GOVERNMENT OF INDIA
MINISTRY OF AGRICULTURE AND FARMERS WELFARE
DEPARTMENT OF AGRICULTURAL RESEARCH & EDUCATION

LOK SABHA
UNSTARRED QUESTION NO. 3826
TO BE ANSWERED ON 11TH AUGUST, 2026

PRECISION AGRICULTURE

3826. SHRI GANESH SINGH:

Will the Minister of AGRICULTURE AND FARMERS WELFARE कृषि और किसान कल्याण मंत्री be pleased to state:

(a) whether the Government has undertaken any study of international best practices in precision agriculture and efficient land-use technologies to enhance productivity and sustainability in smallholder farming systems;

(b) the steps being taken to promote the use of technologies such as AI, drones, sensors, satellite-based monitoring and precision irrigation among farmers;

(c) whether the Government is considering the adoption of a comprehensive precision farming ecosystem to improve productivity on limited land holdings, reduce input costs and optimize water and fertilizer use; and

(d) the expected impact of such technologies on farm incomes, climate resilience and sustainable agricultural growth in the country?

ANSWER

THE MINISTER OF STATE FOR AGRICULTURE AND FARMERS WELFARE
कृषि और किसान कल्याण राज्य मंत्री (SHRI BHAGIRATH CHOUDHARY)

(a): Yes, Indian Council of Agricultural Research (ICAR) has taken up a program of National Importance namely, Network Program on Precision Agriculture (ICAR - NePPA) having 16 ICAR Research Institutes of different domains. Under this program, technologies are developed using sensors, remote sensing at different platforms (ground, airborne -Drone and satellite platforms), AI and ICTs in line with international best practices in precision agriculture related to

- Spatio-temporal monitoring and management of crop and soil health.
- Sensor based post-harvest quality monitoring and management (of mango, banana, pulse and rice, etc).
- IoT based precision vertical farming for high valued vegetables under controlled environment.

- Developed sensor-based monitoring and management of aquatic environment for precision aquaculture.
- Monitoring of livestock health using different IoT enabled sensing for precision livestock.

ICAR continuously studies, adapts and develops advanced precision agriculture and efficient land-use technologies suited to Indian conditions. ICAR Institutes have developed and validated technologies such as sensor-based irrigation, IoT-enabled environmental monitoring, drone-based spraying, AI-enabled precision planters, remote sensing and GIS applications, drip fertigation, poly-mulching, raised-bed cultivation, modified raised and sunken conservation beds, agro-aqua land configuration, automated livestock management systems, low-cost protected cultivation, hydroponics, aeroponics, agrivoltaic farming, precision subsurface drip irrigation and other water-efficient irrigation technologies to improve productivity, resource-use efficiency and sustainability in smallholder farming systems. ICAR has developed and demonstrated a tank-based super-intensive precision shrimp farming system. The technology yields 120–150 tonnes/ha/year over three annual cycles and the system integrate smart automation, strict biosecurity, and eco-efficient management for all farm sizes.

(b): ICAR is promoting precision agriculture through:

- Development and validation of AI-, IoT- and ICT-enabled decision support systems for crop and natural resource management;
- Use of drones for crop monitoring, precision input application and crop health assessment;
- Remote sensing, GIS and satellite-based monitoring for crop assessment and resource mapping;
- Sensor and IoT-based irrigation and fertigation systems for efficient water and nutrient management;
- Precision nutrient management using enhanced-efficiency fertilizers, nano-fertilizers and biofertilizers;
- Development of digital tools such as the Dweep Microclimate Monitor and AI-based models for water stress assessment and livestock management;
- Establishment of a Remote Pilot Training Organisation (RPTO) at Dehradun for UAV/drone training;
- Technology demonstrations, farmer training, capacity building and digital advisory services through ICAR Institutes, AICRPs and Krishi Vigyan Kendras (KVKs).
- AI, sensor and IoT based technologies/equipment/ systems developed for production and post production agriculture such as; smart micro-irrigation system utilizing automation and sensor networks to optimize water use efficiency, Variable rate fertilizers applicator, AI & IoT enable jute grading system, SPAD meter 2.0 for measuring leaf chlorophyll concentration, IoT System for Monitoring and Control of Cold Room, Instrument for Rapid detection of Aflatoxin-B1 in maize, Smart Banana Supply Chain: Sensor based monitoring and Bloc-chain enabled Traceability, Digital twin-based fruit quality monitoring, AI based Grain Analyzer Software, Artificial Intelligence Based Quality Assessment of Rice Seeds, Contamination Measurement Techniques using Image Processing in Seed Cotton, portable device for non-destructive and quick ginning percentage measurement based on computer vision and

machine learning etc. and conducted drone demonstrations in an area of 230 ha, benefitting 2487 farmers.

- ICAR institutes use drones and mobile apps to demonstrate AI-driven fertilizer and pesticide spraying in some crops to farmers.

In addition, some of the areas in which ICAR applies artificial intelligence (AI) are:

- Use of drone for collecting water samples for analysis from open-water bodies & difficult terrains; distribution of feed & medicines to the culture systems; transportation of fish & goods; biomass estimation; health monitoring, etc.
- Developed IoT-based dissolved oxygen management system.
- Fisheries resource assessment and predictions in inland open-water under AI and Big Data platform.
- Establishing smart production system and hatchery using automated devices and gadgets for enhancing production.
- Artificial Intelligence (AI), Internet of Things (IoT) sensors, drones, and satellite imagery—to strengthen early disease warning systems, biosecurity, and overall livestock management. The specific initiatives and technical applications deployed for livestock protection.
- Satellite & AI-Based Early Warning Systems: ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI) utilizes Geographic Information Systems (GIS), satellite spatial datasets, and predictive machine learning models to forecast 15 economically important livestock diseases outbreaks up to two months in advance, enabling state authorities and farmers to take preventive action.
- Sensor-Based Health & Reproduction Monitoring: Wearable IoT sensors (such as smart neck collars, rumination tags, and leg pedometers) are integrated into herd management systems to measure real-time body temperature, rumination activity, and estrus cycles, allowing early diagnosis of illness before clinical symptoms surface.
- Krishi Vigyan Kendra (KVK) scheme to promote adoption of new technologies in agriculture and allied sectors including agri-drones through technology assessment, demonstration and capacity development among the farmers. The KVKs/ICAR Institutes/Agricultural Universities conducted 38,402 Agri-drone demonstrations on nutrients, fertilizers, chemicals (insect & pest) applications in 41,280 ha area. Total 4,54,083 farmers participated in the Agri-Drone demonstrations and field interventions.

(c): Yes. ICAR promotes an integrated precision farming ecosystem by developing location-specific technologies for precision irrigation, nutrient management, protected cultivation, mechanization, digital decision support and climate-smart agriculture. These technologies are being disseminated through field demonstrations, farmer training, capacity building programmes and collaboration with State Departments, Krishi Vigyan Kendras (KVKs) and other stakeholders to facilitate their adoption by farmers.

(d): Precision agriculture technologies have demonstrated significant improvements in productivity, profitability, resource-use efficiency and climate resilience. Precision irrigation technologies, including solar-powered Jhola Kundi systems, farm ponds and micro-irrigation, increased cropping intensity from 137% to 272%, doubled the crop diversification index (0.40 to 0.80), increased average monthly farmer income from ₹4,644 to ₹19,676, and reduced dependence on diesel and electricity while mitigating about 40.5 tonnes of CO_2 emissions annually. At Goa, precision agriculture technologies increased rice and cowpea yields by 4.69% and 6.58%, respectively, while reducing irrigation water use by 92.9% and labour requirement by about 95%. Farm pond-based rainwater harvesting systems increased crop yields by 20–55%, while polyhouse cultivation integrated with automated drip irrigation and fertigation generated net returns of ₹2.72 lakh per 15 gunta with a B:C ratio of 4.57. In Bihar, integration of raised beds, drip fertigation and poly-mulching improved nutrient-use efficiency by 30–85%. Adoption of drip irrigation and protected cultivation reduced irrigation water requirement by 70–80%, while hydroponics reduced water use by up to 90%. Drone-based foliar nutrient application improved crop yields by 4–5%, reduced spraying costs by about 15%, enabled spraying of one acre in about 6 minutes using only 9.5 litres of water and 0.5 litre of nano-fertilizer, while minimizing crop damage and ensuring uniform application. These technologies collectively enhance farm income, optimize water and fertilizer use, reduce production costs and support sustainable and climate-resilient agricultural growth.

The integration of AI, IoT, drones, and satellite imagery enhances livestock management by creating proactive early disease warning systems, strengthening biosecurity, and optimizing overall farm efficiency include:

Predictive Disease Control and Reduced Mortality: AI models and IoT-enabled biometric sensors can detect physiological stress and predict potential disease outbreaks 5–12 days before clinical symptoms appear, enabling timely intervention. This can reduce veterinary expenses by 20–40% while preventing large-scale livestock losses.

Optimized Productivity and Reproductive Performance: Real-time wearable sensors automate estrus detection, improving the success rate of artificial insemination by 15–30%. In addition, smart microclimate control and precision feed management can enhance milk yields by up to 18%, leading to improved overall livestock productivity.

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