Artificial intelligence in plantation crops*

Agriculture plays a vital role in India's economy with over 58% of the rural households dependent on it as their principal means of livelihood. The Indian agriculture sector, currently facing challenges of climate change, population growth and food security concerns, is progressively looking towards means to leverage innovative technologies which can substantially enhance crop productivity. Artificial Intelligence (AI) is steadily emerging as a part of the technological evolution of this sector. Plantation crops are grown in India over an area of 3.7 million hectares and provide livelihood security to around 30 million people, besides contributing Rs 250 billion to the gross domestic product (GDP). To explore the gamut of applications of AI in agriculture, with special reference to plantation crops, a two-day workshop was held last year.

During the inaugural session, P. Chowdappa (ICAR-CPCRI, Kasaragod) put forward three important challenges that required AI interventions in plantation crops, viz. monitoring of pests and

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diseases, spraying of plant protection chemicals, and precision farming for exact delivery of water and nutrients. He mentioned that AI technocrats, policy-making bureaucrats, business and marketing experts, and agricultural scientists should come together to solve the labour crunch and other issues in plantation crops. Raju Narayana Swamy (Coconut Development Board, Kochi) stressed that AI is the need of the hour for use in plantation crops, but any technology is a 'double-edged sword' that needs to be properly implemented. He emphasized the importance of lab-to-land interactions for better delivery of agricultural technologies to help farmers improve their livelihood. Kota Harinarayana (General Aeronautics Pvt. Ltd., IISc, Bengaluru) presented the keynote lecture on 'Drones, deep learning and doubling farmers' income'. He enlightened the audience on the basics of AI, machine learning and deep learning, and mentioned that there is a good opportunity to exploit satellites and drones combined with deep learning, image processing to solve the resource crisis and advance detection of biotic/abiotic stress in agriculture that can help double farmers' income. V. G. Dhanakumar (Indian Institute of Plantation Management, Bengaluru) delivered a talk on 'Disruptive innovation and AIMDel perspective'. He mentioned that there were very few disruptive innovations in agriculture, and there is an excellent opportunity to usher in lean management using Artificial Intelligence-Machine and Deep learning (AIMDel) for making agriculture more resource use-efficient.

There were 10 presentations in the workshop divided into 2 sessions. They addressed the basics of AI, the sparse studies conducted about its use in agriculture, the importance of AI, prerequisites for its utilization and the need for collaborative efforts for successful application of AI in plantation crops.

The first session started with the presentation on 'Scope of artificial intelligence in plantation crops'. The need of AI in plantation crops and some key areas, viz. soil moisture management, plant health management, reproductive biology and post-harvest operations in plantation crops where AI can be used, were enlisted. The talk stressed upon the need for collaboration amongst engineers and scientists to develop cost-effective and efficient sensors. In the presentation on 'Spirit of lean start-up through R&D for AIMDeL products and services', the need to apply AI in supply value chain was emphasized. The role of AI from collection to marketing was demonstrated taking coconut inflorescence sap (Kalparasa®) as a business example.

The talk on 'Fluid mechanics and heat transfer in precision agriculture' described the importance of controlling basic requirements of plants such as light, temperature and moisture in a polyhouse and modified plant growth chambers. The concept of energy-efficient and cost-effective polyhouses, in which internal temperature could be maintained by installing solar chimneys, was introduced. The use of X-ray technology for diagnosing stem-borer infection in coffee was also presented along with the application of AI on pest management, especially in the identification of red palm weevil infestation in coconut in the early stage using radar technology.

The second session commenced with a presentation on 'Applications of IOT, big data, cloud analytics and robots for data-driven plantation management'. It included the basic concept of AI, its applications emerging start-ups in the field of agriculture and available applications. Various driving factors that led to the evolution of AI were discussed. Also, examples of utility of AI in agriculture, e.g. sorting of cucumbers based on size, shape and colour, 'MS-Farmbeats: an end-to-end Internet of Things (IOT) system' that enables AI in agriculture and utilization of TV white spaces-based bandwidth for communication in rural areas were presented. Information about successful business ventures in agriculture that use AI, e.g. 'FASAL', 'CROP IN', 'Blue River', etc. were elaborated. The presentation on 'Electronic crop (e-crop) – an IOT tool for precision farming' explained the components of the e-crop IOT device and crop simulation models, and how these models have been utilized for providing timely advisories to the farmers. The possibilities of adding more crops to the device by incorporating crop models in the system were put forth. It was suggested to incorporate models to address issues such as price instability, labour scarcity and contingencies due to external factors. It was also suggested to test and validate the system for multiple cropping systems.

In the talk on 'Legged machines as farming assistants', the importance of machines in performing operations such as climbing and other associated operations was envisioned, especially the use of robots as a replacement for humans in agricultural operations and the use of 'reinforcement learning' in making legged machines. The challenges in converting the simulations into hardware operations were discussed. In terms of cost of developing legged machines, a comparison was made between India and other countries, especially USA, and the comparative advantage that India has vis-à-vis other tech giants was highlighted. The talk on 'Artificial intelligence in agriculture, growth driven by IOT and automation techniques in irrigation, importance of drones, precision farming' featured the analytics being used to solve the problems in engineering. The technological innovations made abroad require a re-engineering in the Indian scenario for their effective adoption. AI could improve the productivity by optimal utilization of resources. Cross-industry technological collaborations were suggested for improvement in efficiency in value chain management. The talk on 'Digital transformation (AI, ML, Cloud and IoT)' highlighted its importance for success of AI in any field, including agriculture. The soil moisture detection sensor, Google's experimental pages on AI and popular applications of AI in day-to-day life were some of the examples elaborated.

Given the huge scope of agriculture in India, it is imperative that AI is used to the maximum potential so that both farmers and consumers can benefit from it. The recommendations of the two-day workshop include combining computer vision technology, IOT, proximity sensing and remote sensing with drones to understand adverse weather conditions, water requirement, pest and disease identification, spray liquids, nutrient deficiency recognition, crop mature identification and productivity gains in order to make farming 'smart' and more resistant to the problems faced by the farmers.

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