-Chancellor, SKNAU, Jobner	Member
9.	Prof. T. Suguna, OSD & DR, APFU, Vijayawada	Member





Keynote Lectures

Dr. PDKV Model Village Initiative
A Sustainable & Scalable Model for Doubling Farmers' Income

Dr. Sharad Ramrao Gadakh
Vice-Chancellor
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola

Introduction: Why Model Villages?

Vidarbha is an agriculturally rich region, yet it faces chronic challenges — rainfed farming, erratic rainfall, rising input costs, unstable markets, and limited adoption of modern technologies. Recognizing these challenges, Dr. PDKV, Akola adopted 11 villages — one from each district of Vidarbha — during 2022–23, not merely as beneficiaries, but as living laboratories of rural transformation

The goal was very clear:

To Improve socio-economic conditions of farmers and double their income through sustainable, technology-driven, and participatory development.

To achieve this, PDKV designed a Four-Component Model, where each Component contributes 33% income growth, collectively leading to doubling of village income.

Let me now explain this initiative through these four powerful Components.

Component 1: Doubling Crop Productivity

(33% Increase in Income)

The first Component focuses on increasing productivity per unit area.

PDKV scientists, Krishi Vigyan Kendras, and line departments jointly introduced advanced, location-specific, and recommended technologies directly on farmers' fields.

- ❒ Crop demonstrations were conducted during Kharif, Rabi, and Summer seasons
- ❒ More than 115 demonstrations per village on one-acre plots
- ❒ Crops included cotton, soybean, tur, gram, wheat, maize, paddy, oilseeds, and vegetables

Farmers were exposed to:

- ❒ Improved varieties
- ❒ Seed treatment with bio-agents
- ❒ BBF and modern sowing methods
- ❒ Integrated Nutrient and Pest Management
- ❒ Timely irrigation and harvesting

Additionally, crop competitions were organized, motivating farmers to adopt best practices. Outstanding farmers were felicitated at AGROTECH, creating a culture of healthy competition and learning.

Result: Higher yields, reduced crop failure risk, and 33% direct income increase.

Component 2: Reducing Cost of Production by 50%

(33% Increase in Income)

Friends, income does not rise only by producing more — it also rises by spending less. The second Component focuses on cost reduction through mechanization and efficiency.

Key interventions included:

- ❒ Demonstration of PDKV-recommended agricultural implements
- ❒ Promotion of BBF planters, seed drills, power tillers, drone spraying, and post-harvest machinery
- ❒ Establishment of Custom Hiring Centres (CHCs) so that even small and marginal farmers could access machinery at subsidized rates
- ❒ Expansion of micro-irrigation systems like drip and sprinkler irrigation
- ❒ Installation of weather observatories to support climate-based decision making
- ❒ Weedicide use to keep the farm weed free and reduce labour cost

Through mechanization:

- ❒ Labour costs reduced
- ❒ Input wastage minimized
- ❒ Timeliness of operations improved

Result: Production cost reduced by nearly 50%, translating into another 33% income gain.

Component 3: Value Addition and Market Linkages

(33% Increase in Income)

The third Component addresses a long-standing issue — farmers selling raw produce at low prices.

PDKV focused on developing a complete value chain from production to market.

Major initiatives included:

- ❒ Dal mills for tur, moong, udid, and gram
- ❒ Oil extraction units for oilseed crops
- ❒ Fruit and vegetable processing — jam, jelly, squash, pickle, powder, candy, marmalade
- ❒ Production of local value-added foods such as papad, kurdai, noodles, chips, lahi, and kharmure
- ❒ Seed and grain cleaning, grading, and packaging
- ❒ Attractive branding and marketing
- ❒ Promotion of products as a "Village Brand"

Self-Help Groups, women, and rural youth were actively involved, creating local employment and entrepreneurship.

Result: Farmers earned more per unit produce, diversified income sources, and gained market recognition — another 33% income increase.

Component 4: Integrated Farming System (IFS)

– The Sustainability Backbone

IFS is a sustainable solution for enhancing farm income and ensuring food security where multiple farming components like crops, livestock, poultry, horticulture and fisheries are integrated to maximize productivity

The fourth Component ensures income stability and sustainability through diversification.

Under the Integrated Farming System:

- ❒ Dairy units with loose housing systems
- ❒ Goat rearing units with local and commercial breeds
- ❒ Poultry units for eggs and meat
- ❒ Sericulture units for silk production
- ❒ Fish farming in village water bodies
- ❒ Vermi-compost and compost units for organic farming
- ❒ Silage units for year-round fodder
- ❒ Beekeeping units for honey and pollination
- ❒ Fodder demonstration plots

Each model village established multiple allied agriculture units, ensuring year-round income, risk reduction, and better resource recycling.

Impact and Way Forward

Friends, the results speak for themselves:

- ❒ 35% income rise in the initial year (2022-23)
- ❒ Primary findings indicate 100% income rise in 2025–26 over the base year 2022–23
- ❒ Availability of university high-yielding soybean varieties (PDKV Gold ,Suvarn Soya and PDKV Amba) led to an increased crop productivity.
- ❒ Demonstrations on drone spraying, pest management, and soil testing using scientific methods helped farmers adopt improved technologies.
- ❒ Through university participation, farmers received information and guidance on recommended agricultural technologies.
- ❒ Farmers in selected villages have become aware of various government schemes.
- ❒ Farmers participated in farmer cup competition organized by pani foundation
- ❒ Natural farming presented under the new concept is now being accepted, and farmers are willing to adopt it.
- ❒ Use of mechanization and improved implements has increased, resulting in savings of time and money for farmers.
- ❒ Young farmers are adopting allied agricultural enterprises and established poultry farming (79 units), goat rearing (66 units), dairy .(81 dairy units) ,fishery (4 units), vermi composting (84 units) cow-based product preparation, and incense-stick production in model villages.
- ● The productivity of soybean, cotton and paddy in adopted villages increased by 70%.

  (Salai mendha, District Nagpur ,the cotton productivity under HDPS increased from 4 q per acre to 7 q per acre) additional 1.05crore income in village during 2025-26).RAWE students attached in model village.
- ● Village Hirapur, District Gadchiroli PDKV tilak variety shows 4.62 q per acre increase in yield on 445 acre. additional 47lakh income in village during2025-26)
- ● Under Crop diversification, area under cash crops like Turmeric increased due to intervention.
- ● Village ShelgaonGhughe ,Washim, area under turmeric was 15 acres after technical interventions in

2022-23,the area under turmeric increased to 250 acre with total additional turmeric production of 5900 quintals and additional income of 5.93 cr.in the village economy.

Scalability And Way Forward

- ❒ Based on the successful outcomes in 11 PDKV-adopted villages, the PDKV-adopted model village initiative found to sustainable and Replicable scientific model
- ❒ Government of Maharashtra has decided to extend this model to 118 villages across 118 tahsils of Vidarbha under the *Nanaji Deshmukh Krushi Sanjivani Prakalp (POKRA*)

PDKV now envisions scaling this initiative across all talukas of Vidarbha, making every village self-reliant, resilient, and prosperous.

Conclusion

To conclude,

The Dr. PDKV Adopted Model Village Initiative is not just a scheme —

- ❒ It is a scientific roadmap,
- ❒ A farmer-centric movement,
- ❒ and a sustainable solution for doubling village income.

If implemented with the same spirit of science, participation, and convergence, this four-Component model has the power to transform rural India.

Let us work together to ensure that every village becomes a model village.

Thank you

Jai Jawan, Jai Kisan, Jai Vigyan

Climate-Smart Farming for a Resilient Tomorrow

Prof. (Dr.) Indra Mani
Vice-Chancellor
Vasantrao Naik Marathwada Krishi Vidyapeeth
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Agriculture in India stands at a critical juncture, as climate change increasingly threatens the stability of food systems, rural livelihoods, and natural resources. About half of India's population dependent on agriculture and allied sectors for livelihood. The sector is highly vulnerable to climate change impacts, including rising temperatures, erratic rainfall patterns, recurrent droughts, floods, and an increasing frequency of extreme weather events. These challenges are particularly acute for small and marginal farmers who form the backbone of Indian agriculture. Addressing these concerns requires urgent adoption of climate-smart agriculture and climate-resilient technologies that can secure productivity while conserving natural resources and reducing vulnerability. Indian agriculture is therefore undergoing a profound transformation, with climate change compelling us to rethink sustainable food production, environmental conservation, and farmer livelihoods. The increasing frequency of extreme weather, soil degradation, and water scarcity necessitates innovative, science-based solutions and collaborative efforts. Future agriculture is engineering agriculture—engineers must know biology and biologists must know

engineering. Mechnization and automation have been one of the top 20th inventions of the 21st Century. In this context, climate-resilient technologies, smart mechanization, renewable energy, digital innovations, drone applications, and sustainable farming practices have become essential to ensure food and nutritional security. The path forward must be shaped by collaborations, innovations, and commercialization to build a resilient agricultural future for India. Climate-Smart Farming (CSF) offers a sustainable pathway to address these challenges by integrating practices that enhance productivity, build resilience to climate risks, and reduce greenhouse gas emissions. At its core, climate-smart farming focuses on adaptation, mitigation, and sustainability. Adaptive practices such as crop diversification, use of drought- and heat-tolerant varieties, and adjustment of sowing dates help farmers cope with erratic rainfall and rising temperatures. Conservation agriculture minimum tillage, crop residue retention, and crop rotation improves soil health, enhances water retention, and reduces vulnerability to extreme weather events.

Climate-resilient agriculture emphasizes the development and deployment of adaptive technologies, sustainable farming practices, and integrated resource management. The approach includes drought tolerant crop varieties, water harvesting structures, renewable energy use, precision farming, mechanization and digitalization in farming. It also stresses diversification, conservation of soil and water, and risk management strategies. Such innovations are essential not only for ensuring food security but also for safeguarding farm incomes against climate shocks.

Efficient use of resources is another pillar of climate-smart farming. Precision agriculture, drip and sprinkler irrigation, and balanced nutrient management ensure optimal use of water and fertilizers, lowering production costs while minimizing environmental damage. Integrated farming systems that combine crops, livestock, fisheries, and agroforestry further enhance resilience by spreading risk and improving income stability.

Climate-smart farming contributes to climate change mitigation. Practices such as agroforestry, organic manuring, green manuring, and improved livestock management help sequester carbon in soils and biomass, thereby reducing agriculture's carbon footprint. For small and marginal farmers, access to climate information services, weather-based advisories, crop insurance, and digital technologies is crucial to adopt climate-smart practices effectively. Strong extension systems, farmer training, and supportive policies can accelerate large-scale adoption.

In India, significant strides have been made through targeted programs and institutional innovations. The Indian Council of Agricultural Research (ICAR) launched the National Innovations on Climate Resilient Agriculture (NICRA) in 2011 to strengthen the resilience of Indian agriculture against climatic stresses. NICRA works across research, technology demonstration, capacity building, and policy support. The program has introduced drought tolerant crop varieties, improved livestock and fisheries management practices, natural resource conservation models, and innovative farming systems. Through Krishi Vigyan Kendras (KVKs) and research institutes, NICRA has scaled weather-based advisories, integrated farming systems, and resource-conserving practices to thousands of villages.

At the state level, the Government of Maharashtra has pioneered the Project on Climate Resilient Agriculture (PoCRA) (Now Nanaji Deshmukh Krishi Sanjivani Prakalp), supported by the World Bank. Implemented in drought-prone regions such as Marathwada and Vidarbha, PoCRA promotes sustainable practices including efficient water management, soil health improvement, and diversification of cropping systems. The initiative emphasizes community participation through watershed management, farmer producer organizations (FPOs), and the adoption of technologies like micro-irrigation, farm ponds, and

well-recharging structures. By strengthening local institutions, empowering farmers, and reducing vulnerability to climatic shocks, PoCRA has emerged as one of the largest climate-resilience initiatives in India and a replicable model for other Asian countries. Maharashtra's recent initiatives, such as the MahaAgri AI Policy for promoting AI-driven smart farming and the Mahavistaar App for delivering real-time advisories, schemes, and technology access to farmers, serve as promising examples of technology-led agricultural transformation.

Within this broader framework, Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani (MS) has been playing a pivotal role in developing region-specific climate-resilient technologies. VNMKV has a glorious history of more than 106 years in agricultural research. Since its inception, the university has released 160 varieties and hybrids of field, fruit, and vegetable crops, 60 farm implements, and 1146 production technologies spanning crop production, crop protection, animal husbandry, natural resource management, engineering, and home science. Its contributions to cotton research are internationally recognised, including the development of desi cotton varieties with exceptional fibre properties and the first public-sector Bt cotton hybrid in the state, NHH-44 (BG II). The release of three straight Bt cotton varieties such as NH 1901 Bt, NH 1902 Bt, and NH 1904 Bt has empowered cotton growers to save and reuse their own seed.

Globally, millets are cultivated on about 70.8 million hectares, making them one of the most important dryland crops for food and nutritional security. Asia contributes a significant share of this, with India alone accounting for around 15.3 million hectares, the largest millet-growing area in the world. This highlights the crucial role of Asian agriculture, particularly India, in sustaining millet production and promoting climate-resilient food systems. In millets, sorghum, and pulses, VNMKV has made landmark contributions. The release of 'Parbhani Shakti', the first biofortified sorghum variety rich in iron and zinc, marked a milestone in addressing nutritional security under changing climates. Similarly, biofortified pearl millet hybrids AHB 1200 Fe and AHB 1269 Fe provide resilience and high micronutrient content. The pigeonpea varieties BSMR 736, BDN 2, BDN 711, and BDN 13-41 developed by VNMKV are resistant to wilt and sterility mosaic diseases, thereby contributing to enhanced productivity and increased farmers' income. Recently, pigeonpea variety 'Godavari' has demonstrated high yield potential even under rainfed conditions, with climate resilience and tolerance to wilt and sterility mosaic. In soybean, VNMKV has developed climate-smart varieties like MAUS 612, MAUS 725, and MAUS 731 including MAUS 162, a variety suitable for mechanical harvesting. In horticulture, the university is known internationally for 'Parbhani Kranti', the first interspecific hybrid of okra resistant to yellow vein mosaic. The development of Biomix, a bioagent consortium for plant health and productivity, has been widely adopted by the farmers.

In response to increasing water scarcity and erratic rainfall due to climate change, VNMKV has promoted innovative natural resource management practices such as borewell and open well recharging to enhance groundwater sustainability by harvesting excess monsoon rainwater. The construction of farm ponds on farmer fields as per recommended design of the university provides protective irrigation during dry spells, ensuring crop survival and stabilised yields. Renewable energy solutions are also being integrated into farming systems—solar-operated sprayers reduce dependence on fossil fuels, while large-scale AgroPhotovoltaic (AgriPV) projects are being piloted to combine crop cultivation with solar power generation. AgriPV not only reduces energy costs and diversifies farmer income but also moderates field microclimate, thereby reducing heat stress on crops. Together, these water-smart and energy-smart technologies significantly strengthen the resilience of small and marginal holder farmers against climatic uncertainties while promoting sustainable use of natural resources.

On the mechanization front, the University has developed 60 farm implements / equipment including groundnut digger, stripper, seed drill, marking nut dehuller, stubble collector, banana slicer, community

drier, lemon grader, power weeder, bullock-drawn and tractor-operated sprayers, pedal-operated maize thresher, sugarcane earthing-up equipment, turmeric digger, blade harrow, twin ferti hoe, the five-row Broad Bed Furrow (BBF) planter-cum-sprayer, and several other innovative tools. In the Marathwada region, prolonged dry spells during the monsoon often damage crops due to severe moisture stress, while at other times heavy rainfall results in waterlogging. To address these challenges, implements like the BBF planter have been designed to enhance in-situ soil moisture availability, conserve rainwater, and function as drainage channels when excess water occurs, while also providing better aeration in the root zone. Such climate-resilient mechanization solutions not only improve crop productivity under erratic rainfall patterns but also help small and marginal farmers adapt to the increasing uncertainties of climate change by reducing input costs, improving efficiency, and ensuring more reliable harvests. The university is also at the forefront of digital farming and drone technology. With ICAR-NAHEP, VNMKV has established Centres of Excellence in Digital and Sustainable Agriculture, promoting drones, robots, and sensors in agriculture.

Use of Drone in Agriculture : The Ministry of Agriculture and Farmers Welfare, Government of India, has adopted a science-led policy approach for framing Standard Operating Procedures (SOPs) for the use of drones in agriculture by constituting six national-level expert committees. The work of five committees has been completed and the final report of the sixth committee has been submitted. These committees developed generic and crop-specific SOPs for safe, efficient, and environmentally sound drone-based application of pesticides and nutrients, including SOPs for ten major crops released in 2023. Beyond spraying, the committees identified wide-ranging applications of drones in precision agriculture such as resource delivery, decision support, infrastructure mapping, and specified operations, enabled through integration with sensors, AI, IoT, and cloud computing. Key constraints to large-scale adoption—such as high costs, skill gaps, small landholdings, regulatory and infrastructure challenges—were also identified, with recommendations for R&D support, enabling policies, financial incentives, skill development, and public–private partnerships. Expanding drone applications beyond seasonal spraying is essential for economic viability, especially in light of national initiatives like the Namo Drone Didi Yojana, aimed at maximizing the impact of drone technology in Indian agriculture.

VNMKV's initiative to foster the use of drone technology : A six-month professional Agri Drone Course has been started by the University, specifically designed to foster skills and entrepreneurship among agricultural graduates, farmers and rural youth. In addition, the university has established a Custom Hiring Centre to provide drone services for insecticide spraying to farmers at a reasonable price. Furthermore, it has collaborated with the drone industry to set up Remote Pilot Training Organization (RPTO) Centre, offering training and drone pilot license facility. A Centre of Excellence (CoE) in Digital and Sustainable Agriculture has been sanctioned from the Dept of Science and Technology, Govt. of India.

VNMKV's interventions viz., climate-resilient varieties, soil and water conservation, mechanisation, digital advisory, and strong seed systems can transform rainfed farming into a sustainable and profitable enterprise.

In the face of increasing climate uncertainty, climate-smart farming is not merely an option but a necessity. By aligning productivity with environmental stewardship, it offers a practical solution to ensure sustainable agriculture and a resilient tomorrow for farmers and future generations. As we look toward the future, climate-resilient technologies will be the cornerstone of sustainable agriculture. The way forward lies in strengthening collaborations across countries, enhancing investments in research, and promoting innovations that combine traditional knowledge with modern science. With collaborative efforts of policymakers, scientists, institutions, farmers and industry, India can transform its agricultural sector into a resilient, productive, and sustainable system. Such a transformation is essential for realizing the goals of ViksitBharat@1947 and ensuring long-term prosperity, food security, nutritional security and ecological balance for generations to come.

Strengthening Agricultural Research, Education and Extension

Professor B. R. Kamboj
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India has moved from widespread starvation to a food surplus. Despite having 17.78% of the world's population and only 2.4% of total land, India produces large amounts of food, with production rising from 51 million tonnes in 1950 to 357.73 million tonnes in 2024-25. About 58% of people depend on agriculture, which makes up 16% of GDP. Success is due to advances in science and technology since Independence, making India a global leader in key crops and the only country guaranteeing the right to food by law.

Agricultural education, research, and extension form the backbone of the sector, supporting the goal of 5% growth and the vision of 'Viksit Krishi aur Samruddh Kisan' within 'Viksit Bharat.' Achieving this requires coordinated, unified efforts across all pillars.

Overview of the Current State of Agricultural Research, Education, and Extension

India's agricultural education has roots in ancient institutions like Nalanda and Takshila. Modern agrarian science began in 1877 with the first agricultural college in Saidapet, followed by veterinary and agricultural colleges in other cities. By independence, there were 17 agricultural, four veterinary, and one agricultural engineering college. The Indian Council of Agricultural Research (ICAR), formed in 1929, coordinates research and education across the country, overseeing institutes and universities in agriculture, horticulture, fisheries, and animal sciences. Today, India has 75 Agricultural Universities integrating teaching, research, and extension, including 63 State, three Central, five Deemed, and four Central Universities with agricultural faculties.

The network includes 113 ICAR institutes, 731 Krishi Vigyan Kendras, and 69 All India Coordinated Research Projects, supported by 11 regional institutes. With about 30,000 scientists and over 100,000 staff, India's agricultural research and education system is among the largest globally. It has helped transform India from food imports to food security, making the country a top agri-food exporter and the world's second-largest agrarian economy.

Overview of Agricultural Education in India

After independence, India focused on developing agricultural expertise. The Indian Agricultural Research Institute became a Deemed University in 1958, setting a standard for agricultural education. Inspired by Indo-American cooperation, the first agricultural university opened in Pantnagar in 1960, based on the U.S. Land Grant model. Other states soon followed. To ensure consistency, the Indian Council of Agricultural Research (ICAR) introduced a Model Act in 1964 and updated it in 2009. In 1996, ICAR created an Accreditation Board to evaluate universities, revise curricula, and maintain high academic standards.

States mainly oversee agricultural higher education, but it is also on the concurrent list, encouraging collaboration. Agricultural institutions differ from traditional universities by focusing on research, teaching, and farmer support. With the adoption of the National Education Policy 2020, ICAR guides innovation and excellence in agricultural education.

As India faces slow agricultural growth and uneven benefits from scientific progress, under nutrition and child stunting remain serious problems. Income gaps between farming and non-farming communities persist. Globalization brings both challenges and opportunities. To stay competitive, agricultural education must adapt and prepare professionals for a changing world.

Key Gaps and Challenges in Higher Agricultural Education

1. Academic rigor is currently insufficient, and curricula frequently do not address emerging challenges and opportunities. The decline in basic sciences, combined with numerous unfilled faculty positions, has resulted in inadequate academic staffing.
2. The separation between education, research, and extension activities is widening. Integration of international trends and developments is limited, and youth participation in agriculture is steadily decreasing.
3. A substantial disconnect remains between agricultural education and employment outcomes. Many graduates lack essential skills, entrepreneurial training, and experiential learning, which contributes to low employability rates among agriculture graduates (43% for graduates, 25% for postgraduates).
4. Institutional inbreeding is widespread, and access to agricultural education remains limited for rural students, particularly those from tribal and socially disadvantaged backgrounds.
5. Systems for evaluation, monitoring, impact assessment, accountability, and incentives are insufficient. Digitalization efforts are limited, and governance frequently lacks efficiency.
6. Investment in agricultural universities and colleges is inadequate, and available financial resources are steadily declining.
7. New institutions are often established without adequate resources or compliance with established standards. Unplanned division of agricultural universities, insufficient resource planning, and weak coordination between the Centre and states further intensify these challenges.

Although the Indian Council of Agricultural Research (ICAR) and Agricultural Universities (AUs) have contributed significantly to human resource development in agriculture, higher agricultural education in India still faces substantial challenges. Addressing these issues is essential to enhance the vibrancy and appeal of agricultural education.

Current Landscape of Agriculture Graduates

AISHE records show about 2,94,379 students enrolled in undergraduate agriculture programs in India, up from 1,13,595 in 2012-13. This surge in interest creates stiff job competition. Only 29% of top institute graduates got jobs soon after finishing in 2023-24, while 64% pursued further studies. The main challenges are a gap between academia and industry, under-skilled faculty, low entry-level salaries, and a lack of career guidance, leading to difficulties for agriculture graduates finding quality jobs and applying their skills in practice.

Human resource capital is a nation's key asset. NEP 2020 aims to reform education and recognizes the need to revitalize agricultural education. The National Agriculture Education Policy should align with NEP's five pillars—Access, Equity, Quality, Affordability, and Accountability—to help achieve the 2030 Agenda.

Transforming specialized universities into holistic, multidisciplinary institutions is essential. NEP 2020 encourages converting state agricultural and related universities into multidisciplinary education and research universities (MERU) tailored to local socio-economic and technological needs, enhancing their ability to address regional challenges.

Restructuring Agricultural Universities in Accordance with NEP-2020

NEP-2020 calls for turning Agricultural Universities and Colleges into large multidisciplinary institutions or Knowledge Hubs, each with at least 3,000 students, to reduce fragmentation in higher agricultural education.

- ❒ Agricultural education will become multidisciplinary, including basic sciences, social sciences, and allied fields. ICAR-AU single-stream universities are expected to shift to multidisciplinary institutions by 2030, still focusing on agriculture.
- ❒ Many public and private colleges must follow new higher education norms. NEP-2020 aims to phase out the affiliation system by 2035 through university collaboration.
- ❒ ICAR Deemed Universities will be transformed into multidisciplinary, research-focused institutions using existing expertise and resources.
- ❒ Universities should create Institutional Development Plans (IDPs) as strategic guides for growth and funding.
- ❒ Region-specific courses like Coastal, Hill, and Tribal Agriculture address local needs.
- ❒ New degree programs are recommended in areas like biotechnology, nanotechnology, GIS, precision and conservation agriculture, AI, big data, renewable energy, waste management, advanced food processing, and nutrition.
- ❒ Implementing these programs will require more qualified staff and updated teaching methods.

Improvisation is necessary to attain competitive edge

1. OLD Open/Distance/Online
2. Credit bit and credit bite
3. Exam and evaluation reforms
4. Creating research culture
5. 3 and 4 year degree programmes with Multiple exit and entry options
6. Mobility
7. Redesigning and reorganization of courses:
8. Choice of Subjects
9. Multiligualism
10. Academic Bank of Credits

This has to be done at national level some uniformity to enable student mobility and implementation of Academic Bank of Credits. ICAR education division has an important role in creating a frame work for all AUs

Recent initiatives implemented within Agricultural Education include the following:

(a) Ranking of agricultural universities: The top three agricultural universities are recognized annually on 16 July, the Foundation Day of ICAR.

(b) Student READY programme: Launched by the Prime Minister of India on 25 July 2015, this programme comprises five components: Experiential Learning (EL), Rural Agriculture Work Experience (RAWE), In-Plant Training/Industrial Attachment, Hands-on Training (HOT)/Skill Development Training, and student projects.

(c) Declaration of undergraduate degrees as professional degrees.

(d) Reforms to the All India Entrance Examination.

Schemes designed to attract talented students:

- ❒ **National Talent Scholarship (NTS):** Awarded at ₹3,000 per month for undergraduate studies to students who enroll outside their state of domicile and maintain the required academic standards.

- **Post Matric Scholarship for Scheduled Caste and Scheduled Tribe candidates:** This scholarship provides ₹1,000 per month to each eligible student.
- **Merit-cum-Means Scholarship for undergraduate studies:** This scholarship targets meritorious undergraduate students from below poverty line families, with an annual income below ₹1 lakh, to encourage higher studies in agriculture and allied sciences. Recipients receive ₹1,000 per month.
- **Junior Research Fellowship (JRF):** Based on merit in the All India Entrance Examination for Admission (AIEEA-PG), the ICAR-PG Scholarship is awarded to 600 candidates annually for a two-year master's degree, provided they gain admission to agricultural universities in states other than where they completed their undergraduate studies.
- **Senior Research Fellowship (SRF):** This scholarship is awarded to 300 students each year for Ph.D. programs within the ICAR-AU System, contingent upon meeting the prescribed eligibility requirements.
- **International Fellowships:** DARE/ICAR facilitates the annual admission of over 250 foreign students from more than 20 countries to degree programmes in agriculture, horticulture, forestry, veterinary science, agricultural engineering, and related fields.
- **Netaji Subhas-ICAR International Fellowship:** Thirty fellowships are awarded annually for Ph.D. programmes under this scheme. In addition to economy class airfare, Indian fellows studying abroad receive US $2,000 per month, while overseas candidates receive ₹40,000 per month. Both groups receive a lump sum preparatory and contingency amount of US $1,000 and ₹25,000 per annum, respectively.
- India-Africa Fellowship.
- India-Afghanistan Fellowship.

The Development of Agricultural Research in India

Agricultural research in India began in the colonial era and now supports a complex food system. Key innovations have sustained over 1.4 billion people, driven the Green Revolution, and continue to shape the future through advances in biotechnology and sustainable practices. Research has boosted rural economies, created jobs, and helped share expertise with other developing countries.

The National Agricultural Research, Education, and Extension System, led by ICAR, links research institutions with farmers, policymakers, businesses, and international partners. Together, they work to improve food security, livelihoods, and sustainable agriculture through research, education, and outreach.

Going forward, India's agricultural research must feed a growing population and address climate change while protecting the environment. Continued progress in crops, practices, and technology will be crucial, building on a strong foundation for future challenges.

Current Challenges Faced by Indian Agriculture family

- **Overexploitation of Water Resources:** In several regions, farmers extract groundwater from depths greater than 1,000 feet. This extraction threatens water quality, aquifer sustainability, and long-term availability.
- **Disregard for Nature and Loss of Crop Diversity:** In the early 1970s, paddy cultivation accounted for 10.8% of Punjab's and 8% of Haryana's net sown area. These proportions have risen to 73.3% and 39.5%, reflecting a substantial reduction in crop diversity.

- **Imbalances and Regional Disparities:** Discrepancies remain between the demand for and domestic production of essential crops such as rice. Agricultural productivity also differs markedly among regions.
- **Technology Generation and Dissemination:** Agricultural challenges are becoming more complex, and research requires greater capital investment. Climate change, greenhouse gas emissions, and sustainability concerns complicate research and development. Limited technology transfer from developed countries and intellectual property rights constraints make accessing new technologies more difficult and costly. Strengthening self-reliance in agricultural research is essential for India.
- **Viability of Smallholders:** According to the 2015-16 Agricultural Census, 68% of farm holdings are smaller than 1 hectare, and 85% of agricultural households cultivate less than 2 hectares. These small-scale holdings generally fail to generate adequate income through conventional practices.
- **Nutrition, Food Safety, and Health:** India faces the paradox of widespread hunger despite overall food abundance.
- **Low Income of Farmers:** On average, non-agricultural workers earn 3.75 times more than agricultural workers, including both laborers and cultivators.

Emerging trends in agricultural research influence the future trajectory of food production and resource management.

- Precision agriculture and smart farming employ advanced technologies, including the Internet of Things, artificial intelligence, and remote sensing, to optimize farm productivity.
- Sustainable and climate-resilient agricultural practices focus on developing crop varieties tolerant to drought and heat, which is essential for maintaining food security under changing environmental conditions.
- Biotechnology and genetic engineering, including CRISPR and other gene-editing technologies, have enabled the development of high-yield, pest-resistant, and climate-adaptive crops. However, regulatory and ethical considerations continue to influence adoption across regions.
- Urban agriculture encompasses alternative methods such as vertical farming, hydroponics, and aeroponics.
- Alternative protein sources and sustainable livestock management include plant-based proteins, insect farming, and lab-grown meat.
- Big Data and blockchain technologies play a significant role in modern agriculture. Predictive analytics enable data-driven decision-making in crop selection and pest management, while blockchain enhances traceability and transparency in food supply chains, thereby reducing fraud and improving food safety.
- In the livestock sector, research should prioritize assessing the genetic potential of indigenous breeds. Comprehensive studies are required to identify and characterize traits of excellence in Indian breeds.
- Indigenous plant species possessing genes for enhanced nutritive value, such as increased protein and micronutrient content, should be identified and utilized to improve the nutritional quality of rainfed crops.

Contemporary Challenges in Agricultural Research and Development in India

- ❒ Private sector investment in agricultural research and development in India remains constrained, largely as a result of limitations imposed by the current Intellectual Property Rights (IPR) regime.
- ❒ The progress of agricultural biotechnology in India has stagnated due to restrictions on field testing and the decision not to release Bt brinjal.
- ❒ The context of agricultural production, trade, and consumption is becoming more dynamic and is evolving in ways that are difficult to predict.
- ❒ A lack of collaboration and formal agreements among institutions, including between public and private partners, restricts access to new knowledge, weakens the articulation of research and training needs, and impedes both technological and organizational learning, including access to innovation financing.
- ❒ Basic and strategic research provides the foundation for significant breakthroughs in any discipline. Within the National Agricultural Research System (NARS), this area has weakened substantially due to a shift in focus toward applied and problem-solving research. Although this shift produces incremental gains, it does not support major breakthroughs.
- ❒ The Indian Council of Agricultural Research (ICAR) and State Agricultural Universities (SAUs) have identified inadequate research funding as their primary concern.
- ·❒ Fragmentation of the institutional structure, with separate universities for agriculture, animal sciences, horticulture, and fisheries, negatively impacts multidisciplinary research.
- ·❒ Limited budgetary support and the proliferation of institutions undermine the interdisciplinary character of agricultural research, foster turf conflicts, impede research progress, and diminish scientists' morale.

The following reforms are required to enhance the effectiveness of India's agricultural research system.

1. Agro-climatic research should use remote sensing, soil mapping, and geospatial tools to address India's diverse conditions. Lessons from Japan and South Korea show that mixing local practices with resilient crops improves food security and sustainability.
2. India should increase agricultural research funding (currently 0.4% of GDP vs. 1–2% in China/Netherlands) and promote public-private partnerships with tax incentives to boost innovation and infrastructure.
3. Collaboration among universities, industry, and farmers is key for innovation. South Korea's interdisciplinary teamwork raised productivity by 60% in 30 years; India can benefit from similar models.
4. Training programs for researchers and farmers should focus on advanced, locally relevant methods. Israel and Taiwan show that technology and strong support systems work. Adapting research projects to state needs will improve results.
5. Modern technology—drones, data analytics, and biotechnology—can transform agriculture. Funding, policy support, and integrating digital platforms and extension centers will spread innovation. Successful state models should be replicated, and sustainable farming practices prioritized to boost yields and protect the environment.
6. Enhancing the quality of research institutions is more important than merely increasing their quantity.

7. India should create top-tier agricultural research institutes like IITs and IIMs to drive progress.
8. Strengthen higher agricultural education and professional skills to support research, technology, and institutional growth.

Researchable Issues for Indian Research Institutions

Socio-economic and institutional challenges require interdisciplinary research on market access, scheme implementation, landholding, and inclusion for women, youth, and marginalized groups. Tailoring innovations to regions and integrating them with national schemes will help research institutions make agricultural development more effective and sustainable, supporting the Viksit Bharat @2047 vision.

- ❒ Soil Health Management, Sustainability & Environmental Stewardship
- ❒ Precision & Digital Nutrient Management
- ❒ Fertilizer Product Development & Innovation
- ❒ Nutritional Security & Biofortification
- ❒ Development of Machinery, Implements, and Tools for Post-harvest Management
- ❒ Natural Farming and Conservation Agriculture
- ❒ Plant Protection
- ❒ Weed Management
- ❒ Horticulture
- ❒ Animal Science & Fisheries Science
- ❒ Farmer Practices & Indigenous Knowledge

Origin and present status of agricultural extension system in India

Agricultural extension in India has evolved through key initiatives, starting with the Etawah Pilot Project (1948) and Community Development Program (1952). Later programs like the Intensive Agricultural District Program, High-Yielding Variety Program, and National Agricultural Extension Project further developed the system. The creation of Krishi Vigyan Kendras (KVKs) in 1974 played a major role by focusing on on-farm testing and vocational training.

Recent programs like Farmer FIRST, MGMG, ARYA, NARI, VATICA, and KSHAMTA have made extension services more participatory, inclusive, and technology-driven. These initiatives help extension systems address new agricultural and social challenges, meeting the diverse needs of farmers.

Major public extension providers include KVKs, SAUs, and ICT-based programs from the Department of Agriculture. The National Mission on Agriculture Extension and Technology (NMAET), launched in 2014-15, restructured extension services and promoted technology through four sub-missions. New platforms like the Farmers' Portal, m-Kisan, Kisan Call Centre, Kisan TV, and community radio have improved outreach.

The Viksit Krishi Sankalp Abhiyan (VKSA), held in 2025, was a nationwide campaign to engage farmers, share new technologies, and gather feedback. It reached 13.5 million farmers in 728 districts and provided a platform for sharing technology, identifying service gaps, and addressing challenges in technology adoption.

Constraints in the Agricultural Extension System

Extension services were vital during and after the Green Revolution, helping transfer technology, empower farmers, and boost skills, which increased food production and made India self-sufficient. In the past two decades, however, state governments have largely neglected agricultural extension.

The current extension system faces structural and operational issues, mainly due to chronic under investment (just 0.12–0.16% of agricultural GDP in two decades). This has caused major gaps in infrastructure, human resources, and capacity building.

The primary constraints within the Agricultural Extension System are as follows:

- ❒ India employs approximately 0.12 million extension professionals, compared to China's 7.13 million.
- ❒ The extension worker-to-farmer ratio is less than 1:5000, which falls significantly short of the national guidelines of 1:1100 in irrigated areas, 1:750 in rainfed areas, and 1:400 in hilly regions.
- ❒ Insufficient coordination among public institutions, private companies, and civil society organizations results in fragmented efforts and overlapping activities.
- ❒ Limited feedback between research and extension systems often results in innovations that do not address farmers' specific needs.
- ❒ Technology transfer depends primarily on the 731 Krishi Vigyan Kendras (KVKs), while extension agencies at the state, district, block, and village levels remain underutilized.

Transforming the Role of Agricultural Extension

Historically, agricultural extension has concentrated on production. As the sector evolves, adopting a holistic agri-business model that emphasizes value addition, food processing, branding, and enhanced market access is essential. Consequently, modern extension should prioritize the following objectives:

- ❒ Facilitating the inclusion and equity of smallholder and marginal farmers.
- ❒ Advancing sustainable and climate-smart agricultural practices.
- ❒ Delivering advisory services that are market-oriented, value chain-based, and export-driven.
- ❒ Enhancing agri-business literacy, food processing capabilities, branding, and market access.
- ❒ Integrating service providers, agro-industries, and exporters within the agricultural extension framework.

Restructuring the Agricultural Extension System

India's agricultural extension system needs transformation for modern, sustainable, and export-driven farming. While many local innovations succeed, they rarely scale up due to institutional barriers and insufficient policy and funding. Fast-changing markets and technology require a more adaptive, networked extension approach.

New institutional innovations are gradually shaping India's agricultural system. To spread their benefits, scaling up is essential, along with a strong policy framework to promote coordination and knowledge sharing.

A comprehensive upgrade of the current extension system is necessary. The following key actions are recommended.

1. Strengthen Krishi Vigyan Kendras (KVKs) with a uniform structure, a broader mandate, and local offices. KVKs should act as Agri-Clinics, use a single window approach, and partner with private organizations to expand reach and services.
2. Promote digital tools (AI, remote sensing, mobile apps) and virtual KVKs for broader, more targeted extension, including data-driven, district-specific solutions.
3. Strengthen research-extension links by improving feedback and focusing on practical application and impact assessment.

4. Foster government, private, and civil society collaboration for joint demonstrations, advisory services, and training in modern farming.
5. Modernize ATMA, encourage youth entrepreneurship, support agri-startups, build a national extension advisor network, and increase funding.
6. Prioritize on-going training for extension staff, strengthen partnerships with universities and companies, and boost participation of women and youth.
7. Learn from international extension models, such as the decentralized systems in the US and Australia, integrated approaches in China, and technology-driven strategies in Israel. India's system remains mostly supply-driven with limited feedback.

With more investment, coordination, and innovation, India's extension system can boost agricultural productivity and sustainability, aligning with the vision of "Better Production, Better Nutrition, Better Environment, and Better Life."

Anticipated challenges and strategic priorities

1. Systematically revise and improve the academic curriculum
2. Integrate advanced technologies into teaching and learning
3. Apply national and international best practices to provide practical, future-focused education and training
4. Promote problem-solving, innovation, community engagement, and forward-thinking among students
5. Optimize faculty, resources, infrastructure, and funding across all institutions
6. Build and strengthen institutional partnerships nationally and internationally, including collaborative clusters
7. Secure additional funding for education and research
8. Involve stakeholders in training, internships, industry-aligned courses, and collaborative research
9. Develop comprehensive emergency preparedness strategies for teaching and research environments encourage original research over adoption and repetition

Summary of key conclusions

1. The National Agricultural Research, Education, and Extension system is the largest globally and has produced substantial benefits
2. The National Agricultural Research, Education, and Extension System (NARES) should be restructured and revitalized to align with contemporary, technology-driven pedagogical methods
3. Course curricula should be revised to emphasize outcome-based learning, increased flexibility, and expanded elective options. Vocational courses should be integrated within the initial two years
4. Faculty should receive training in innovative pedagogical strategies and blended learning techniques
5. The Land-Grant System should be reassessed to enhance resource utilization, expand student enrolment, and facilitate the establishment of Model Education and Research Units (MERUs)
6. The creation of mono-disciplinary universities should be discouraged
7. A cluster approach should be adopted, grouping institutions to facilitate the sharing of distinguished faculty, courses, and equipment across a broader network

8. Research funding should be increased while maintaining a salary-to-Agricultural Research for Development (AR4D) expenditure ratio of 60:49
9. Admissions and recruitment processes should be accessible to talented individuals from diverse backgrounds and disciplines
10. Regulatory frameworks should promote institutional advancement and minimize unnecessary constraints
11. Accreditation processes should be strengthened through the establishment of clear and distinct criteria for programs, colleges, and universities
12. Accreditation and educational standards should be aligned with the Higher Education Commission of India (HECI), National Higher Research and Education Council (NHREC), General Education Council (GEC), and National Accreditation Council (NAC) via the Department of Agricultural Research and Education (DARE) to secure statutory recognition
13. A National Agricultural Education Commission should be established to examine, prioritize, restructure, and recommend essential reforms.
14. An India-centric approach should be maintained while integrating international educational content to strengthen the country's influence in the Afro-Asian region and globally
15. Universities should foster diversity in academic content, faculty, and student populations to ensure broad relevance and prevent academic inbreeding.

Future Perspectives of Genome Editing and Cloning in Animals

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Abstract

Reproductive biotechnologies have profoundly advanced livestock productivity worldwide, including in India, with genome editing and animal cloning emerging as transformative tools to enhance production traits and overcome disease-related challenges. Genome editing technologies, particularly CRISPR-Cas systems, have enabled precise genetic modifications leading to significant breakthroughs such as myostatin (MSTN) knockout beef cattle with enhanced muscle growth, β-lactoglobulin (BLG)-free dairy animals producing hypoallergenic milk, FGF5 knockout sheep with superior fiber yield, and the development of disease-resistant livestock including cattle resistant to bovine viral diarrhea virus (BVDV) and pigs resistant to porcine reproductive and respiratory syndrome (PRRS). These innovations demonstrate the role of genome editing in improving animal health, welfare, and farm-level sustainability. Parallel progress in animal cloning has facilitated large-scale multiplication of elite germplasm, and commercial companies across the world now offer cloning services, enabling the conservation and rapid dissemination of superior genetic resources. A landmark development in 2025 was the approval by the U.S. FDA of the world's first gene-edited livestock—PRRS-resistant pigs—for commercial use, underscoring the transition of genome editing from experimental research into real-world agricultural practice and marking a new era in livestock biotechnology. Taken together, genome editing and cloning provide unprecedented opportunities to enhance productivity, improve disease resilience, ensure food safety, and strengthen food security, thereby offering sustainable solutions to meet the rising global demand for animal protein while addressing the pressing challenges of climate change and agricultural sustainability.

Keywords: Livestock, Animal Cloning, Genome editing, OPU-IVF, SCNT, CRISPR, PRRS-resistant pig.

1. Introduction

The global population is projected to reach 9.7 billion by 2050, with the majority of this growth occurring in tropical and subtropical regions, particularly in Asia and Africa (United Nations, Department of Economic and Social Affairs, 2019). Livestock production, which contributes substantially to global food supply, will therefore require significant efficiency gains to sustainably meet future food and nutritional demands. Over recent decades, reproductive biotechnologies have emerged as powerful tools to accelerate genetic improvement in farm animals. Techniques such as artificial insemination (AI), embryo transfer (ET), ovum pick-up coupled with in vitro fertilization (OPU-IVF), and somatic cell nuclear transfer (SCNT) have been instrumental in propagating superior germplasm, enhancing reproductive efficiency, and conserving valuable genetic resources (Jennife et al., 2013). These methods have already had a profound global impact (Hasler, 2014; Moore et al., 2017; Sjunnesson et al., 2019), enabling rapid dissemination of elite traits and contributing to the preservation of endangered livestock breeds. In parallel, the advent of genome editing technologies, most notably CRISPR-Cas systems, has revolutionized the scope of targeted genetic improvement. CRISPR enables precise, efficient, and relatively cost-effective genetic modifications, with wide-ranging applications including accelerated growth rates, increased milk yield, improved fiber quality, enhanced disease resistance, and better adaptability to climate stressors (Pacesa et al., 2024). More recent innovations, such as base editors and prime editors, have further expanded the genome editing toolkit by allowing highly accurate single-nucleotide substitutions without the requirement for donor DNA templates (Averina et al., 2024). Additionally, CRISPR-based recombinases and transposases now hold promise for the precise insertion of large DNA fragments (Chen et al., 2024), thereby broadening the scope of genetic interventions possible in livestock. The integration of genome editing with cloning technologies offers a particularly powerful synergy, as animals with desirable traits generated through genome editing can be replicated rapidly via cloning, enabling faster multiplication of elite genotypes and the preservation of rare or locally adapted breeds. Such combined approaches not only accelerate production efficiency but also contribute to biodiversity conservation and animal welfare, thereby positioning reproductive biotechnologies and genome editing at the forefront of sustainable livestock improvement in the twenty-first century. This chapter therefore highlights the transformative role of reproductive biotechnologies and genome editing in shaping the future of livestock production systems worldwide.

The global population is projected to reach 9.7 billion by 2050, with the majority of this growth occurring in tropical and subtropical regions, particularly in Asia and Africa (United Nations, Department of Economic and Social Affairs, 2019). Livestock production, which contributes substantially to global food supply, will therefore require significant efficiency gains to sustainably meet future food and nutritional demands. Over recent decades, reproductive biotechnologies have emerged as powerful tools to accelerate genetic improvement in farm animals. Techniques such as artificial insemination (AI), embryo transfer (ET), ovum pick-up coupled with in vitro fertilization (OPU-IVF), and somatic cell nuclear transfer (SCNT) have been instrumental in propagating superior germplasm, enhancing reproductive efficiency, and conserving valuable genetic resources (Jennife *et al.*, 2013). These methods have already had a profound global impact (Hasler, 2014; Moore et al., 2017; Sjunnesson *et al.*, 2019), enabling rapid dissemination of elite traits and contributing to the preservation of endangered livestock breeds. In parallel, the advent of genome editing technologies, most notably CRISPR-Cas systems, has revolutionized the scope of targeted genetic improvement. CRISPR enables precise, efficient, and relatively cost-effective genetic modifications, with wide-ranging applications including accelerated growth rates, increased milk yield, improved fiber quality, enhanced disease resistance, and better adaptability to climate stressors (Pacesa *et al.*, 2024). More recent

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2. Reproductive Biotechnologies

Reproductive biotechnologies have transformed livestock production by enabling the rapid multiplication of high-quality germplasm, thereby accelerating genetic improvement. Among these, artificial insemination (AI) remains the most widely used technique globally, including in India (Sjunnesson et al., 2019; Saha et al., 2021). For decades, AI has been central to livestock development programs, allowing the use of semen from genetically superior bulls to enhance both productivity and genetic quality of herds. Building on this foundation, embryo transfer (ET) emerged as the second generation of reproductive biotechnology, focusing on the multiplication of superior females. In ET, embryos are collected from a genetically elite donor female and transferred into surrogate mothers. While AI primarily facilitates dissemination of male genetics, ET enables propagation of valuable female lines (Sjunnesson et al., 2019). However, the number of offspring that can be obtained from a single female through ET remains limited, restricting its scalability.

The third generation, ovum pick-up followed by in vitro fertilization (OPU-IVF), addressed this limitation by enabling repeated oocyte collection from elite females within a short period (Ferré et al., 2020). These oocytes can be fertilized in vitro using semen from different bulls, providing flexibility in breeding strategies and accelerating the expansion of superior female germplasm. OPU-IVF also integrates effectively with genomic selection, thereby enhancing genetic gain. Despite these advantages, both ET and OPU-IVF require highly skilled personnel, advanced laboratory infrastructure, and are more costly compared to AI, which constrains their widespread use. In recent years, in vitro embryo production (IVEP) has surpassed in vivo embryo production in both adoption and success rates, highlighting the growing impact of laboratory-based reproductive methods on livestock improvement (Ferré et al., 2020).

The fourth generation of reproductive biotechnology is animal cloning, scientifically referred to as somatic cell nuclear transfer (SCNT). In this process, a somatic cell from a desired animal is reprogrammed to a totipotent state to generate an embryo, which can then develop into a genetically identical animal when transferred into a surrogate. Cloning plays a unique role in producing exact genetic replicas of valuable animals and conserving endangered breeds (Keefer, 2015). While its commercial application in dairy and meat sectors is still limited, cloning has gained traction in pet and companion animals, including horses, with multiple companies worldwide offering cloning services (Olsson et al., 2022).

In India, reproductive biotechnologies have also been employed to improve livestock quality, but adoption has been uneven. At present, AI is the most widely implemented technology, yet its coverage extends to only 30–40% of the national herd, significantly below the 80–90% target required to maximize productivity

from existing land and feed resources (Saha et al., 2021). To address this gap, the Government of India launched the Rashtriya Gokul Mission (RGM) in 2014, aimed at accelerating multiplication of indigenous germplasm through ET and OPU-IVF (https://www.dahd.gov.in/schemes/programmes/rashtriya_gokul_mission). These initiatives have demonstrated success in producing genetically superior calves; however, the application of advanced reproductive biotechnologies remains confined to a few research institutions, with limited field-level deployment and a relatively small number of calves produced (Annual Report, 2024–25, Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India). Cloning research has also progressed in India, but its use is largely restricted to laboratories, despite its significant potential for replicating elite animals and conserving endangered breeds (Selokar et al., 2022).

Scaling up such advanced technologies for commercial use continues to face challenges, including high operational costs, technical complexity, limited skilled manpower, and the need for specialized infrastructure. Ethical concerns and the absence of clear regulatory guidelines for cloned animals further slow the transition from laboratory research to farm-level application. To ensure India's livestock sector remains competitive and capable of meeting future food demands, a holistic strategy is required that integrates AI, ET, OPU-IVF, cloning, and emerging tools such as genome editing. Such integration will enable rapid dissemination and multiplication of top-tier genetics, ensuring animals with higher productivity, improved disease resistance, and enhanced adaptability to climate challenges. Strong government support in expanding AI coverage, establishing regional ET and OPU-IVF centers, promoting public-private partnerships for scaling up cloning, and developing cost-effective, field-suitable protocols will be critical for realizing the full potential of reproductive biotechnologies in India.

2. Genome Editing

Genome editing is a powerful biotechnological approach that enables precise modification of DNA at specific locations in an animal's genome, allowing targeted changes in nucleotide sequences to introduce, delete, or replace genetic material and thereby create animals with tailored traits such as enhanced productivity, improved disease resistance, and better welfare (Pacesa et al., 2024). Over the past two decades, several genome editing tools have been developed, including Zinc Finger Nucleases (ZFNs), Transcription Activator-Like Effector Nucleases (TALENs), and the now widely adopted CRISPR-Cas systems. These tools function by creating targeted double-strand breaks in DNA, which are subsequently repaired by the cell's natural mechanisms, leading to the desired modifications. Compared to traditional breeding, genome editing is faster, more precise, and capable of introducing beneficial traits that would otherwise take many generations to achieve (Pacesa et al., 2024).

The application of genome editing in livestock has opened unprecedented opportunities for transforming animal production systems. It offers the potential to boost productivity, enhance disease resistance, and develop animals resilient to climate change (Fig. 2). A key example is the knockout of the myostatin (MSTN) gene, which has been applied in cattle, buffalo, pigs, sheep, and goats, resulting in animals with increased muscle mass and higher meat yield (Bi et al., 2016; Gim et al., 2022; Zhang et al., 2019; Crispo et al., 2015). Such modifications address the growing global demand for protein without proportionally increasing the use of land, feed, and water resources. Beyond production traits, genome editing is also being harnessed to improve product quality and human health compatibility, exemplified by the generation of β-lactoglobulin (BLG)-free milk aimed at eliminating a major allergen in cow's milk (Sun et al., 2018). This innovation has significant implications for the development of hypoallergenic dairy products and for expanding consumer access to nutritionally beneficial animal-derived foods. Disease resistance represents another high-impact

application area: pigs resistant to Porcine Reproductive and Respiratory Syndrome (PRRS) have been developed by modifying the CD163 gene, which the virus exploits for entry into host cells (Whitworth et al., 2016). Such innovations can dramatically reduce the economic and welfare costs associated with major livestock diseases.

The full potential of genome editing in livestock can be realized when integrated with advanced reproductive biotechnologies such as AI, ET, OPU-IVF, and cloning. Genome-edited embryos can be efficiently propagated through these reproductive tools, enabling rapid multiplication of genetically improved animals (Mueller et al., 2022). For example, OPU-IVF systems can be used for repeated production of genome-edited embryos from elite females, while cloning permits exact replication of high-value genome-edited individuals. This synergy reduces the time required to disseminate beneficial traits across populations and ensures genetic uniformity, ultimately transforming livestock breeding programs into faster, more targeted, and more sustainable systems.

Globally, genome editing in livestock has progressed from proof-of-concept studies to real-world applications, with a landmark achievement being the 2025 approval by the U.S. FDA of PRRS-resistant pigs for commercial use. This development signals the transition of genome editing into mainstream livestock production and demonstrates its viability as a tool for improving animal agriculture. In India, however, the field remains in its nascent stage, with progress only recently gaining momentum. Several institutes under the Indian Council of Agricultural Research (ICAR) have initiated projects exploring the potential of genome editing in farm animals, with efforts directed toward enhancing milk yield, growth rate, reproductive efficiency, and disease resistance. Among these, the ICAR–National Dairy Research Institute (NDRI) has achieved notable early successes, applying CRISPR-based tools for targeted gene modifications in dairy animals (Dua et al., 2023; Tara et al., 2024; author's lab work). With its advanced biotechnology infrastructure and expertise in reproductive technologies, NDRI is now positioned as a national leader in livestock genome engineering and capable of contributing at the global level.

Despite these promising advances, the translation of laboratory results into field-level applications in India remains constrained by multiple factors. Chief among these is the absence of a comprehensive and supportive regulatory framework for genome-edited livestock. While India has established biosafety and regulatory mechanisms for genetically modified organisms (GMOs) in crops, current policies do not explicitly address genome editing in animals, especially when edits involve no insertion of foreign DNA. To enable the safe, ethical, and sustainable use of genome editing in livestock, India must adopt a regulatory framework that is science-based, proportionate to actual risks, and aligned with global best practices. Such a framework will facilitate the responsible commercialization of genome-edited livestock, encourage public-private partnerships, and help position India as a leader in livestock biotechnology innovation at a time when global food security and agricultural sustainability are of critical concern.

4. Applications in Livestock Agriculture

4.1 Multiplication and Conservation

Conventional selective breeding has long served as the cornerstone of livestock genetic improvement. While effective, this approach is inherently slow, often requiring several generations to realize substantial gains (Schultz et al., 2020). Reproductive biotechnologies provide an accelerated pathway, with somatic cell nuclear transfer (SCNT) emerging as a particularly powerful tool.

SCNT enables the cloning of elite animals possessing desirable traits such as high milk yield, superior feed efficiency, climate resilience, and disease resistance (Moore & Hasler, 2017). Once produced, these clones

can be integrated into ovum pick-up and in vitro fertilization (OPU-IVF) programs to rapidly multiply superior germplasm (Polejaeva et al., 2013; Selokar et al., 2025). Research has consistently demonstrated that clones generally exhibit normal growth, physiology, reproductive performance, and overall health, with their offspring indistinguishable from those produced via conventional breeding methods (Tecirlioglu et al., 2006; Smith et al., 2007; Ortegon et al., 2007; Polejaeva et al., 2013; Selokar et al., 2019; Yadav et al., 2024; Selokar et al., 2025). Importantly, the U.S. FDA has confirmed that meat and milk derived from clones and their progeny are safe for human consumption (FDA, 2008).

Beyond genetic gain, SCNT has enormous potential in conservation of endangered livestock breeds. The Food and Agriculture Organization (FAO) reports that 7% of the world's documented livestock breeds (out of 8,859) are already extinct, and 2,360 breeds are at risk of disappearing in the near future (FAO, 2023). For such at-risk breeds, SCNT provides a viable rescue strategy. However, a major limitation is the scarcity of oocytes from endangered animals. This can be addressed through interspecies SCNT (iSCNT), where somatic cells from endangered breeds are fused with enucleated oocytes from more common, related breeds.

For instance, somatic cells from India's critically endangered Punganur cattle could be paired with oocytes from more abundant indigenous breeds such as Sahiwal, Gir, or Tharparkar. Similar strategies have already been successfully demonstrated in endangered species such as the Gaur (Lanza et al., 2000), European mouflon (Loi et al., 2001), African wildcat (Gomez et al., 2004), and Bactrian camel (Wani et al., 2017). These successes underscore the urgent need to systematically collect and cryopreserve somatic cells or tissue samples from threatened breeds in national bio-banks. In the event of population collapse, these stored cells can be revived through iSCNT, thereby preserving biodiversity and safeguarding valuable genetic resources for future generations.

4.2 Improving Productivity Traits

Genome editing (GE) technologies provide a precise and transformative approach to improving key livestock traits associated with milk, meat, and fiber production. Unlike conventional breeding, which relies on naturally occurring genetic variation and requires multiple generations, GE enables targeted modifications that can directly introduce desirable traits within a single generation.

Milk Production

A major focus of GE in dairy animals has been the removal of allergens such as β-lactoglobulin (BLG). While absent in human milk, BLG is a common whey protein in cow and goat milk and is known to trigger allergic reactions in infants (El-Agamy, 2007; Roth-Walter et al., 2021). Using GE, researchers have successfully developed animals that produce BLG-free milk. In some cases, these animals also secrete beneficial human proteins such as lactoferrin and serum albumin, which enhance both the nutritional and therapeutic value of milk (Cui et al., 2015; Luo et al., 2016). Another milestone has been the introduction of the human lysozyme gene into cows, producing milk with natural antimicrobial activity against mastitis-causing pathogens (Liu et al., 2014). Such advances not only improve milk safety and infant nutrition but also reduce the reliance on antibiotics in dairy farming.

Meat Production

In meat animals, the myostatin (MSTN) gene has been a central target. MSTN acts as a negative regulator of muscle growth. Naturally occurring MSTN mutations in breeds such as the Belgian Blue lead to the "double-muscled" phenotype, characterized by enhanced muscle mass without adverse health effects (McPherron et al., 1997). Through GE, scientists have replicated these beneficial mutations across multiple species—including cattle, pigs, sheep, goats, and buffalo—resulting in substantial increases in muscle yield,

improved feed conversion efficiency, and higher profitability for farmers (Crispo et al., 2015; Wang et al., 2015; Yu et al., 2016; Gim et al., 2022).

Fiber Production

For fiber-producing livestock, GE has been utilized to improve wool and hair quality. Wool is a renewable and eco-friendly textile source, yet its growth is naturally restricted by the fibroblast growth factor 5 (FGF5) gene, which limits hair and fiber elongation. Knocking out FGF5 through GE has yielded sheep and goats with longer, softer, and stronger fibers (Wang et al., 2016; Hu et al., 2017). These modifications not only enhance textile quality but also significantly increase the commercial value of each animal's yield.

4.3 Enhancing Disease Resistance Traits

Livestock are highly susceptible to a wide range of infectious diseases that compromise animal health, reduce productivity, and result in substantial economic losses. Conventional disease-control approaches—such as vaccination, improved biosecurity, and antibiotic therapy—have provided some relief, but they often require repeated interventions, entail high costs, and may be limited in long-term effectiveness. Genome editing (GE) offers a more durable solution by directly modifying host genetic architecture to confer disease resistance.

Disease Resistance in Dairy Cattle

Mastitis remains one of the most persistent and economically significant diseases in dairy cattle, caused primarily by Staphylococcus aureus, Escherichia coli, and Streptococcus spp. GE strategies have focused on altering the udder's microenvironment to reduce bacterial colonization. A landmark example is the targeted insertion of the human lysozyme gene into the bovine casein locus, producing milk with enhanced antibacterial properties and significantly lowering mastitis incidence (Liu et al., 2014). In addition, targeted modification of the bovine CD46 gene has generated calves resistant to Bovine Viral Diarrhea Virus (BVDV), one of the most challenging viral diseases in the cattle industry (Workman et al., 2023).

Disease Resistance in Pigs

In swine production, viral diseases such as Porcine Reproductive and Respiratory Syndrome (PRRS) and Classical Swine Fever (CSF) remain major global threats. PRRS virus (PRRSV) requires the CD163 receptor to gain entry into host cells. Through GE-mediated disruption of CD163, scientists have developed pigs that are completely resistant to PRRSV infection (Whitworth et al., 2016; Guo et al., 2019). For CSF, transgenic approaches involving the introduction of the human MxA gene or insertion of the pRSAD2 gene at the porcine ROSA26 locus have demonstrated strong antiviral properties (Zhao et al., 2016; Xie et al., 2020).

Translational Milestones

A major breakthrough in this field is the recent approval of PRRS-resistant GE pigs for commercial production by the U.S. FDA—marking one of the first successful translations of genome editing from laboratory research to real-world livestock farming (PIC, 2023). This milestone establishes a precedent for the regulatory acceptance and deployment of GE-based disease resistance in farm animals, paving the way for broader adoption in other species and diseases.

4.4 Biomedical Application

Genome-edited (GE) livestock have emerged as transformative tools for biomedical research, offering distinct advantages over traditional rodent models. Unlike mice or rats, large animals such as pigs, sheep, and goats exhibit physiological, anatomical, and metabolic characteristics that more closely resemble those of humans, making them superior models for studying human disease and testing therapeutic

strategies (Lin et al., 2022).

Pigs as Biomedical Models

Among livestock, pigs are the most extensively utilized GE species in biomedical research. Their organ size, lifespan, and genetic similarity to humans provide unique opportunities for modelling complex diseases and evaluating potential treatments (Lin et al., 2022). Notable examples include:

- **Huntington's disease (HD):** A GE pig model created by inserting an expanded CAG repeat into the HTT gene successfully recapitulates the neuropathology and behavioral abnormalities of HD, enabling exploration of gene therapy and drug interventions (Yan et al., 2018).
- **Serotonin deficiency:** Pigs engineered with serotonin-related gene modifications provide a model for studying psychiatric and neurological disorders (Li et al., 2018).
- **Complement protein deficiency:** GE pigs lacking key complement proteins serve as models for immune disorders and transplant research (Zhang et al., 2017).
- **Cardiovascular diseases:** Targeted gene modifications in pigs mimic human heart diseases, allowing for the testing of surgical interventions and novel therapies (Huang et al., 2017).
- **Type II collagenopathy:** Pigs engineered with mutations in COL2A1 replicate skeletal dysplasias and joint diseases in humans, offering platforms for orthopedic research (Zhang et al., 2020).

Sheep and Goats as Biomedical Models

Sheep and goats also play an important role as GE biomedical models, particularly in diseases where body size, tissue structure, and lifespan are critical for translational outcomes. Examples include:

- **Cystic fibrosis (CF):** GE sheep models carrying CFTR mutations reproduce hallmark symptoms of CF, providing a long-lived system to evaluate new therapies (Fan et al., 2018).
- **Hypophosphatasia:** GE goats have been developed to mimic this rare metabolic bone disorder, facilitating preclinical evaluation of enzyme replacement therapies (Williams et al., 2018).
- **Otoferlin-related deafness:** GE goats with otoferlin mutations replicate congenital hearing loss, offering realistic models for auditory gene therapy trials (Menchaca et al., 2020).

Translational Significance

These GE livestock models not only reproduce the clinical manifestations of human genetic and metabolic disorders but also serve as invaluable preclinical platforms for testing gene therapies, novel drugs, surgical interventions, and regenerative medicine approaches. Their closer physiological resemblance to humans compared to rodents greatly enhances the likelihood of translational success, bridging the gap between laboratory research and clinical application.

5. Regulatory Status of Gene-Edited and Cloned Animals

The regulatory landscape for genome-edited (GE) and cloned animals varies widely across the globe, reflecting divergent scientific, ethical, and socio-political perspectives. While some nations have embraced progressive, science-driven frameworks that recognize the potential of these technologies for sustainable food production and biomedical innovation, others maintain restrictive approaches due to concerns about animal welfare, ethics, and consumer acceptance.

Gene-Edited Animals

A number of countries—including Argentina, Australia, Brazil, Colombia, and Japan—classify site-directed

nuclease 1 (SDN1) and site-directed nuclease 2 (SDN2) modifications as equivalent to naturally occurring mutations (Ledesma et al., 2024). Under these frameworks, if no foreign DNA remains in the final organism, the edit is regulated similarly to outcomes achieved through conventional breeding. This pragmatic approach has accelerated the approval of GE animals for agricultural use.

Notable regulatory approvals include:

- **Japan:** Authorized several fast-growing fish species, including red sea bream, olive flounder, and tiger pufferfish, engineered for enhanced growth rates.
- **Argentina & Brazil:** Approved MSTN-knockout fish and cattle, enabling increased muscle mass and improved productivity.
- **United States & Colombia:** Cleared PRRS-resistant pigs for commercial production, a landmark approval in GE disease-resistance livestock (Van Eenennaam, 2023; PIC, 2025).
- **Brazil, Argentina, & the United States:** Authorized cattle carrying the "slick" gene edit, which provides heat tolerance without compromising milk or meat yield (Hallerman et al., 2024).

Together, these developments highlight a growing global consensus that precisely targeted, DNA-free genome edits can be regarded as natural genetic variations, offering safe and beneficial applications for agriculture.

Cloned Animals

The regulation of cloned livestock also varies considerably:

- **United States:** The FDA (2008) determined that meat and milk from cloned animals and their progeny are safe for human consumption, with no requirement for special labeling.
- **European Union:** Enforces stricter controls, driven by animal welfare and ethical concerns, and does not permit cloned animal products in the food chain.
- **Asia-Pacific:** Countries such as China, South Korea, and Australia actively employ cloning for the multiplication of elite livestock germplasm and, increasingly, for companion animal reproduction (Selokar et al., 2022).

India's Current Status

In India, there are currently no dedicated regulatory guidelines for genome-edited or cloned animals. While this regulatory vacuum has enabled significant research progress and successful proof-of-concept demonstrations, it also creates uncertainty for technology translation, commercialization, and global trade acceptance.

For India to fully harness the benefits of animal biotechnology, it will be essential to establish:

- Science-based and transparent regulatory frameworks aligned with international standards.
- Ethical and welfare safeguards to address societal concerns.
- Farmer-centric policies ensuring that benefits reach producers directly.

Such steps will allow India to transform its advances in GE and cloning into tangible gains for agricultural productivity, food security, conservation of indigenous breeds, and global competitiveness.

6. Future Prospects

Genome editing technologies such as CRISPR-Cas systems are revolutionizing livestock breeding by enabling precise, targeted modifications to enhance productivity, disease resistance, and climate resilience. Despite their transformative potential, several challenges remain—most notably the risk of off-

target mutations and the dependency on protospacer adjacent motif (PAM) sequences, which can restrict editing efficiency (Pacesa et al., 2024). To address these limitations, next-generation tools have emerged:

- ❒ Base editors and prime editors, which allow single-nucleotide substitutions without requiring donor DNA templates.
- ❒ CRISPR-based recombinases and transposases, which facilitate accurate insertion of larger DNA fragments, thereby broadening the scope of genetic interventions (Kantor et al., 2020).

Cloning serves as a powerful complement to genome editing, enabling the replication and multiplication of edited genotypes. By cloning genome-edited founders, elite traits can be rapidly propagated into large herds, ensuring uniformity and accelerated dissemination of genetic improvements. This synergy is particularly valuable for traits such as disease resistance, where a single successfully edited animal can give rise to entire populations carrying the beneficial modification. Beyond productivity gains, cloning also holds promise for conservation biology, where preserved somatic cells from endangered or locally adapted breeds can be revived and multiplied to restore threatened populations.

Looking forward, the integration of genome editing and advanced cloning is poised to transform global livestock agriculture. Together, these technologies could enable the large-scale production of disease-resistant, climate-resilient, and welfare-friendly livestock, while safeguarding genetic diversity. Such innovations will not only help meet the rising global demand for animal protein but also advance goals of sustainability, environmental stewardship, and ethical responsibility. This convergence represents a new era of high-precision livestock farming, aligning agricultural innovation with the broader imperatives of food security, biodiversity conservation, and planetary health.

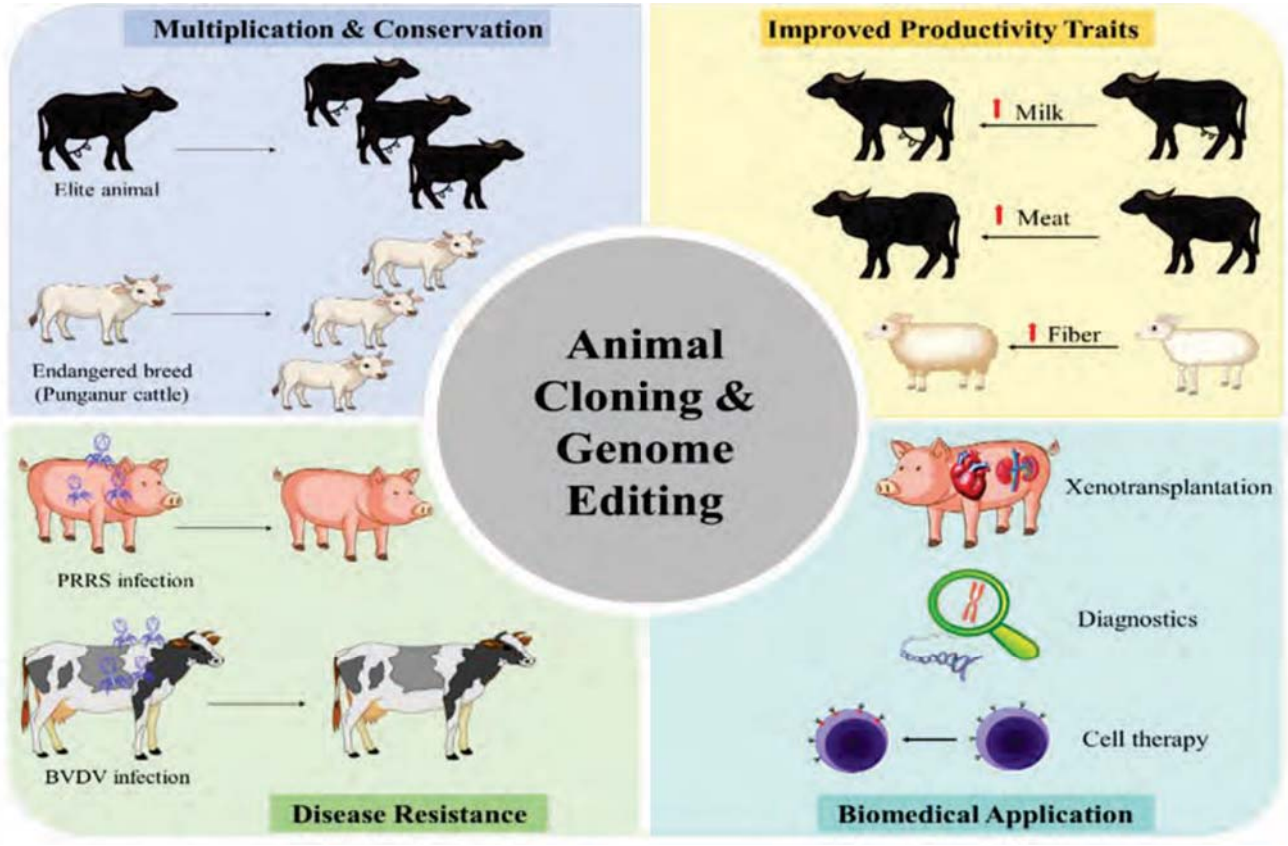


Figure - 1: Applications of animal cloning and genome editing for sustainable livestock improvement.



Figure - 2 : Timeline of key achievements in reproductive biotechnology in India: (A) 10 calves from a single cow via embryo transfer (1990); (B) world's first IVF buffalo calf (1991); (C) world's first cloned water buffalo (2009); (D) India's first OPU–IVF cow (2012); (E) birth of cloned buffalo in the field (2017); (F) seven cloned copies from a single bull (2019–2020); (G) cloned buffalo Garima produced eight calves in lifetime (2024); (H) India's first cloned cow (2023).

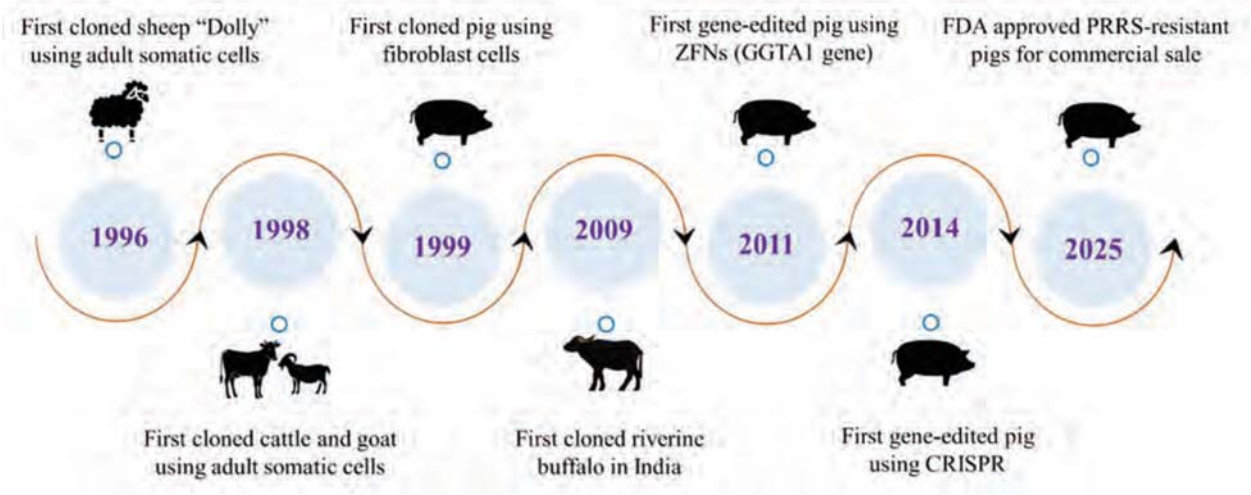


Figure - 3 : Chronological breakthroughs in animal cloning and genome editing.

Table - 1 : Applicationof genome editingfor improved production and health of livestock species

Category	Target Gene	Species	Trait	Reference(s)
Productivity trait	MSTN	Pig	Enhanced muscle mass	Bi et al. (2016)
		Cattle	Enhanced muscle mass	Gim et al. (2022)
		Goat	Enhanced muscle mass	Zhang et al. (2019)
		Sheep	Enhanced muscle mass	Crispo et al. (2015)
	BLG	Cattle	BLG allergen-free milk	Sun et al. (2018)
		Goat	BLG allergen-free milk	Cui et al. (2016)
	FGF5	Sheep	Increased fiber length	Li et al. (2017)
		Goat	Increased fiber length	Wang et al. (2016)
Disease resistance	Lysozyme (HLZ)	Cattle	Mastitis resistance	Liu et al. (2014)
	CD46	Cattle	BVDV resistance	Workman et al. (2023)
	CD163	Pig	PRRS resistance	Whitworth et al. (2016)

Table - 2: Global status of genome-edited livestock.

Target Gene	Description	Country	Company
PRLR	PRLR edited cows exhibit short hair phenotype (SLICK phenotype), which results in improved heat tolerance, thus, results in weight gain and enhance milk production.	USA, Brazil, Argentina	Acceligen, USA
CD163	Pigs with edited CD163 receptor, prevent PRRS virus entry and provide resistance to Porcine Reproductive and Respiratory Syndrome (PRRS).	USA, Columbia, Brazil, Dominican Republic	Genus PIC, USA
MSTN	MSTN gene knockout allowed the enhanced muscle growth in Red Seabream.	Japan	Regional Fish Institute, Japan
Leptin Receptor	Pufferfish developed by disrupting leptin receptor gene allows the fish to eat more and grow faster.	Japan	Regional Fish Institute, Japan

Traditional Livestock Management with Smart Health Monitoring

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Introduction

Livestock plays a crucial role in ensuring food security, rural livelihood generation, and sustainable agricultural development in many countries, particularly in India. Dairy and livestock farming contribute significantly to the agricultural economy and provide employment opportunities for millions of small and marginal farmers. Traditionally, livestock management practices have relied heavily on indigenous knowledge, farmer experience, and locally available resources. These traditional methods have supported sustainable animal production systems for generations. Traditional livestock management systems are characterized by manual feeding practices, open grazing, natural breeding, and health monitoring based primarily on visual observation and experiential judgment. Farmers often identify health problems by observing behavioral changes, feed intake patterns, and visible symptoms. These methods have proven effective under small herd conditions and resource-limited environments.

However, with increasing herd sizes, intensification of livestock production systems, rising market competition, and growing consumer demand for traceability and quality assurance, traditional management approaches alone are no longer sufficient. There is an increasing need for integrating modern technological interventions into livestock management systems to improve productivity, disease surveillance, and overall animal welfare. Smart health monitoring technologies represent a transformative approach in livestock farming by enabling continuous, automated, and real-time monitoring of animal health parameters. These technologies combine sensors, digital platforms, data analytics, and artificial intelligence to create data-driven decision support systems. Integrating traditional knowledge with advanced monitoring technologies can significantly enhance livestock productivity, reduce disease risks, and improve farm management efficiency.

Traditional Livestock Management Practices

Traditional livestock management refers to the practice of rearing and managing farm animals using indigenous knowledge, natural resources, and time-tested farming practices. These systems are generally characterized by low external input use and reliance on locally adapted breeds and environmental conditions.

Key components of traditional livestock management include:

- ❒ Manual feeding and watering practices
- ❒ Open grazing systems
- ❒ Natural breeding methods
- ❒ Experience-based disease diagnosis
- ❒ Visual observation of animal health and behavior
- ❒ Manual record keeping

These practices provide several advantages. They are cost-effective, environmentally sustainable, and rely on readily available resources. Traditional systems also promote resilience, as farmers often adapt their practices based on local climatic and ecological conditions. Moreover, such systems reduce dependency on

complex technologies and external inputs.Traditional livestock management contributes significantly to sustainable milk production and supports low-cost dairy farming. Farmers rely on accumulated experience and community knowledge to manage animal health and reproduction.

Despite these strengths, traditional management systems have several limitations. Health assessment based solely on visual observation can be subjective and prone to errors. Disease detection often occurs only after clinical symptoms appear, which may delay treatment and increase economic losses. Additionally, the absence of systematic digital record keeping limits long-term data analysis and decision-making.Another challenge is the poor transfer of traditional knowledge to younger generations, which threatens the sustainability of indigenous livestock management practices. As herd sizes increase and livestock farming becomes more commercialized, the limitations of traditional approaches become more pronounced.

Need for Smart Technology in Livestock Health Monitoring

Modern livestock production systems require efficient health monitoring mechanisms to maintain productivity and ensure animal welfare. The growing demand for high-quality dairy products, increasing herd sizes, and global competition necessitate the adoption of advanced monitoring tools. Several factors highlight the need for technological intervention in livestock management:

1. **Large herd management:** Traditional visual monitoring becomes impractical when herd sizes increase. Automated monitoring systems help track individual animal health efficiently.
2. **Early disease detection:** Many diseases cause physiological changes before visible symptoms appear. Smart monitoring systems can detect these changes early and alert farmers or veterinarians.
3. **Productivity improvement:** Monitoring feeding behavior, rumination patterns, and activity levels allows farmers to optimize management practices and improve productivity.
4. **Traceability and quality assurance:** Modern consumers increasingly demand traceable food products. Digital livestock records help ensure transparency and food safety.
5. **Regulatory compliance:** Government regulations and international trade standards require accurate animal health and production records.
6. **Reduction in economic losses:** Early diagnosis and timely treatment reduce mortality, treatment costs, and productivity losses.

Smart livestock health monitoring integrates sensors, data processing technologies, and communication systems to enable continuous tracking of animal health parameters. These systems generate valuable real-time data that support evidence-based farm management decisions.

Technologies Used in Smart Livestock Health Monitoring

Several modern technologies are now being utilized to monitor livestock health, behavior, and productivity. These technologies enable continuous observation without disturbing the animals and provide accurate and timely information.

Smart Bolus Technology

Smart bolus devices are ingestible electronic sensors placed inside the rumen of ruminant animals. These devices remain within the digestive system and continuously monitor internal physiological parameters.

Key parameters monitored include:

- ❒ Body temperature
- ❒ Rumen pH
- ❒ Drinking patterns
- ❒ Internal activity levels

Smart bolus technology plays a critical role in early disease detection. It can identify fever and infections before clinical symptoms appear. Additionally, it helps monitor metabolic disorders such as ruminal acidosis and detect heat stress conditions in animals.

The major advantages of smart bolus devices include high accuracy, long operational life, and protection from external damage because they remain inside the animal's body.

Smart Collar Technology

Smart collars are wearable devices fitted around the neck of livestock animals. These devices are equipped with sensors that record various behavioral and physiological parameters.

Common parameters monitored include:

- ❒ Animal movement and activity
- ❒ Rumination time
- ❒ Feeding behavior
- ❒ Resting patterns

These devices provide valuable information for early detection of diseases and metabolic abnormalities. Smart collars are also widely used for detecting lameness, monitoring reproductive cycles, identifying estrus (heat), and assessing stress levels.

One of the key benefits of smart collar technology is its non-invasive nature. It can be easily deployed across large herds and significantly reduces labor requirements for animal monitoring.

Computer Vision Technology

Computer vision involves the use of cameras combined with artificial intelligence algorithms to monitor animal behavior and physical condition. This technology captures images and videos of animals and analyzes them automatically.

Computer vision systems can detect:

- ❒ Changes in body posture
- ❒ Gait abnormalities
- ❒ Lameness
- ❒ Body condition score
- ❒ Facial expressions associated with pain

These systems enable continuous visual monitoring without direct human intervention. They are particularly useful in large-scale dairy farms where manual observation is difficult.

Automated distress detection and behavioral anomaly identification are some of the major applications of computer vision in livestock farming.

Radio Frequency Identification (RFID)

RFID technology is widely used for animal identification and record management. RFID tags are attached to animals through ear tags or implants, allowing unique identification of each animal.

RFID systems support

- ❒ Digital identification of animals
- ❒ Recording of production data
- ❒ Linking of health records with individual animals
- ❒ Vaccination and treatment tracking
- ❒ Disease outbreak tracing

RFID technology is relatively inexpensive, easy to use, and widely adopted across livestock industries worldwide. It plays an essential role in maintaining digital records and improving herd management.

Internet of Things (IoT) Systems

The Internet of Things (IoT) refers to interconnected devices and sensors that collect and exchange data through wireless networks. In livestock farming, IoT integrates multiple technologies such as smart collars, cameras, environmental sensors, and digital dashboards.

Key components of IoT-based livestock monitoring systems include:

- ❒ Sensors and monitoring devices
- ❒ Wireless connectivity
- ❒ Cloud data storage platforms
- ❒ Mobile or web-based dashboards

IoT systems enable real-time health monitoring and automatic alerts for farmers and veterinarians. Environmental parameters such as temperature, humidity, and gas levels can also be monitored to ensure optimal housing conditions.

These systems support remote herd supervision and automated record keeping, significantly improving farm management efficiency.

Acoustic-Based Sensors

Acoustic monitoring systems use microphones and sound analysis algorithms to detect animal vocalizations and behavioral signals. Changes in animal sounds can indicate health problems or distress.

Acoustic sensors can identify:

- ❒ Coughing associated with respiratory diseases
- ❒ Distress vocalizations
- ❒ Changes in rumination or feeding sounds

This technology enables continuous monitoring of animal health even under low visibility conditions and is particularly suitable for indoor housing systems.

Data Generation and Advanced Analytics

The integration of multiple sensors and monitoring devices generates large volumes of data from livestock farms. These data include physiological measurements, environmental readings, audio signals, images, and event records.

The major characteristics of livestock data include:

- ❒ **Volume:** Large datasets generated from multiple animals and sensors.
- ❒ **Velocity:** Continuous real-time data generation.
- ❒ **Variety:** Different data formats including text, numbers, images, videos, and audio.

To extract meaningful insights from such complex datasets, advanced analytical tools are required.

Big Data Analytics

Big data technologies enable storage, processing, and analysis of massive datasets generated from livestock monitoring systems. Through pattern recognition and predictive modeling, these systems can identify disease trends, seasonal health risks, and performance variations across herds.

Big data analytics supports:

- ❒ Disease prevalence mapping
- ❒ Long-term health trend analysis
- ❒ Productivity benchmarking
- ❒ Data-driven decision making

Artificial Intelligence (AI)

Artificial intelligence plays a critical role in modern livestock health monitoring systems. AI algorithms analyze sensor data and mimic expert decision-making processes.

AI applications include:

- ❒ Automated disease diagnosis
- ❒ Early warning systems
- ❒ Behavioral anomaly detection
- ❒ Predictive health management

By integrating multi-sensor inputs, AI improves the accuracy of disease detection and reduces dependency on manual observation.

Integrated Smart Livestock Health Monitoring Framework

An effective smart livestock monitoring system integrates traditional knowledge with advanced digital technologies. Such a framework typically includes:

- ❒ Traditional livestock management practices
- ❒ Smart sensors and wearable devices
- ❒ IoT connectivity and cloud platforms
- ❒ Big data analytics tools
- ❒ Artificial intelligence and machine learning models
- ❒ Blockchain-based secure record systems
- ❒ Decision support systems and automated alerts

This integrated approach ensures continuous data collection, transparent record keeping, and objective decision-making. It enhances farm productivity while maintaining animal welfare and sustainability.

Benefits of Smart Health Monitoring Systems

Adoption of smart health monitoring technologies provides several advantages:

- ❒ Early detection of diseases and reduced treatment costs
- ❒ Lower mortality rates in livestock
- ❒ Improved milk production and productivity
- ❒ Enhanced animal welfare and comfort
- ❒ Better farm management and labor efficiency

- ❒ Data-driven policy formulation and insurance support
- ❒ Improved market confidence through product traceability

These benefits collectively contribute to sustainable livestock production and improved economic returns for farmers.

Challenges in Adoption

Despite the potential advantages, several challenges limit the widespread adoption of smart livestock technologies:

- ❒ High initial investment costs
- ❒ Limited digital literacy among farmers
- ❒ Poor internet connectivity in rural areas
- ❒ Lack of technical support and training
- ❒ Need for institutional and policy support

Addressing these challenges requires coordinated efforts from governments, research institutions, and the livestock industry.

Conclusion

Smart livestock health monitoring technologies represent a significant advancement in modern animal husbandry. While traditional livestock management practices provide valuable indigenous knowledge and sustainability, integrating them with digital monitoring tools can greatly enhance efficiency, productivity, and disease management. Smart technologies do not aim to replace traditional practices; rather, they complement them by transforming experience-based management into data-driven decision-making systems. Through continuous monitoring, predictive analytics, and automated alerts, these technologies enable precise, preventive, and proactive livestock management. The successful integration of traditional knowledge with modern smart monitoring systems has the potential to revolutionize livestock farming, ensuring improved productivity, better animal welfare, and sustainable agricultural development.

Roadmap for Atmanirbhar Krishi: Policies, Institutions and Innovations for 2047

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Introduction

Agriculture remains the backbone of India's economy, employing more than 40 per cent of the national workforce. The sector plays a critical role in ensuring food security, rural livelihoods and economic stability. However, emerging structural, environmental and socio-economic challenges necessitate a forward-looking roadmap for transforming Indian agriculture.

Vision 2047: Viksit Bharat

The vision for Viksit Bharat 2047 emphasizes inclusive economic growth supported by scientific innovations, sustainable agricultural practices and good governance. Achieving self-reliance in agriculture (Atmanirbhar Krishi) requires coordinated policy reforms, institutional strengthening and technology-

driven innovation across the agricultural value chain.

Structural challenges in indian agriculture

Indian agriculture is predominantly characterized by small and marginal farmers, who constitute nearly 89.4 per cent of the farming community. Fragmented landholdings significantly limit economies of scale and mechanization. Intensive cultivation practices, particularly on a large proportion of the net sown area, have contributed to declining soil fertility and reduced resource-use efficiency.

Environmental concerns and climate change

Climate change poses a major threat to agricultural sustainability through increased frequency of extreme weather events, rising temperatures and erratic rainfall patterns. These changes have resulted in biodiversity loss, degradation of arable land and heightened vulnerability of farming systems. Coastal agriculture faces additional risks due to land loss and salinity intrusion.

Impact on allied sectors

Global warming has led to an increased incidence of pests and diseases across crops and livestock systems. In fisheries, climate-induced changes have caused drastic shifts in fish populations and seafood availability, adversely affecting livelihoods and nutritional security.

Continuing challenges affecting Atmanirbhar Krishi

A major concern in Indian agriculture is persistently low farm income, which limits the capacity of farmers to adopt new technologies and resilient practices. The slow integration of digital technologies with Indigenous Technical Knowledge (ITK) further constrains productivity gains and adaptive capacity at the grassroots level.

Food and nutritional security concerns

Challenges related to food and nutritional security remain central to the agricultural development agenda. These issues directly influence the goal of Atmanirbhar Krishi, as ensuring adequate, nutritious and affordable food is fundamental to national self-reliance and social stability.

Structural limitations in cropping systems

Indian agriculture continues to face insufficient crop diversification, with a heavy dependence on cereals. Persistent cultivation patterns dominated by water-guzzling crops have resulted in excessive water use, placing significant stress on groundwater resources and long-term sustainability of production systems.

Priority thrust areas for agricultural transformation

The roadmap for 2047 emphasizes food and nutritional security alongside augmentation of farmers' income as core priorities. Economic growth driven by self-reliant technologies, farm diversification and enhanced skill development and entrepreneurship is essential for transforming rural livelihoods.

Sustainable production and resource conservation

Sustainable pest and disease management, coupled with efficient resource conservation, forms the backbone of sustainable agronomic practices. Infrastructure development and environmental sustainability are critical to conserving natural resources and ensuring agricultural resilience for future generations.

Roadmap for Viksit Bharat: role of agriculture

The roadmap for Viksit Bharat places strong emphasis on achieving self-reliance in food production, with

agriculture playing a pivotal role in national development. Strengthening agricultural systems is essential for ensuring food security, farmer prosperity and sustainable economic growth by 2047.

Innovative interventions in agriculture

Innovative interventions are central to transforming Indian agriculture into a resilient and future-ready sector. These interventions focus on improving efficiency, productivity and sustainability through the adoption of advanced technologies and scientific management practices.

Precision agriculture and data-driven decision making

Precision agriculture, supported by GPS, Internet of Things (IoT) and drones, enables data-driven decision-making at the farm level. Controlled environment agriculture further enhances resource-use efficiency and productivity by optimizing crop growth conditions and minimizing external stresses.

Climate-smart agriculture for resilience

Climate-smart agriculture promotes adaptation and mitigation strategies such as adoption of drought- and flood-tolerant crops, carbon sequestration practices and efficient water management. Emphasis on mechanization, natural farming and climate-resilient production systems helps farmers cope with climate variability while maintaining productivity. Real-time weather information further supports timely and informed farm decisions.

Digital agriculture and market integration

Digital agriculture leverages mobile applications and digital platforms to provide farmers with timely advisory services and decision support. The integration of artificial intelligence enhances predictive capabilities, while blockchain technology strengthens supply chain transparency. Smart marketplaces enable direct linkage between farmers and buyers, reducing intermediaries and improving price realization.

Mechanization, robotics and automation

Mechanization and robotics play a critical role in addressing labour shortages and enhancing farm efficiency. Promotion of affordable farm machinery, use of drones for spraying and surveillance and deployment of robotics in harvesting and weeding contribute significantly to modernizing agricultural operations.

Strengthening research and development (R&D)

Strengthening agricultural research and development is a cornerstone of the roadmap for Atmanirbhar Krishi. Establishment of world-class laboratories, promotion of energy-efficient production systems and adoption of green energy solutions are essential to enhance innovation capacity. Public–private partnerships were emphasized as key drivers for accelerating research translation and technology dissemination.

Soil health sovereignty

Achieving soil health sovereignty is critical for long-term agricultural sustainability. Region-specific bio-input packages were highlighted as an effective strategy to restore soil health and enhance productivity. Integrated soil health management practices, coupled with efficient waste utilization, can significantly improve soil fertility while reducing environmental degradation.

Water management for sustainable agriculture

Water management was identified as a major priority area. Revival of traditional water bodies and wider

adoption of micro-irrigation systems such as drip and sprinkler irrigation are essential to improve water-use efficiency. The use of IoT-based sensors for irrigation scheduling, promotion of drought-resistant crop varieties and adoption of water-saving farming systems were emphasized to address growing water scarcity.

Climate-resilient and resource-conserving practices

Maintenance of green crops and farm gardens was highlighted as a strategy to enhance farm resilience and ecological balance. These practices contribute to climate adaptation, efficient resource use and sustained farm productivity under changing environmental conditions.

Agri–nutrition linkages

Strengthening agri–nutrition linkages is vital for ensuring food and nutritional security. The launch of dedicated Agri-Nutritional Missions was proposed to integrate agriculture with nutrition outcomes. Promotion of nutri-cereals and forgotten foods was emphasized as a strategy to improve dietary diversity, address malnutrition and enhance national health security.

Agri-Tech Innovation Zones (ATIZs)

The establishment of Agri-Tech Innovation Zones (ATIZs) was proposed to pilot frontier technologies in agriculture. These zones will focus on testing and scaling AI-based applications such as crop diagnostics, precision advisory systems and other emerging digital solutions, thereby accelerating innovation-to-field translation.

Future farming systems

Future farming models will increasingly rely on advanced technologies, including the deployment of survey drones and coordinated fleets of agribots. These systems will support real-time field assessment, precision operations and automation, improving efficiency and reducing labour dependency.

Concluding Perspective

The roadmap emphasizes that successful agricultural transformation hinges on the integration of advanced technologies with sustainable practices and strong policy support. A coordinated approach is essential to achieve long-term resilience, productivity and inclusiveness in Indian agriculture.

Capacity Building and Human Resource Development

Capacity building through Massive Open Online Courses (MOOCs), structured training programmes and internships was highlighted as a priority. Strengthening research components within academic programmes, including a two-year postgraduate structure, will help align education with emerging sectoral needs.

Academic Reforms and Curriculum Flexibility

Academic flexibility was emphasized by enabling students to migrate from foundational disciplines such as Agronomy after the first semester to other streams based on interest and aptitude. This approach supports interdisciplinary learning and skill-oriented education.

Institutional and Policy Reforms

Reforms related to the Board of Studies and Management of Agriculture (BSMA) were proposed, covering undergraduate and postgraduate programmes. A new institutional policy framework for undergraduate education was emphasized to modernize curricula, promote innovation and align education with national priorities.

Technical Programme

DAY-1			
05 JANUARY, 2026			
Inaugural Session		09.00-10.30 hr	
Photo Session and High Tea		10.30-11.00 hr	
Technical Session - I		**11.00-12.30 hr**	
Theme - I		**From Field to Future: Navigating New Frontiers in Agriculture**	
Chairperson		Dr. Parvinder Kaushal, Vice-Chancellor, Veer Chandra Singh Garhwali Uttarakhand University of Horticulture & Forestry, Bharsar, Uttarakhand	
Co-Chairperson		Dr. Bidyut Chandan Deka, Vice-Chancellor, Assam Agricultural University, Jorhat, Assam	
			Topic
Keynote Speakers	1.	Dr. Sharad Ramrao Gadakh Vice-Chancellor, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola Maharashtra	A Sustainable & Scalable Model for Doubling Farmers' Income
	2.	Prof. (Dr) Indra Mani Vice-Chancellor, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra	Climate-Smart Farming for a Resilient Tomorrow
Rapporteurs	1.	Dr. Rajbir Garg, Director of Research, CCSHAU, Hisar	
	2.	Dr. Suresh, Joint Director Crops, CCSHAU, Hisar	
Panelists	1.	Dr. Rajeshwar Singh Chandel, Vice-Chancellor, Dr. Y.S Parmar University of Horticulture & Forestry, Solan, HP	
	2.	Dr. V. P. Chovatia, Vice-Chancellor, Junagadh Agricultural University, Junagadh, Gujarat	
	3.	Dr Satbir Singh Gosal, Vice-Chancellor, Punjab Agricultural University, Ludhiana, Punjab	
	4.	Dr. K. K. Singh, Vice-Chancellor, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, UP	
	5.	Dr. Vinod Kumar Verma, Vice-Chancellor, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana	
	6.	Dr. Suresh K. Malhotra, Vice-Chancellor, Maharana Pratap Horticultural University, Uchani- Karnal, Haryana	
	7.	Dr. Aldas Janaiah, Vice-Chancellor, Prof. Jayashankar Telangana Agricultural University, Rajendranagar, Hyderabad, Telangana	

	8.	Dr. R. Sarada Jayalakshmi Devi, Vice-Chancellor, Acharya N.G. Ranga Agricultural University, Guntur, AP	
	9.	Dr. S. D. Solanki, Vice-Chancellor, SDAU, Sardarkrushinagar, Banaskantha, Gujarat	
Visit to Agri-Tourism followed by Lunch		12.30-14.00 hr	
Technical Session - II		**14.00-16.00 hr**	
Theme - II		**Viksit Bharat 2047: Role and Contribution of Agricultural Institutions**	
Chairperson		Prof. Parvat Kumar Roul, Vice-Chancellor, OUAT, Bhubaneswar, Odisha	
Co-Chairperson		Dr. Dheer Singh, Director & Vice-Chancellor ICAR–NDRI, Karnal, Haryana	
			Topic
Keynote Speakers	1.	Prof. Baldev Raj Kamboj Vice-Chancellor, CCSHAU Hisar, Haryana	Strengthening Agricultural Research, Education and Extension
	2.	Dr. Manmohan Singh Chauhan Vice-Chancellor, Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, Uttrakhand	Genome Editing and Cloning in Animals for 2047
Rapporteurs	1.	Dr. K. D. Sharma, Dean, College of Biotechnology, CCSHAU, Hisar	
	2.	Dr. Anil Kumar, Senior Scientist, CCSHAU, Hisar	
Panelists	1.	Prof. Parvat Kumar Roul, Vice-Chancellor, Odisha University of Agriculture & Technology, Bhubaneswar, Odisha	
	2.	Dr. Dheer Singh, Director & Vice-Chancellor, ICAR & National Dairy Research Institute, Karnal, Haryana	
	3.	Col. Comdt. Dr. Sanjay G. Bhave, Vice-Chancellor, Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra	
	4.	Dr. S. C. Dubey, Vice-Chancellor, Birsa Agricultural University, Kanke, Ranchi, Jharkhand	
	5.	Prof. U. P. Singh, Director, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, UP	
	6.	Dr. Vimla Dunkwal, Vice-Chancellor, Agricultural University, Kota, Rajasthan	
	7.	Dr. J. V. Ramana, Vice-Chancellor, Sri Venkateswara Veterinary University, Dr YSR Bhavan, Tirupati, AP	

	8.	Dr. K. Subhrahmaniyan, Vice-Chancellor, Tamil Nadu Agricultural University, Coimbatore, Tamilnadu	
	9.	Dr. Gopal Vadodariya, Director of Research, Gujarat Natural Farming Science University, Halol, Gujarat	
High Tea		16.00 - 16.30 hr	
General Body Meeting		16.30 - 18.00 hr	
Music and Dinner		19.00 hr	
DAY-2			
06 JANUARY, 2026			
Technical Session - III		**09.00 - 10.30 hr**	
Theme - III		**Bridging Tradition and Technology for Sustainable Agricultural Futures**	
Chairperson		Dr. Manmohan Singh Chauhan, Vice-Chancellor, Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, Uttrakhand	
Co-Chairperson		Prof. Baldev Raj Kamboj, Vice-Chancellor, CCS Haryana Agricultural University, Hisar, Haryana	
			Topic
Keynote Speakers	1.	Prof. Vinod Kumar Verma Vice-Chancellor, LUVAS, Hisar Haryana	Traditional livestock management with smart health monitoring
	2.	Prof. Parvat Kumar Roul Vice-Chancellor, OUA&T Bhubaneswar, Odisha	Roadmap for atmanirbhar Krishi: Policies, Institutions and Innovations for 2047
Rapporteurs	1.	Dr. Pawan Kumar, Registrar, CCSHAU, Hisar	
	2.	Dr. Rachna Gulati, Principal Scientist, CCSHAU, Hisar	
Panelists	1.	Dr. Vishnuvardhana, Vice-Chancellor, University of Horticultural Sciences, Udyanagiri, Navanagar, Bagalkot, Karnataka	
	2.	Dr. P.H. Tank, Vice-Chancellor, Kamdhenu University, Gandhinagar, Gujarat	
	3.	Dr. Vilas K. Kharche, Vice-Chancellor, Mahatma Phule Krishi Vidyapeeth, Ahilyanagar, Rahuri, Maharashtra	
	4.	Dr. Ashok Kumar Panda, Vice-Chancellor, Chaudhary Sarwan Kumar Himachal Pradesh Agriculture University, Palampur, HP	
	5.	Dr. Tummala Suguna, Officer on Special Duty/Registrar, Andhra Pradesh Fisheries University, Vijayawada, AP	
	6.	Prof. (Dr.) T. S. Rajeev, Director of Entrepreneurship, Kerala Veterinary & Animal Sciences University, Pookode, Kerala	

	7.	Dr. Dinesh Kumar, Executive Secretary, IAUA, Pusa Campus, New Delhi
	8.	Dr. C. Babu, Dean, School of Postgraduate Studies,Tamil Nadu Agricultural University, Coimbatore, Tamilnadu
	9.	Dr. M. Balram, Director of Research, Professor Jayashankar Telangana Agricultural University, Rajendranagar, Hyderabad, Telangana
	10.	Dr. Vishal Bector, Associate Director (Institution Relations), Punjab Agricultural University, Ludhiana, Punjab
	11.	Dr. B. Fakruddin, Director of Research, University of Horticultural Sciences, Udyanagiri, Navanagar, Bagalkote, Karnataka
Visit to DDUCE-OF and Tea		10.30 - 11.30 hr
Plenary Session		11.30 - 13.00 hr
Chairperson		Dr. Manmohan Singh Chauhan, Vice-Chancellor, Govind Ballabh Pant University of Agriculture &Technology, Pantnagar, Uttrakhand
Co-Chairperson		Prof. Baldev Raj Kamboj, Vice-Chancellor, CCS Haryana Agricultural University, Hisar, Haryana
Rapporteurs	1.	Dr. Ramesh Kumar, Director Human Resource Management, CCSHAU, Hisar
	2.	Dr. Anil Yadav, Principal Scientist, CCSHAU, Hisar
		Presentation of Rapporteurs Report and finalization of recommendations
		Concluding Remarks by Chair and Co-Chair
		Vote of Thanks
		National Anthem
Lunch		13.00-14.00 hr
Excursion		14.00 hr

Acknowledgements

We extend our profound gratitude to everyone who contributed to the success of the 49th Vice-Chancellors' Convention. We greatefully acknowledge, the Organizing Committees, Keynote Speakers, Panelists, Participants and Delegates. This compendium of proceedings is intended to serve as a valuable resource for policymakers, academic institutions and industry stakeholders invested in Navigating New Frontiers in Agriculture. It encapsulates the diverse perspectives and innovative ideas presented during the convention and aims to stimulate ongoing research, discussion and collaboration in the contribution of Agriculture Institution for Viksit Bharat 2047. Thank you to everyone who played a part in making this convention an enlightening and inspiring milestone.

List of Participants

Sr. No.	Name	Affiliations
1.	Prof. Parvinder Kaushal	Vice-Chancellor, Veer Chandra Singh Garhwali Uttarakhand University of Horticulture & Forestry, Bharsar, Pauri Garhwal, Uttarakhand
2.	Dr. Manmohan Singh Chauhan	Vice-Chancellor, Gobind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand
3.	Dr. Bidyut C. Deka	Vice-Chancellor, Assam Agricultural University, Jorhat, Assam
4.	Dr. Dinesh Kumar	Executive Secretary, IAUA, G-5, Office Block-A, NASC Complex, Dev Prakash Shastri Marg, Pusa Campus, New Delhi
5.	Prof. B.R. Kamboj	Vice-Chancellor, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana
6.	Dr. Rajeshwar Singh Chandel	Vice-Chancellor, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh
7.	Prof. (Dr) Indra Mani	Vice-Chancellor, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra
8.	Dr. V. P. Chovatia	Vice-Chancellor, Junagadh Agricultural University, Junagadh, Gujarat
9.	Dr. Satbir Singh Gosal	Vice-Chancellor, Punjab Agricultural University, Ludhiana, Punjab
10.	Prof. Pravat Kumar Roul	Vice-Chancellor, Odisha University of Agriculture & Technology, Bhubaneswar, Odisha
11.	Dr. S.R Gadakh	Vice-Chancellor, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra
12.	Dr. K.K. Singh	Vice-Chancellor, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, UP
13.	Dr. Dheer Singh	Vice-Chancellor, ICAR & National Dairy Research Institute, Karnal, Haryana
14.	Prof. (Dr.) Vinod Kumar Verma	Vice-Chancellor, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana
15.	Col. Comdt. Dr. Sanjay G. Bhave	Vice-Chancellor, Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra
16.	Dr. S. C. Dubey	Vice-Chancellor, Birsa Agricultural University, Kanke, Ranchi
17.	Dr. Suresh K. Malhotra	Vice-Chancellor, Maharana Pratap Horticultural University, Karnal, Haryana
18.	Dr. Vishnu Vardhana	Vice-Chancellor, University of Horticultural Sciences Udyanagiri, Navanagar, Bagalkote, Karnataka
19.	Prof. Aldas Janaiah	Vice-Chancellor, Professor Jayashankar Telangana Agricultural University, Rajendranagar, Hyderabad, Telangana

20.	Dr. P.H. Tank	Vice-Chancellor, Kamdhenu University, Gandhinagar, Gujarat
21.	Dr. Pushpendra Singh Chauhan	Vice-Chancellor, Sri Karan Narendra Agriculture University, Machhar Khani, Jobner, Rajasthan
22.	Dr. Vimla Dunkwal	Vice-Chancellor, Agriculture University, Baran Road, Kota
23.	Dr. Vilas K. Kharche	Vice-Chancellor, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra
24.	Dr. R. Sarada Jayalakshmi Devi	Vice-Chancellor, Acharya N.G. Ranga Agricultural University, Lam, Guntur, Andhra Pradesh
25.	Dr. J. V. Ramana	Vice-Chancellor, Sri Venkateswara Veterinary University, Tirupati, Andhra Pradesh
26.	Dr. A.K. Panda	Vice-Chancellor, Chaudhary Sarwan Kumar Himachal Pradesh Agriculture University, Palampur, Himachal, Pradesh
27.	Dr. S. D. Solanki	Vice-Chancellor, Sardarkrushinagar Dantiwada Agricultural University, S.K. Nagar, Gujarat
28.	Dr. K. Subhrahmaniyan	Registrar and Acting Vice Chancellor, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu
29.	Dr. Tummala Suguna	Officer on Special Duty/Registrar,Andhra Pradesh Fisheries University Camp Office, Vijayawada, Andhra Pradesh.
30.	Prof. U.P. Singh	Director, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, UP
31.	Dr. Gopal Vadodariya	Director of Research, Gujarat Natural Farming Science University, Halol, Gujarat
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34.	Dr. C. Babu	Dean, School of Postgraduate Studies, Tamil Nadu Agricultural University, Coimbatore
35.	Dr. M. Balram	Director of Research, Professor Jayashankar Telangana Agricultural University, Rajendranagar, Hyderabad
36.	Dr. Alpesh Bhimani	Scientist, Gujarat Natural Farming Science University, Halol, Gujarat
37.	Dr. Vishal Bector	Associate Director (Institution Relations), Punjab Agricultural University, Ludhiana, Punjab
38.	Dr. B. Fakruddin	Director of Research, University of Horticultural Sciences, Udyanagiri, Navanagar, Bagalkote, Karnataka

List of Committee members from CCS HAU, Hisar

1.	Prof. B. R. Kamboj, Vice-Chancellor CCS HAU, Hisar	Chairman
2.	Director HRM-cum-Dean, PGS	Convener-cum-Organizing Secretary
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4.	Director of Research	Member
5.	Director Extension Education	Member
6.	Dean, College of Agriculture	Member
7.	Dean, College of Agril. Engg. & Technology	Member
8.	Dean, College of Basic Sciences & Humanities	Member
9.	Dean, College of Fisheries Sciences	Member
10.	Dean, College of Biotechnology	Member
11.	Dean, College of Community Science	Member
12.	Director Students' Welfare	Member
13.	University Librarian	Member
14.	Comptroller	Member
15.	EO-cum-CE	Member
16.	Secretary to Vice-Chancellor	Member
17.	Nodal Officer, IAUA	Member

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	All Deans, Directors, Officers of the University, CCS HAU, Hisar	
2.	**Invitation Committee:**	
	Dr. Yogesh Kumar Jindal, Convener	DHRM
	Dr. Jitender Bhatia	DHRM
	Sh. Harish Pahwa, SPS to VC	Vice-Chancellor's Office
	Sh. Surender, SSS	DHRM
3.	**Felicitation Committee:**	
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	Dr. Gulab Singh	Biotechnology
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	Dr. Sandhya Sharma	DSW
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	Dr. Rajnikant	Chemistry
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	Dr. Anurag	DHRM
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	Sh. Rampal, AI	LSU
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	Dr. Surbhi Gupta	Campus Hospital
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	Dr. Virender Kumar	Campus Hospital
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	Dr. Shikha Yashvir	Biotechnology
	Dr. Amita Girdhar	MBA
	Dr. Megha Goyal	MBA

List of CCS HAU, Hisar liaisoning officers associated with Hon'ble Vice-Chancellors

Sr. No.	Name	Designation
1	Dr. Mohit Sehal	Assistant Scientist
2	Dr. Padmanabha A.	Assistant Scientist
3	Dr. Vinod	Assistant Scientist
4	Dr. S.S. Yadav	Senior Scientist
5	Dr. R.S. Dadarwal	Assistant Scientist
6	Dr. Anupam Anand	Assistant Professor
7	Dr. Manmohan	Assistant Scientist
8	Dr. Maloth Mohan	Assistant Scientist
9	Dr. Vishal Gandhi	Assistant Scientist
10	Dr. Nitin Bhardwaj	Assistant Scientist
11	Dr. Sumit Saini	Assistant Scientist
12	Dr. Anil Jakhar	Assistant Scientist
13	Dr. Amit Kaushik	Assistant Professor
14	Dr. Prakash Banakar	Assistant Scientist
15	Dr. Charan Singh	Assistant Scientist
16	Dr. Suresh Kumar	Senior Scientist
17	Dr. Jayant Sidhu	Assistant Scientist
18	Dr. Adesh Kumar	Assistant Scientist
19	Dr. Deepak	Assistant Scientist
20	Dr. Bhagat Singh	Senior Scientist
21	Dr. Lomash	Assistant Professor
22	Dr. Alka	Assistant Professor
23	Dr. Chaitra	Assistant Scientist
24	Dr. Gulab Singh	Assistant Professor
25	Dr. Vikas	Assistant Scientist
26	Dr. Anil Kumar	Assistant Scientist
27	Dr. Ravika	Assistant Professor
28	Dr. Ashish Jain	Assistant Scientist
29	Dr. Jagmohan	Assistant Scientist
30	Dr. Bajrang Lal	Assistant Scientist
31	Dr. Vinod Goyal	Assistant Scientist
32	Dr. Karmal Malik	Senior Scientist
33	Dr. P. Bhaskar	Assistant Scientist

Inaugural Session











Honoring the Guests














Honoring the Guests



Deliberations and Discussion

Technical Sessions



















Deliberations and Discussion
Technical Sessions













A Visit to Dr. Mangal Sein Agricultural Sciences Museum









A Visit to Agri Tourism













Convention in Media



सम्मेलन
एचएयू में कृषि विश्वविद्यालयों के कुलपतियों के 49वें सम्मेलन का डिप्टी स्पीकर डॉ. कृष्ण लाल मिड्ढा ने किया उद्घाटन
कृषि में नवीनतम तकनीकों के उपयोग व युवाओं की भागीदारी पर जोर
किसानों को ध्यान की सीधी बिजाई और पलवल प्रबंधन अपनाने के लिए प्रेरित किया
कुलपतियों का सम्मेलनः तकनीकी सत्रों में हुआ कृषि शिक्षा, शोध एवं नवाचार पर मंथन, किसानों की आय दोगुनी करने का मॉडल प्रस्तुत किया
आई.ए.यू.ए.का उद्देश्य विश्वविद्यालयों के उत्कृष्ट कार्यों को साझा करना एवं चुनौतियों का हल निकालनाः डॉ मनमोहन सिंह
हकृवि में 49वां कुलपति सम्मेलन आज, तैयारियां पूरी
एचएयू में 49वां कुलपति सम्मेलन आज से, डिप्टी स्पीकर करेंगे शिरकत
सम्मेलन में तीन तकनीकी सत्र होंगे आयोजित
कृषि अर्थव्यवस्था का आधार नहीं बल्कि सभ्यता की पहचान भी : डॉ. मिड्ढा
ऐसे सम्मेलनों से देश में कृषि शिक्षा, अनुसंधान व नवाचार को मिलेगी नई दिशा : डॉ. मनमोहन सिंह
स्मार्ट खेती-2047: एआई बताएगा खेत में कितना पानी और खाद देना है; ड्रोन टेक्नोलॉजी और रोबोटिक्स मशीनें किसानों का खर्च कम करेंगी
चौधरी चरण सिंह हरियाणा कृषि विश्वविद्यालय में कुलपतियों के 49वें सम्मेलन का शुभारंभ
भारतीय कृषि केवल अर्थव्यवस्था का आधार नहीं बल्कि हमारी सभ्यता की पहचान भी : डॉ. कृष्ण लाल मिड्ढा
कृषि हमारी सभ्यता की पहचान, केवल अर्थव्यवस्था का आधार नहीं : मिड्ढा
हकृवि में कुलपतियों के 49वें सम्मेलन का डिप्टी स्पीकर ने किया शुभारंभ
कृषि में पैदावार तकनीक बढ़ाने और लागत खर्च घटाने पर काम करने के लिए देशभर के कुलपति ए
मशीनीकरण से मजबूती, नवाचार से समृद्ध होगी
हकृवि में 49वां कुलपति सम्मेलन आज से, विस के डिप्टी स्पीकर करेंगे शुभारंभ
Varsities mull roadmap for developed India
हरियाणा कृषि विश्वविद्यालय मे कुलपतियों के 49वें सम्मेलन का शुभारंभ
देश के कृषि क्षेत्र को आत्मनिर्भर बनाने में कृषि विश्वविद्यालयों की महत्वपूर्ण भूमिका : डॉ. मिड्ढा

Convention in Social Media

भारतीय कृषि केवल अर्थव्यवस्था का आधार नहीं बल्कि हमारी सभ्यता की पहचान भीः डॉ. कृष्ण लाल मिड्ढा

हरियाणा कृषि विश्वविद्यालय में कुलपतियों के 49वें सम्मेलन का शुभारंभ





चौधरी चरण सिंह हरियाणा कृषि विश्वविद्यालय में कृषि विश्वविद्यालयों के कुलपतियों का 49वां सम्मेलन शुरू हुआ। सम्मेलन में हरियाणा विधानसभा के डिप्टी स्पीकर डॉ. कृष्ण लाल मिड्ढा ने बतौर मुख्य अतिथि शिरकत की जबकि इंडियन एग्रीकल्चरल यूनिवर्सिटी एसोसिएशन (आईएयू) के अध्यक्ष एवं जीबीपीयूएटी पंतनगर के कुलपति डॉ. मनमोहन सिंह कार्यक्रम में विशिष्ठ अतिथि के तौर पर उपस्थित हुए। हकृवि के कुलपति प्रो. बी.आर. काम्बोज ने सम्मेलन की अध्यक्षता की।

विधानसभा के डिप्टी स्पीकर डॉ. कृष्ण लाल मिड्ढा ने अपने सम्बोधन में कहा कि कृषि केवल भारतीय अर्थव्यवस्था का आधार ही नहीं बल्कि हमारी सभ्यता की पहचान भी है। कृषि विश्वविद्यालय किसानों को नवीनतम तकनीक, उन्नत किस्मों के खोज देने के अलावा कृषि क्षेत्र के भविष्य को उज्जवल बनाने के लिए विद्यार्थियों को भी तैयार करते हैं। उन्होंने कहा कि यह सम्मेलन कृषि शिक्षा, अनुसंधान, विस्तार और नवाचार को समावेश और युवाओं को कृषि क्षेत्र से जोडने की आवश्यकता पर बल दिया। उन्होंने कहा कि कृषि भारतीय अर्थव्यवस्था की धुरी है। देश के कृषि क्षेत्र को आत्मनिर्भर बनाने तथा खाद्यान्न उत्पादन में वृद्धि करने में कृषि विश्वविद्यालयों की महत्वपूर्ण भूमिका रही है। उन्होंने कहा कि चौधरी चरण सिंह हरियाणा कृषि विश्वविद्यालय का एशिया महाद्वीप के कृषि विश्वविद्यालयों में महत्वपूर्ण स्थान है। हकृवि ने अपने गठन के पश्चात 305 से अधिक विभिन्न फसलों की उन्नत किस्में विकसित करके देश के खाद्यान्न उत्पादन में बढ़ोतरी करने में विशेष योगदान किया है। गत पांच वर्षों के दौरान हकृवि द्वारा 50 से अधिक किस्में विकसित एवं चिन्हित की गई हैं जिनमें गेहूं, सरसों, मूंग, बाजरा तथा चारा फसलों की भी उन्नत किस्में शामिल हैं। डिप्टी स्पीकर ने धान की सीधी बिजाई, फसल अवशेष प्रबंधन, मत्स्य पालन सहित विभिन्न योजनाओं एवं कार्यक्रमों के बारे में विस्तार से प्रकाश डाला। उन्होंने सम्मेलन में भाग ले रहे कुलपतियों से आह्वान करते हुए कहा कि कृषि क्षेत्र को गति देने का विमोचन भी किया।

नई शिक्षा नीति के तहत विद्यार्थियों का ज्ञान के साथ होगा कौशल विकास- डॉ. मनमोहन सिंह

: इंडियन एग्रीकल्चरल यूनिवर्सिटी संगठन के अध्यक्ष एवं जीबीपीयूएटी पंतनगर के कुलपति डॉ. मनमोहन सिंह ने अपने भाषण में कहा कि जलवायु परिवर्तन एवं घटती जोत जैसी चुनौतियों से निपटने के लिए कृषि विश्वविद्यालयों को एकजुट होकर कार्य करना होगा। साथ ही उन्होंने कहा कि कृषि विश्वविद्यालय राष्ट्रीय शिक्षा नीति-2020 को अपना चुके हैं जिसमें विशेष तौर पर विद्यार्थियों को 50 प्रतिशत प्रैक्टिकल एक्टिविटी में समय देकर ज्ञान के साथ साथ उनका कौशल विकास भी किया जा रहा है। उन्होंने दो दिवसीय सम्मेलन के दौरान तकनीकी सत्रों में रखें जाने वाले विभिन्न विषयों के बारे में विस्तार से जानकारी दी।

कार्यक्रम के आयोजन सचिव एवं मानव संसाधन प्रबंधन निदेशक डॉ. रमेश कुमार ने धन्यवाद प्रस्ताव पारित किया। मंच का संचालन डॉ. जयंती टोकस ने किया। इस अवसर पर हकृवि

ग्रामीण अर्थव्यवस्था की मजबूती के लिए कृषि को उद्यमिता के तौर पर अपनाएं किसानः प्रो. बीआर काम्बोज

हकृवि के कुलपति प्रो. बीआर काम्बोज ने कार्यक्रम में सभी का स्वागत करते हुए कहा कि इस दो दिवसीय सम्मेलन में खेत से भविष्य तक: कृषि में नए क्षेत्रों का अन्वेषण, विकसित भारत 2047: कृषि संस्थानों की भूमिका और योगदान तथा सतत कृषि के भविष्य के लिए परंपरा और प्रौद्योगिकी का सेतु बनाना विषयों पर गहन चर्चा की जाएगी जिससे सभी कृषि विश्वविद्यालयों को भविष्य की नीति निर्धारित करने में सहायता मिलेगी। उन्होंने इंडियन एग्रीकल्चरल यूनिवर्सिटी एसोसिएशन (आईएयू) का धन्यवाद करते हुए कहा कि 1967 से यह एसोसिएशन कृषि विश्वविद्यालयों को एक ऐसा मंच प्रदान कर रही है जहां विश्वविद्यालय अपने कार्यक्षेत्र में कृषि से जुड़ी समस्याओं पर मंथन करने के साथ-साथ कृषि शिक्षा में बदलती जरूरतों के हिसाब से अपने आप को इस तरह तैयार करते हैं ताकि वे देश की प्रगति में महत्वपूर्ण योगदान दे सकें। उन्होंने कहा कि कृषि में नए आयाम के तहत स्मार्ट एवं डिजिटल कृषि, जैविक एवं प्राकृतिक खेती, जलवायु अनुकूल कृषि, फसल विविधीकरण, दलहन, तिलहन और मोटे अनाज तथा कृषि उद्योग एवं मूल्य संवर्धन को प्राथमिकता देनी होगी। भविष्य में कृषि के योगदान के महत्व पर प्रकाश डालते हुए उन्होंने बताया कि खाद्य सुरक्षा सुनिश्चित करने एवं

आईएयू का उद्देश्य विश्वविद्यालयों के उत्कृष्ट कार्यो को सांझा करना एवं चुनौतियों का हल निकालना : डॉ. मनमोहन सिंह

हरियाणा कृषि विश्वविद्यालय में कुलपतियों के 49वें सम्मेलन का हुआ समापन





सम्मेलन का मुख्य उद्देश्य कृषि शिक्षा को समसामयिक, रोजगारपरक और तकनीक आधारित बनाना- प्रो. बी.आर. काम्बोज

हकृवि में कुलपति सम्मेलन के तकनीकी सत्रों में हुआ कृषि शिक्षा, शोध एवं नवाचार पर मंथन



भारतीय कृषि केवल अर्थव्यवस्था का आधार नहीं बल्कि हमारी सभ्यता की पहचान भीः डॉ. कृष्ण लाल मिड्ढा

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Agroha Dham





















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