



# Proceedings



**43<sup>rd</sup> Vice Chancellors' Convention**  
February 11 - 12, 2019

## **Artificial Intelligence for Smart Agriculture**



*Sponsored by*  
**Indian Agricultural Universities Association**  
New Delhi

*Organised by*  
**Punjab Agricultural University**  
Ludhiana



# PRIDE & GLORY OF PAU



First ICAR Best Institution Award to PAU (1995)



Sardar Patel ICAR Best Institution Award to PAU (2017)



**Proceedings**

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## **Artificial Intelligence for Smart Agriculture**

**Punjab Agricultural University  
Ludhiana  
2019**





## About the host institution – PAU, Ludhiana

The Punjab Agricultural University (PAU) is an internationally acclaimed university which has carved a niche for itself in the areas of research, teaching and extension. It came into being on October 17, 1962 and was inaugurated by the First Prime Minister of India Pandit Jawaharlal Nehru on July 8, 1963. The University has made remarkable contributions to the agricultural development of Punjab in particular and India in general. The untiring efforts made by its scientists paved way for Green Revolution in the country and made the nation food secure. Its deep rooted connection with the farmers speaks volumes of the faith reposed by them in PAU developed crop varieties and their production and protection technologies. It is proud of its alumni who have contributed to improvement in agricultural production. In recognition of its outstanding contributions to agricultural research, education and transfer of technology, PAU was adjudged as the "ICAR Best Institution" by the Indian Council of Agricultural Research (ICAR) in 1995 and again in 2017.

### Awards and Recognitions

- First recipient of "ICAR Best Institution Award" (1995)
- Sardar Patel Outstanding ICAR Institution Award (2017)
- Top ranked agricultural university by ICAR and MHRD (2016, 2017)
- Ranked first for number of research publications and citations among state universities by CII-Indian Citation Index (2017)
- Ranked first among agricultural institutions for development of landmark crop varieties (2017) by the Indian Society of Genetics and Plant Breeding, New Delhi
- First recipient of 'International Potash Institute-Fertilizer Association of India Award' (2009)
- First recipient of Mahindra and Mahindra 'Krishi Shiksha Samman' (2011)
- Identified as 'Institution of Excellence' in Agriculture under "Institution of Eminence" scheme of MHRD/UGC (2018)
- First recipient of Special Grant of Rs 100 crore from Government of India (2005-06)
- Bagged the prestigious "Agricultural Leadership Award" in 2015 for its remarkable contribution to the transfer of technology
- Declared one of the "Icons of the Modern India" by a leading magazine, India Today in its special issue (August 2017) celebrating 70 years of Independence
- International and National awards won by PAU Alumni, Faculty and Students
  - Padma Bhushan : 7
  - Padma Shri : 12
  - World Food Prize : 1
  - Rafi Ahmed Kidwai Memorial Prize : 55
  - Shanti Swarup Bhatnagar Award : 2





▪ Dr B P Pal Memorial Award	:	2
▪ Om Parkash Bhasin Award	:	3
▪ ICAR Jawaharlal Nehru Award	:	20
▪ Arjuna Award	:	3
▪ Sahitya Academy Award	:	3

### Benefits to the society

- Food grain production in Punjab jumped from 3.2 million tonnes in 1960-61 to 31.7 million tonnes in 2017-18, against India's 82 and 279 million tonnes, respectively, for the corresponding period.
- Punjab contributed highest wheat (38.0%) and rice (28.5%) to the central pool amongst all the states during Rabi marketing season (2017-18) and Kharif marketing season (2016-17), respectively.
- The PAU wheat variety, PBW 343 sown at one time on 90 per cent area of Punjab and 70 per cent in North-West Plain zone, accrued benefit worth Rs 26,000 crore to the farmers.
- Integrated Pest Management technology resulted in reduction in insecticide sprays on cotton (28.2%) and basmati rice (30.8%), thereby, reducing production cost.
- Inter-state campaign (Punjab, Haryana and Rajasthan), led by PAU, successfully managed whitefly in cotton. Record cotton productivity (756 kg/ha of lint) was obtained during Kharif 2016 and pesticides worth Rs 54.42 crore (Rs 2,156/ha) were saved.
- Punjab beekeepers produce 39.5 per cent of India's total honey.
- Punjab is the largest producer of mushrooms and seed potato hub of the country.

### About the convention

The Agricultural Universities have been a fountain of knowledge for the farmers as well as overall development of agriculture in the country. The 43<sup>rd</sup> Vice Chancellors' Convention of Indian Agricultural Universities Association (IAUA) was organized on the theme 'Artificial Intelligence for Smart Agriculture' at Punjab Agricultural University, Ludhiana on February 11 – 12, 2019. The Indian farmers, scientists and stakeholders have been contributing continuously towards national food security. But due to highly competitive global economy and increasing food requirements of increasing world population, technological interventions are required like use of artificial intelligence, sensor based advanced farming system, big data management, IT tools for Predictive Analytics, Robotics and Unmanned Vehicles (UMVs) to develop eco-friendly and sustainable farm technologies for SMART AGRICULTURE. The convention was organized to deliberate on the emerging needs, giving new and innovative directions of applying Artificial Intelligence (AI) to the field of agriculture. The Vice Chancellors of State Agricultural Universities, Central Agricultural Universities and Deemed Universities of India, experts from IIT Bombay and Indian Agricultural Research Institute (IARI) shared their knowledge and expertise and gave an overview on that how artificial intelligence can be an instrumental and a revolutionary step for achieving quantum jump in the Indian farm and food sector. The deliberations were made to align agricultural education and research programs in India during the following five technical sessions conducted on the sub themes selected for the convention:





- Sensor Based Technologies for Precision Agriculture and Advanced Farming System
- Application of Big Data Management Tools in Agriculture
- Robotics and UMV Technologies in Farm and Food Sector
- IT Tools for Predictive Analytics in Crop, Livestock and Fisheries
- Policy Interventions for Promoting Artificial Intelligence in Indian Agriculture

The Vice Chancellors, experts from IIT, IARI and industries made technical presentations. Panel discussions were conducted in these five technical sessions and the plenary session of the convention.









## RECOMMENDATIONS

1. Strengthening the National Agricultural Research System (NARS) with special focus on Artificial Intelligence (AI) in agriculture by the Central and State Governments.
2. ICAR should be approached for a network programme or common platform on AI across all SAU's.
3. Inter-institutional consultancy mode should be developed for trainings and joint projects in AI and precision agriculture should be planned.
4. All the SAUs should start digitizing their data. Analyzed data should have standardized data sets since data will be available from varying sources.
5. A comprehensive policy should be drafted on the use, storage, maintenance and ownership of the data. There is a need to discuss the issues of ownership of data and generating workforce to handle the Big Data and AI related activities.
6. Applying disruptive innovations in precision agriculture by combining technological advances (i.e. Sensors, Internet of Things (IoT), Machine Learning, Automation etc.) and the associated business/ social intelligence (in terms of food and water security) through stakeholders should be one focus.
7. An appropriate policy needs to be developed on the use of drones in Indian agriculture in order to boost the technological ecosystem of the country. Different stakeholders may be brought on a single platform to frame guidelines for their smooth implementation.
8. Work on exploring the huge potential of AI to promote animal husbandry sector, especially animal traceability, genetics, management and health should be initiated.
9. Drones should be used for monitoring crop health as well as data recording. Training in use of drones for ultra low volume (ULV) sprays is need of the hour.
10. Technology should be developed for use of drones with GPS enabled spraying linked with imaging and mechatronics for precise sprayings on hotspots.
11. Work should be initiated in the field of precision farming with the application of robotics and drones to attract youth in agriculture, saving of inputs, increasing productivity and sustainability of agriculture.





## List of the Participating Vice Chancellors

1	<b>Dr N C Patel</b> Anand Agricultural University, Anand (Gujarat)	
2	<b>Dr A R Pathak</b> Junagadh Agricultural University, Junagadh (Gujarat)	
3	<b>Dr B S Dhillon</b> Punjab Agricultural University, Ludhiana (Punjab)	
4	<b>Prof P K Sharma</b> Sher-e-Kashmir-University of Agricultural Science & Technology, Jammu (Jammu and Kashmir)	
5	<b>Dr A S Nanda</b> Guru Angad Dev Veterinary and Animal Science University, Ludhiana (Punjab)	
6	<b>Dr Ashok A Patel</b> SD Agricultural University, Sardarkrushinagar, (Gujarat)	
7	<b>Dr C J Dangaria</b> Navsari Agricultural University, Navsari (Gujarat)	
8	<b>Dr K P Vishwanatha</b> Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra)	



9	Dr G L Keshwa Agriculture University, Kota (Madhya Pradesh)	
10	Dr K P Singh Chaudhary Charan Singh Haryana Agricultural University, Hisar (Haryana)	
11	Dr H C Sharma Dr Y S Parmar University of Horticulture & Forestry, Nauni, Solan (Himachal Pradesh)	
12	Prof (Dr) Ashok Kumar Sarial Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidalaya, Palampur (Himachal Pradesh)	
13	Dr Parvinder Kaushal Birsa Agricultural University, Kanke, Ranchi (Jharkand)	
14	Dr V Damodara Naidu Acharya N G Ranga Agricultural University, Guntur (Andhra Pradesh)	
15	Dr M B Chetti University of Agricultural Sciences, Dharwad (Karnataka)	
16	Dr N H Kelawala Kamdhenu University, Gandhinagar (Gujarat)	





## List of Invited keynote speakers

1	Dr J Adinarayana Prof. & Head, CSRE-IIT Bombay, Mumbai (Maharashtra)	
2	Dr. Ajit Maru Former Sr. Officer, Food & Agriculture Organization, Ahmedabad (Gujarat)	
3	Dr K P Chinnaswamy University of Agricultural Sciences, Bengaluru (Karnataka)	
4	Dr S K Singh Project Director, Directorate of Knowledge Management in Agriculture, ICAR (New Delhi)	
5	Dr Rabi N Sahoo Principal Scientist, Indian Agricultural Research Institute (New Delhi)	
6	Mr Sandeep Joshi Director, Asia Technology Innovation Center John Deere India, Pune (Maharashtra)	
7	Dr Shankar Venugopal Vice President, Mahindra Research Valley, Chennai (Tamil Nadu)	
8	Dr Deven J Patel Asstt. Prof, Junagarh Agricultural University, Junagarh (Gujarat)	





**43rd Vice Chancellors' Convention  
Punjab Agricultural University, Ludhiana  
February 11 – 12, 2019**

Programme	
Time	Session
<b>February 10, 2019</b>	
7:00 – 7:50 pm	<b>Executive Meeting</b> (Committee Room, Office of Vice Chancellor, PAU)
8:00 pm onwards	<b>Welcome Dinner</b> (Sutton House, PAU)
<b>February 11, 2019</b>	
9:30 – 11:30 am	Inaugural Session (Pal Auditorium)
11:30 – 12:00 am	Tea Break
12:00 – 01:15 pm	<b>Technical Session: I (Farmers' Service Centre)</b> <i>Theme: Sensor Based Technologies for Precision Agriculture and Advanced Farming System (AFS)</i>
1:15 – 02:00 pm	Lunch Break
02:00 – 03:15 pm	<b>Technical Session: II (Farmers' Service Centre)</b> <i>Theme: Application of Big Data Management Tools in Agriculture</i>
03:15 – 03:45 pm	Tea Break
03:45 – 05:00 pm	<b>Technical Session: III</b> <i>Theme: Robotics and UMV Technologies in Farm and Food Sector</i>
5.00 - 6.00 pm	General Body Meeting (Farmers' Service Centre)
6.00 - 7.00 pm	Cultural programme (Pal Auditorium)
8:00 pm onwards	Dinner (Hotel Park Plaza, Ludhiana)
<b>February 12, 2019</b>	
9:30 – 10:45 am	<b>Technical Session: IV (Farmers' Service Centre)</b> <i>Theme: IT Tools for Predictive Analytics in Crop, Livestock and Fisheries</i>
10.45 – 11:15 am	Tea Break
11:15 – 01:00 pm	<b>Technical Session: V (Farmers' Service Centre)</b> <i>Theme: Policy interventions for Promoting Artificial Intelligence in Indian Agriculture</i>
1:00 – 2:00 pm	Lunch Break
2:00 – 3:30 pm	Plenary Session (Farmers' Service Centre)
3:30 pm onwards	Concluding Tea
8:00 pm onwards	Dinner (Hotel Park Plaza, Ludhiana)





**43<sup>rd</sup> Vice Chancellors' Convention**  
**Punjab Agricultural University, Ludhiana**  
**Programme: Technical Sessions (February 11 – 12, 2019)**

Technical Session: I February 11, 2019 (12:00 – 1:15 pm)		Technical Session: II February 11, 2019 (02:00 – 3:15 pm)		Technical Session: III February 11, 2019 (3:45 – 5:00 pm)	
<b>Theme: Sensor Based Technologies for Precision Agriculture and Advanced Farming System (AFS)</b>		<b>Theme: Application of Big Data Management Tools in Agriculture</b>		<b>Theme: Robotics and UMW Technologies in Farm and Food Sector</b>	
Chairman	Dr A R Pathak VC, JAU, Gujarat	Chairman	Dr P K Sharma VC, SKUAST (J), Jammu	Chairman	Dr Ashok A Patel VC, SDAU, Gujarat
Co-chairman	Dr C J Dangaria VC, NAU, Navsari	Co-chairman	Dr K P Vishwanatha VC, MPKV, Rahuri	Co-chairman	Dr G L Keshwa VC, AU, Kota
Keynote Speakers	Dr N C Patel VC, AAU, Gujarat <b>Artificial Technologies &amp; Robotic: Application for Precision Agriculture</b>	Keynote Speakers	Prof Dr Ashok Kumar Sarial VC, CSKHPKV, Palampur <b>Policy Interventions for Promoting AI in Indian Agriculture with Special Reference to HP</b>	Keynote Speakers	Dr A R Pathak VC, JAU, Gujarat <b>Scope of Robotics and Drone Technology in Indian Agriculture</b>
	Dr V Damodara Naidu VC, ANGARA, Aandhra Pradesh <b>Sensor Based Technologies for Advanced Farming System</b>		Dr Rabi N Sahoo IARI, New Delhi <b>Remote Sensing for Precision Agriculture and Plant Phenomics</b>		Mr Sandeep Joshi Director, Asia Technology Innovation Centre, John Deere <b>Robotics in Agriculture</b>
	Dr J Adinarayana Prof. & Head, CSRE-IIT (B), Mumbai <b>Disruptive Technologies for Smart Agriculture</b>		Prof K P Chinnaswamy University of Agricultural Sciences Bangalore <b>"Application of big data Management in Agriculture"</b>		Dr K P Vishwanatha VC, MPKV, Rahuri <b>Precision agricultural Technologies and MPKV Initiatives</b>
<b>Panel Discussion</b>		<b>Panel Discussion</b>		<b>Panel Discussion</b>	
Moderator	Dr A R Pathak VC, JAU, Gujarat	Moderator	Dr P K Sharma VC, SKUAST (J), Jammu	Moderator	Dr Ashok A Patel VC, SDAU, Gujarat
Panelists	Dr C J Dangaria VC, NAU, Navsari Prof Dr Ashok Kumar Sarial VC, CSKHPKV, Palampur	Panelists	Dr K P Vishwanatha VC, MPKV, Rahuri Dr Parvinder Kaushal VC, BAU, Ranchi Dr M B Chetti VC, UAS, Dharwad Dr Dharminder Bhatia, Dr Gurupkar Singh	Panelists	Dr G L Keshwa VC, AU, Kota Dr S K Meti Director of Education, UAS, Raichur
Rapporteurs	Dr Manjeet Singh, Dr R Sharda	Rapporteurs		Rapporteurs	Dr G S Manes, Dr Vishal Bector



## 43rd Vice Chancellors' Convention Punjab Agricultural University, Ludhiana

Programme: Technical Sessions (February 11 – 12, 2019)

Technical Session: IV February 12, 2019 (9:30 – 10:45 pm)		Technical Session: V February 12, 2019 (11:15 – 01:00 pm)		Plenary Session February 12, 2019 (2:00 – 3:30 pm)	
<b>Theme: IT Tools for Predictive Analytics in Crop, Livestock and Fisheries</b>		<b>Theme: Policy Interventions for Promoting Artificial Intelligence in Indian Agriculture</b>			
Chairman	Dr A S Nanda VC, GADVASU, Ludhiana	Chairman	Dr K P Singh VC, CCS, HAU, Hisar	Chairman	Dr N C Patel VC, AAU, Gujarat
Co-chairman	Dr Parvinder Kaushal VC, BAU, Ranchi	Co-chairman	Dr V Damodara Naidu VC, ANGRAU, Guntur, AP	Co-chairman	Dr A S Nanda VC, GADVASU, Ludhiana
	Dr H C Sharma VC, Dr YSPUH&F, Solan <b>Digital Applications for Expert Systems in IPM</b>		Dr K P Singh VC, CCS, HAU, Hisar <b>Policy Interventions on Use of Artificial Intelligence and Robotics in Agriculture</b>	Presentation of reports	
	Dr Shankar Venugopal Vice President, MRV, Chennai <b>Industry Perspective in Adopting Disruptive Technologies in Indian Agriculture</b>		Dr Satendra Kumar Singh Project Director, DKMA ICAR, New Delhi <b>Policy Perspective &amp; Preparedness of NARS for AI, ICT, Smart Agriculture</b>		
	Prof G D Gohil Directorate of IT Cell, JAU Gujarat <b>Role of Big Data Analysis in Smart Farming</b>		Dr Ajit Maru Former Senior Officer, GFAR/FAO <b>Making Indian Agriculture &amp; Agri-Food System More Knowledge Intensive</b>		
Panel Discussion		Panel Discussion		Vote of Thanks	
Moderator	Dr A S Nanda VC, GADVASU, Ludhiana	Moderator	Dr Ashok A Patel VC, SDAU, Gujarat		
Panelists	Dr K P Singh VC, CCS, HAU, Hisar Dr V Damodara Naidu VC, ANGRAU, Guntur, AP	Panelists	Dr K P Singh VC, CCS, HAU, Hisar Dr S K Rao VC, RVSKV, Gwalior Dr N H Kelawala VC, KU, Gandhinagar		
Rapporteurs	Dr Derminder Singh, Dr Lokesh Jain	Rapporteurs	Dr K S Thind, Dr Kamal Vatta		







## Inaugural Session: February 11, 2019



Dr Baldev Singh Dhillon, Vice Chancellor, PAU, while welcoming the dignitaries and participants, affirmed that technological interventions like use of Artificial Intelligence, sensor based advanced farming system, big data management, IT tools for predictive analytics, robotics and unmanned vehicles are required to develop eco-friendly and sustainable farm technologies for smart agriculture. He enumerated a number of initiatives like Leaf Colour Chart, Laser Leveller, Tensiometer, etc. developed by PAU. He informed that PAU has been identified to get the status of Institute of Excellence which would bring many collaboration opportunities to expand research, teaching and extension programmes at the university. He also emphasized the need to build network of all stakeholders involving institutions, industry, farmers and policy makers to align agricultural research towards smart agriculture.



Prof. Sarit Kumar Das, Director of Indian Institute of Technology (IIT), Ropar and Chief Guest at the inaugural session of the two-day 43<sup>rd</sup> Vice-Chancellors' Convention of Indian Agricultural Universities' Association (IAUA) mentioned that "The key to smart agriculture lies in collaboration between IITs and agricultural universities of the country. The symbiotic relationship between the two can lead to synthesis of Artificial Intelligence with agriculture – a necessity of the future to deal with various issues in agriculture." Speaking on the occasion, Dr Das pointed out that Green





Revolution has been one of the most significant achievements of India in which PAU has played a pivotal role. Today 1.3 billion people of the country are being fed but issues like depleting water resources, indiscriminate use of pesticides, high incidence of cancer, etc. have emerged. This has called for concerted efforts to increase food production without harming our natural resources and environment, he opined. This is where Artificial Intelligence (AI) come into play, he said.

Explaining further, Dr Das said the promise of AI in agriculture will be enabled by numerous other technological advances, including big data analytics, the Internet of Things, the availability of cheap sensors and cameras, drone technology and even wide-scale internet coverage on geographically dispersed fields. AI has the power of analyzing data and learning from it by a perspective. By analyzing distinct data sources such as temperature, weather, soil analysis, moisture, and historic crop performance, AI systems will be able to provide predictive insights into which crops to plant in a given year and when to sow and harvest in a specific area for improving crop productivity, he added.

Dr N C Patel, Vice Chancellor of Anand Agricultural University, Gujarat and President of IAUA, in his remarks, cited the history of IAUA and informed that IAUA acts as a liaison between member universities and government departments to facilitate communication and expedite the needed action in matters of importance. Talking about precision agriculture, he revealed that it is a field in which with new technologies such as satellite imaging, distributed sensor data and autonomous drone surveillance of fields, the researchers are able to train AI systems to optimize the use of inputs on a precise level – i.e. applying just the right amount of fertilizer, only in the part of the field that requires it, thus maximizing yields while preserving resources. He proposed that agricultural universities should start an undergraduate programme in AI.



Dr A R Pathak, Vice Chancellor of Junagadh Agricultural University and Vice President of IAUA, said the promises of AI in agriculture were numerous and of great importance to the world. Higher crop productivity and decreased use of water, fertilizer, and pesticides via application of AI technologies could reduce the impact on natural ecosystems and increase worker safety, which in turn keep food prices down and ensure that our food production system will keep pace with population while keeping our planet safe.







The Chief Guest and the dignitaries were felicitated by Dr B S Dhillon, Vice Chancellor, PAU, Ludhiana. Dr B S Dhillon was also honoured by IAUA for being conferred with the award of Padma Shri.

In the end, the vote of thanks was proposed by Dr Gurinder Kaur Sangha, Dean Post Graduate Studies, PAU and convener of the Convention.





## Technical Session I: February 11, 2019

Theme: Sensor Based Technologies for Precision Agriculture and Advanced Farming System

Chairman	Dr A R Pathak Vice Chancellor, JAU, Junagarh
Co-Chairman	Dr C J Dangaria Vice Chancellor, NAU, Navsari
Panelist	Prof Ashok Kumar Sarial Vice Chancellor, CSKHPKV, Palampur
Keynote Speakers	Dr N C Patel Vice Chancellor, AAU, Gujarat <i>"Artificial Technologies and Robotic Application for Precision Agriculture"</i>
	Dr V Damodra Naidu Vice Chancellor, ANGRAU, Guntur <i>"Sensor Based Technologies for Advanced Farming Systems"</i>
	Dr J Adinarayan Prof & Head, CSRE-IIT (B), Mumbai <i>"Disruptive Technologies for Smart Agriculture."</i>
Rapporteurs	Dr Manjeet Singh and Dr Rakesh Sharda

Dr N C Patel delivered his keynote address on "Artificial Technologies & Robotics: Application for Precision Agriculture". He enumerated that precision agriculture helps in optimizing technologies for enhancing crop yields and improvement of quality of produce. He discussed the applications of remote sensing in agriculture in detail and outlined that drones now a days are being used for aerial survey and are helpful in improving agricultural production systems. He gave an overview of the smart farming project for which they have employed electrical conductivity, soil temperature and soil moisture sensors and the other different sensors for use in open as well as in protected cultivation. Artificial Intelligence



can be used for predictive analytics such as in automated irrigation system, image processing and in animal husbandry. He concluded that it was high time to adopt these technologies.





Dr V Damodra Naidu gave a presentation on "Sensor Based Technologies for Advanced Farming Systems". He stressed that under the low labour availability scenario and to reduce drudgery in farming, precision agriculture is the need of the hour. He presented in detail the various equipments and tools needed for precision agriculture. He stressed upon collaborative research projects on development of sensors for

precision agriculture through creating synergy among agriculture, mechanical, software and electronic engineers. He proposed the creation of agricultural mechatronics department in agricultural universities and suggested that government policies should be redrafted to create a roadmap for adoption of precision farming.



Dr J Adinarayana from IIT Bombay while presenting a keynote address on "Disruptive Technologies for Smart Agriculture" suggested that there was a need for disruptive innovations in precision agriculture by combining technological advances and associated business intelligence. Disruptive innovations like Nano and Bio materials, instrumentation for targeted drug delivery for plant pest/disease, protection before seed germination, etc. are the need of the hour. He emphasized

that emerging techniques like 'Cloud-Fog-Edge' computing which could extend support for modeling complex (physical and empirical) crop models should be explored for its use in agriculture. He clarified that cloud devices can model more complex interactions. Fog Devices can model the spatio-temporal behavior and trend of data collected from different edge devices, that capture the micro-level agro-meteorological data. There were new sensing techniques such as Bio-Sensors, high-frequency high-resolution proximal sensing platforms (Field Scan, LiDAR, UAVs), Multispectral/Hyper-spectral-Thermal imaging and remote sensing (high temporal and spatial resolution) which are revolutionizing the use of sensors in agricultural domain.



Dr Adinarayana highlighted that the challenge is to develop an integrated infrastructure to support these





sensing platforms. *Different ICT tools like Grid Sense, interoperable platform for remote monitoring and for real-time decision making should be explored for water management in horticulture, pest/disease management for yield improvement in horticulture. He stressed the need to develop data based approaches using high-end integrated information and agricultural science platform such as IoT, big data analytics, deep learning, crop modeling and Genomics/Phenomics to support high performance and sustainable agri-systems in semi-arid tropics of India. He also presented 'SenseTube or SenseQube', an IoT platform developed by IIT Bombay, for smart agriculture deploying different sensors for measuring temperature, humidity, wind speed and direction, soil moisture, etc. that can be used for weather monitoring, and water, nutrient and disease management in agriculture.*

#### **Following recommendations emerged out of the presentations and discussions:**

1. Use of precision agriculture technologies for Indian agriculture is the need of the hour to increase input utilization efficiency as well as to reduce input cost.
2. Challenges faced in adoption of Robotics and UAVs need to be discussed with different stakeholders to develop an efficient implementation mechanism.



3. Disruptive Innovations should be integrated into a single framework to have a holistic view of different domain specific problems as 'interdependent processes' and not as separate problems (systems-approach).
4. Cloud devices can model complex, multi-sensor and spatio-temporal interactions for local or regional applications. Fog devices can model the aggregating behavior (merging data from several sources) and trend of data collected from different edge devices. Edge devices can capture the micro-level agro-meteorological data for field application.
5. To develop an integrated sensing infrastructure to support applications of bio-sensors, high-frequency high-resolution proximal sensing platforms (Field Scan, LiDAR, UAVs), Multispectral/Hyper-spectral-Thermal imaging and satellite based Earth observations and remote sensing in agricultural domain.
6. Data science-based approaches using high-end integrated information and agricultural sciences using novel AgIoT, big data analytics, deep learning, crop modeling and genomics/phenomics that support high performance and sustainable agri-systems in semi-arid tropics of India should be developed.
7. Use of IoT platform like 'Sense Qube' developed by IIT Bombay needs to be enhanced.

The session was followed by visit of participating Vice Chancellors and experts to exhibition area showcasing PAU Research and Development Technology



Visit to exhibition area



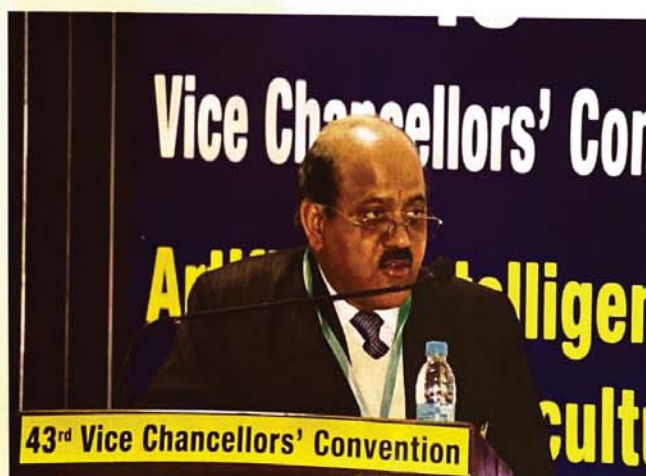
## Technical Session II: February 11, 2019

Theme: Application of Big Data Management Tools in Agriculture

Chairman	Dr P K Sharma Vice Chancellor, SKAUST, Jammu
Co-Chairman	Dr K P Vishwanatha Vice Chancellor, MPKV, Rahuri
Panelist	Dr Parvinder Kaushal, Vice Chancellor, BAU, Ranchi
	Dr M B Chetti Vice Chancellor, UAS, Bengaluru
Keynote Speakers	Dr Ashok Kumar Sarial Vice Chancellor, CSKHPKV, Palampur <i>"Policy Interventions for Promoting Artificial Intelligence (AI) in Indian Agriculture with Special Reference to Himachal Pradesh"</i>
	Dr Rabi N Sahoo Division of Biophysics, IARI, New Delhi <i>"Remote Sensing for Precision Agriculture and Plant Phenomics"</i>
	Dr K P Chinnaswamy UAS, Bengaluru <i>"Application of Big Data Management in Agriculture"</i>
Rapporteurs	Dr Dharminder Bhatia and Dr Gurupkar Singh Sidhu

The session started with the presentation of Dr A K Sarial on the topic "Policy Interventions for Promoting Artificial Intelligence (AI) in Indian Agriculture with Special Reference to Himachal Pradesh." Dr. Sarial initiated his talk by highlighting the status of investment of different countries in AI related activities. USA and China are the core leaders in AI sector and there is a huge potential of this sector in Indian agriculture. However, there is a lack of trained workforce that could handle

the AI related data. Dr Sarial expressed concern over the declining contribution of agriculture towards GDP in Himachal Pradesh. Climatic change is substantially impacting agriculture in HP as observed with shifting of peak rainfall from July to August and apple and medicinal crop belt from lower to upper hills.





Dr R N Sahoo while delivering note on "Remote Sensing for Precision Agriculture and Plant Phenomics", described precision agriculture as a way of smart agriculture. He stressed upon the requirements of smart agriculture with development of sensor based innovations, big data integration and its efficient usage. He also emphasized the requirement of tools to analyze big data to make support decision/models and integrating it with mobile network for real time monitoring. He highlighted the country's growth in space technologies such as launch of several remote sensing satellites simultaneously. However, there is a need to utilize these technologies in precision agriculture. He also presented successful applications of use of remote sensing technologies for predicting insect pests and diseases of crop plants and also expressed the concern for innovations to assist the transformation of knowledge from lab to land.



The third presentation in the session was by Dr K P Chinnaswamy on "Application of Big Data Management in Agriculture". He talked about the huge data collected through satellite surveys & sensors and focussed on the volume of crop data available with NARS. He remarked that the data was however inadequately processed and utilized. He emphasized on several challenges in big data management such as ownership, cost, data quality, bandwidth and security issues, and integrating all the data for getting precise information.



**After the three keynote lectures, the panellists gave their viewpoints, which are summarized as follows:**

1. AI has a big role in smart agriculture.
2. Remote sensing can support precise collection of data which need to be validated with field situations.
3. There is an urgent need to develop low cost AI and precision farming technologies.
4. To make innovations in high resolution data capturing, interpretation of data, retrieving potential information and passing on this knowledge to farmers is required.



At the end, Chairman of the session Dr P K Sharma presented the concluding remarks:

Big data and AI technologies are developing at an incremental rate and have immense potential to transform traditional agriculture into smart agriculture. However, with large spatial and temporal variability in agriculture, and huge diversity in social, cultural, educational and economic ecosystem, it is challenging to objectively gather and process the data. Strong policies are to be put in place together specifically for the small/marginal and large farmers with respect to use of AI technologies in Indian agriculture, with focus on building confidence and experience of farmers along with large scale adoption of AI technologies. He also cautioned that care should be taken that agriculture *per se* in the race of use of AI technologies, should not shift from the hands of Indian farmers to the technocrats and AI experts.







## Technical Session III: February 11, 2019

Theme: Robotics and UMV Technologies in Farm and Food Sector

Chairman	Dr Ashok A Patel Vice Chancellor, SDAU, Gujarat
Co-Chairman	Dr G L Keshwa Vice Chancellor, AU, Kota
Panelist	Dr S K Meti Director of Education, UAS, Raichur
Keynote Speakers	Dr A R Pathak Vice Chancellor, JAU, Gujarat <i>"Scope of Robotics and Drones in Indian Agriculture"</i>
	Dr K P Vishwanatha Vice Chancellor, MPKV, Rahuri <i>"Artificial Intelligence for Smart Agriculture"</i>
	Mr Sandeep Joshi Director, Asia Technology Innovation Centre, John Deere <i>"Robotics in Agriculture"</i>
Rapporteurs	Dr G S Manes and Dr Vishal Bector

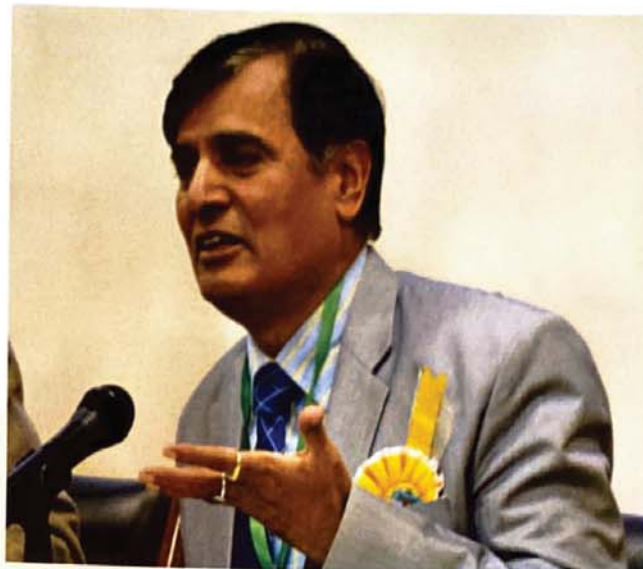
The first presentation in this session by Dr A R Pathak, Vice Chancellor of Junagarh Agricultural University, Gujarat was on "Scope of Robotics and Drones in Indian Agriculture." He emphasized on the need of robotics and drones in agriculture to overcome the labour problems, reducing crop losses, increasing efficacy and having a uniform quality of output. He explained that robotics has a great potential in agriculture as it can be used for farm operations like seeding and planting, monitoring and scouting, thinning, milking, cultivation tractors, irrigation, crop monitoring, weed control, pruning, grafting, harvesting, sorting and packaging. He highlighted their use in various countries like Netherlands, Israel, Korea, Japan, Australia, USA etc. where these technologies are being used for various agricultural operations. Similarly, the drones could be used for monitoring crop, animals, buildings and equipment, mapping and analysis of wild game damage, soil erosion, crop yield, water stress, diagnosis of diseases, variable rate fertility and creating smart data for





research. He said that we should encourage investment in such projects and have partnership with private industries to create infrastructure. There is a need to shift to custom hiring for generating extensive data and developing master trainers. In India, there is a scope for use of robotics in cotton harvesting and fruit picking.

The second presentation was by Dr K P Vishwnatha, Vice Chancellor of MPKV Rahuri on "Artificial Intelligence for Smart Agriculture." The main emphasis of talk was on precision and climate smart irrigation water management as it is one of the most important inputs in agriculture. He elaborated upon managing irrigation water optimally and precisely while taking into consideration the variability in weather, soil, crop and all local variations on sustainable basis. He further talked about the need of various irrigation methods, their efficiency and precision and highlighted that with high accuracy in



water management interventions there is 20-50% increase in water productivity even during monsoons and dry spells. He shared the efforts of MPKV towards developing GIS based maps for irrigation water requirement and also informed about a mobile app named 'PhuleJal' developed for real time precise irrigation scheduling.

The third presentation was by Mr Sandeep Joshi, Director, Asia Technology Innovation Centre, John Deere on "Robotics in Agriculture". He shared in brief about the Industry and various types of agriculture equipments being manufactured. He informed that John Deere has formed an Intelligent Solution Group which is working on application of automated machines (robotics) for use in various agricultural operations worldwide. The future trend of machines will be smart, easier to use and with more precision. He also talked about 'Blue River



Technology' working on the principle of 'see and spray' using artificial intelligence tools. Mr Joshi appreciated the organizers for selecting the theme of convention on Artificial Intelligence for Smart Agriculture which is a priority thrust area for research and development in Indian Agriculture these days. He also mentioned the need for building collaborations between industry and academia to develop the scalable farm technologies for precision agriculture in India.



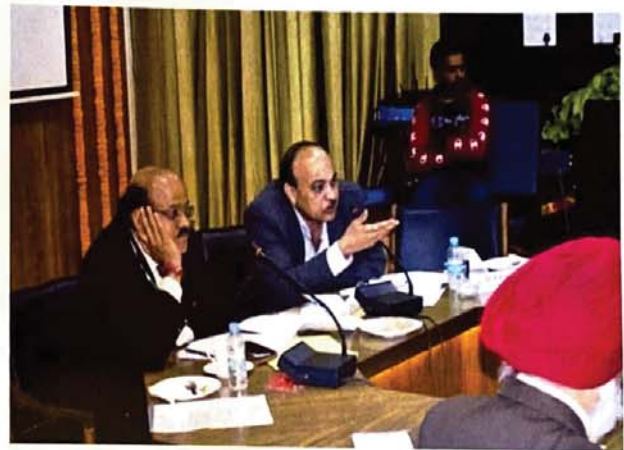
**From the discussion, the following points emerged out:**

1. Capacity building, especially of the rural youth should be a priority to retain them in agriculture. Infrastructure should be developed for custom hiring of these technologies.
2. The academic programs should include these technologies for creating special job opportunities for agriculture graduates.
3. Network of Partners/Government/Institutions/Industry should be built up.



At the end of technical sessions scheduled for first day of convention, General Body Meeting of IAUA members was held. Thereafter, the students of constituent colleges of PAU presented a cultural programme comprising of music, mime and folk dance events. The performances given by the students were well appreciated by all the delegates.





General Body Meeting of IAUA





**Glimpses of cultural programme presented by the students of PAU**



## Technical Session IV: February 12, 2019

Theme: IT Tools for Predictive Analytics in Crop, Livestock and Fisheries

Chairman	Dr A S Nanda Vice Chancellor, GADVASU, Ludhiana
Co-Chairman	Dr P K Kaushal Vice Chancellor, BAU, Ranchi
Panelist	Dr V Damodara Naidu Vice Chancellor, ANGRAU, Guntur
Keynote Speakers	Dr H C Sharma Vice Chancellor, Dr YSPUH&F, Solan <i>"Decision Support System in IPM"</i>
	Dr Shankar Venugopal, Vice President, Mahindra Research Valley, Chennai <i>"Agri Tech Innovations with Disruptive Technologies"</i>
	Dr Devan J Patel Asstt. Professor (IT), JAU, Junagarh <i>"Role of BIGDATA Analysis in Smart Farming"</i>
Rapporteurs	Dr Derminder Singh and Dr Lokesh Jain

Dr H C Sharma, Vice Chancellor, Dr YSPUH&F, Solan, HP gave a talk on "Decision Support System in IPM". He highlighted the need of Decision Support Systems (DSS) in crop production, pest management and addressing, global warming and food security. He emphasized that appropriate DSS can provide proper and timely advice in diverse geographical eco-systems. Some of the available DSS simulation models, such as *SIRATAC*, *CottonLogic*, *Helicoverpa*, *Rice Brown Plant HoPer* Expert System and *Medicila* Expert System were also discussed. He gave a detailed overview of DSS for cotton pest in Punjab. He concluded with the note that there was a need of collaboration between crop scientists and ICT experts for sustainable crop production and food security.







The second presentation was made by Dr Shankar Venugopal, Vice President, Mahindra Research Valley, Chennai, Tamil Nadu on "AgriTech Innovations with Disruptive Technologies". His focus was mainly on exponential thinking for affordable solutions to local problems as it was the need of the hour particularly for marginal farming community. He discussed various disruptive technologies like agricultural robots, drone based solutions, predictive farming, accessing crop health and autonomous farm machinery. There was an urgent need to encourage open innovations, push artificial intelligence for small and medium entrepreneurs with special focus on cost reduction and decision making.



The third talk was delivered by Dr Devan J Patel, Assistant Professor (IT), JAU, Junagarh, Gujarat on "Role of BIG DATA Analysis in Smart Farming". He explained that presently we all are big data generators and consumers. The challenge was to manage, analyze, summarise and visualize data and to generate the knowledge from this huge amount of data. He talked about 5V's: Volume, Velocity, Variety, Veracity and Value which are the dimensions of BIGDATA. *Hadoop*, *mangoDB* and *Casendra* are some of the Open Source tools available for mining the knowledge from BIGDATA. He explained different techniques of BIGDATA which should be applied in various fields of agriculture, forestry, horticulture and livestock. Data chain of BIGDATA applications are data capture, storage, transfer, transformation and analysis. He concluded his talk with the note that insufficient understanding, confusing variety, cost effectiveness, complexity, ownership and security of BIGDATA are the key challenges.



After presentations, the chairman pointed out that the Artificial Intelligence (AI) and BIGDATA are relatively new concepts but most of the SAUs are already into it albeit on a small scale.





### From the deliberations following points emerged:

1. Work should be initiated to build skilled and trained workforce especially in the field of Artificial Intelligence (AI), Machine Learning and Data analytics.
2. There is an urgent need for crop scientist and ICT experts to collaborate with each other for sustainable crop production and food security.
3. There is need to engineer ideas as to how Artificial Intelligence (AI), Machine Learning and Data analytics can be utilized for specific purposes being pursued by SAUs/Society.





At the end of session, Dr B S Dhillon, Vice Chancellor, PAU, Ludhiana was honoured by the Mahindra Research Valley, Mahindra and Mahindra in recognition to conferment of Award of "Padam Shri" upon Dr B S Dhillon.



## Technical Session V: February 12, 2019

Theme: Policy Interventions for Promoting AI in Indian Agriculture

Chairman	Dr K P Singh Vice Chancellor, HAU, Hisar
Co-Chairman	Dr V Damodra Naidu Vice Chancellor, ANGRAU, Guntur
Panelist	Dr N H Kelawala Vice Chancellor, Kamdhenu University, Gandhinagar
Keynote Speakers	Dr S K Singh Project Director, Directorate of Knowledge Management in Agriculture, ICAR, New Delhi <i>"Policy Perspective &amp; Preparedness of NARS for AI, ICT, Smart Agriculture"</i>
	Dr Ajit Maru Former Senior Officer, GFAR/FAO <i>"Making Indian Agriculture &amp; Agri-Food System Moore Knowledge Intensive"</i>
	Dr K P Singh Vice Chancellor, CCSHAU, Hisar <i>"Policy Interventions on Use of Artificial Intelligence and Robotics in Agriculture"</i>
Rapporteurs	Dr K S Thind and Dr Kamal Vatta

The session started with the highlight that policy intervention is the key to make Artificial Intelligence (AI) a reality in agriculture.

Dr S K Singh in his keynote address *"Policy Perspective & Preparedness of NARS for AI, ICT, Smart Agriculture"* pointed towards the widening gap in terms of knowledge management. He talked about the multiplicity of information sources, which often cause confusion and gaps between the haves and have-nots in knowledge of agriculture. He also highlighted the system weaknesses and stressed on the need to develop a culture for effective use of database being generated in the current times.



Finally, he emphasized on development of a clear roadmap for knowledge management, it being a key asset of the agricultural system and suggested promoting competencies in the use of AI in agriculture.





Dr Ajit Maru gave a brief overview of "AI in Agriculture and Agri-food Systems". He highlighted the need for knowledge intensive agriculture and agri-food systems to increase availability, productivity and conserve natural resources. He gave a comprehensive definition of smart agriculture which aimed at reducing costs, processing time, improving quality, reducing drudgery and optimising production and processing for sustainability.



He put a major emphasis on the kind of developments needed in India on AI front and highlighted the choices between rural revitalisation/rural abandoning and between large agro-industrial systems linked to global markets or small/numerous multi-functional systems linked to local markets. There was a need for clarity on the path to be followed before deciding the strategy. Further, there was a need to develop smart management of agri-food systems in India, which required development of a data ecosystem that has multiple layers. The objectives and directions for future requirements, aims and objectives should be chalked out before defining the policies for AI. Societal needs, objectives and goals have to come before the policies. There was a need for data cooperatives since huge data is being generated. Simultaneously, training of manpower for conducting research on ICT tools and their applications in farming was required, with emphasis on traceability, identity preservation and societal impacts. To develop knowledge driven agri-food systems, Universities and other research institutions would play an important role in generating, arranging and disseminating validated data. There is a need to generate trained manpower and conduct

As a way forward, Universities should use ICT to enable democratisation of learning and access to knowledge. They should also encourage mass innovation. Substantial funding for research and innovations for the future is required and sources would have to be sought out. These funds should focus on incubation, mentoring and technology innovation.

Dr K P Singh while speaking on "Policy Interventions on Use of Artificial Intelligence and Robotics in Agriculture" mentioned three major aspects of AI, namely drones, robots and use of big data or smart technologies in agriculture. He talked about the need to have access to these technologies before their use. He also mentioned about various uses of drones, their legal and other requirements. He also pointed to the fact that





despite many patents, the availability of commercial products was limited. He gave practical insights into the use of smart technologies at HAU.



### During the discussions the following points emerged:

There is a need to:

1. Bring together various strengths of the interventions being undertaken by different universities in the field of AI in agriculture.
2. Identify the potential already existing in our system and restructure it to achieve the desired objectives of AI.
3. Collaborate with leading science institutions like IISC and ISRO for developing skills in data collection through drones and satellite imaging.
4. Each state should develop data hubs.
5. The use of AI in agriculture should also address the concerns of small farmers.





## Plenary Session: February 12, 2019

Chairman	Dr. N C Patel Vice Chancellor, AAU, Gujarat
Co-Chairman	Dr. H.C. Sharma Vice Chancellor, Dr YSPUA&F, Solan



The plenary session was chaired by Dr N. C. Patel, Vice Chancellor, Anand Agricultural University, Gujarat and President of IAUA. He highlighted that farming is on the cusp of a major change and it will be transformed by data science and artificial intelligence. The revolutionary change will help the farming community at large to get the most from every acre. He also stressed upon the need to train the youth to make use of the new and innovative techniques. Introduction of certificate and diploma courses in AI in agricultural universities requires a serious contemplation, he suggested.

Dr A S Nanda, Vice Chancellor, Guru Angad Dev Veterinary and Animal Sciences University, co-chaired the plenary session. He delved into the need to implement strategic planning for achieving the desired goal of applying AI to agriculture. He opined that the Universities must work in collaboration with the industry to make the technologies cost-effective. The rapporteurs of different sessions presented their reports and the recommendations emerging from the deliberations thereof.

Dr Baldev Singh Dhillon, Vice Chancellor, PAU, while presenting the vote of thanks, emphasized that the time for action in the field of agricultural artificial intelligence has arrived and technologies like machine learning, image recognition and predictive modeling if applied to agriculture can boost productivity and efficiency. He also emphasized that these approaches could be important steps in the effort to produce more food for a growing population by helping farmers reduce chemical inputs, detect diseases sooner, buffer against labour shortages and respond to

weather conditions as the climate changes. Towards the end, he expressed his gratitude towards IAUA for entrusting the responsibility of the convention to PAU. He also thanked the Vice Chancellors of various universities of India and the participating experts for their erudite and innovative deliberations. He also thanked them for sharing their valuable inputs during the technical sessions.







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