Emerging GPS & GIS Applications in the Agriculture Sector

India faces the urgent challenge of ensuring food and feed security amid climate change, shrinking farmland, and rising demand. In this scenario technologies like Geographic Information System (GIS) and Global Positioning System (GPS) offer powerful solutions. By adopting these tools, India can boost productivity, reduce waste, and build a climate-resilient agricultural system.

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TABLE OF CONTENTS

1 Introduction: Mapping the Future of Food & Feed Security with GIS & GPS 1

2 The Role of GIS & GPS in Transforming Indian Agriculture 2

3 The Evolution of Agricultural Technologies 6

4 Applications of Geographic Information Systems (GIS) 9

4.1 Applications of GIS in Agriculture 10

4.2 Application of GIS in Agri-allied Sectors 11

5 Applications of GPS 13

5.1 Application of GPS in Agriculture 13

5.2 Application of GPS in Agri-allied Sector: 15

6 Real-World Success Stories: Innovation on the Ground 17

6.1. Precision Farming in Punjab: Boosting Wheat & Rice Yields 18

6.2. Maharashtra's Grapes Export Success with GIS & GPS 18

6.3. Smart Water Management in Karnataka's Sugarcane Belt 18

6.4. GIS-Powered Cold Chain Logistics in Uttar Pradesh 18

6.5. Rajasthan's Livestock Health Monitoring System 19

6.6. Israel-India Collaboration on Smart Farming 19

7 The Way Forward: Enabling GPS and GIS for Indian Agriculture 20

8 References 21

1) Introduction: Mapping the Future of Food & Feed Security with GIS & GPS

India, home to over **1.4 billion people**, faces an urgent challenge—**how do we ensure food and feed security for a growing population while dealing with shrinking farmland, climate change, and resource constraints?** The answer lies in technology, and two powerful tools – **Geographic Information System (GIS) and Global Positioning System (GPS)** – are transforming agriculture like never before.

Today, **30-40% of India's total food production is lost due to inefficient supply chains, unpredictable weather, and poor resource management** . At the same time, the demand for **quality animal feed** is increasing, with India ranking **first in milk production, contributing 24% of global supply** and **third in global fish production, reaching a record 175.45 lakh tonnes in 2022-23**. Yet, many farmers still rely on age-old methods, leading to wastage and low productivity.

Imagine a farmer in Maharashtra getting **real-time weather alerts on his phone**, advising him when to irrigate to **save 30% more water**. Or a dairy farmer in Punjab using GPS to **track grazing patterns**, ensuring his cattle receive **nutrient-rich fodder at the right time**. These are not futuristic ideas—they are happening today, thanks to GIS and GPS.

By using **GIS to analyze soil quality, predict yield patterns, and monitor crop health** and **GPS to optimize farm-to-market logistics**, India can **reduce food loss, improve farm productivity, and strengthen its agricultural economy**. Countries like **Israel and the Netherlands**, despite having limited arable land, have achieved remarkable agricultural efficiency using these technologies. **Why should India lag behind?**

This paper explores how **GIS and GPS can be the backbone of India's food and feed security**, making farming more **precise, resource-efficient, and climate-resilient.** Whether you are a farmer, a policymaker, a business leader, or a student, understanding and adopting these tools is **no longer an option – it's a necessity.**

2) The Role of GIS & GPS in Transforming Indian Agriculture

In a rapidly evolving agricultural landscape, **precision and efficiency** are the new currencies of success. With challenges like erratic monsoons, soil degradation, and increasing food demand, India's farmers can no longer rely on **traditional, intuition-based farming.** Instead, they need **data-driven insights and real-time decision-making tools**, which is where **Geographic Information Systems (GIS) and Global Positioning Systems (GPS)** come into play.

GIS enables **farmers to visualize and analyze spatial data**, helping them understand soil health, water availability, and crop conditions with unprecedented clarity. Meanwhile,

GPS provides **precise location tracking**, ensuring accuracy in **land surveying, resource allocation, and farm logistics**. Together, these technologies form the foundation of **modern, climate-resilient, and high-yield farming.**

Benefit	Impact	Data & Statistics
Higher Yields & Precision Farming	Reduces input wastage and increases productivity	**Precision farming can increase yields by 10-15% and reduce input costs by 20%** (ICAR)
Water Conservation	Optimizes irrigation and prevents overuse	**GIS-based irrigation planning has saved up to 40% water in drought-prone regions** (NITI Aayog)
Reduced Soil Degradation	Prevents excessive fertilizer and pesticide use	**30% of India's soil is degraded; GIS-based soil analysis helps in targeted nutrient management** (FAO)
Lower Post-Harvest Losses	Enhances supply chain efficiency	**India loses 92,000 crore worth of food annually due to poor logistics; GPS tracking reduces transport losses** (FICCI)
Climate Resilience	Helps predict weather patterns and mitigate risks	**Farmers using GIS-based climate prediction models saw 20-30% reduction in crop loss due to extreme weather** (IMD)
Efficient Land Use	Prevents overuse of farmland and improves planning	**GIS helps in smart land mapping, reducing farm expansion into forests by 25% in monitored regions** (Ministry of Agriculture)

As India pushes for **sustainable and technology-driven agriculture**, embracing GIS and GPS is not just an advantage – it is a necessity. These tools offer a **scalable, cost-effective way to optimize resources, maximize yields, and strengthen India's food and feed security**. By integrating these technologies into mainstream farming and supply chains, India can not only meet the demands of its growing population but also establish itself as a **global leader in agri-innovation.**

3) The Evolution of Agricultural Technologies

Agriculture 1.0," was marked by the invention of the plough and the widespread use of animal drafts. Agriculture 2.0 started towards the tail end of the 19th century with the introduction of mechanical machinery such as tractors. This was followed by an strong focus on applying science and technology to agriculture for increasing crop yields, leading to:

- Better genetics/ high yielding variety seeds
- Better plant nutrition through fertilizers
- Better water provision through water sourcing technology and management
- Better pest control through pesticides
- Better farm power and machinery for better physical and time efficiency

These developments galvanized the growth of numerous agribusinesses and industries including the seed industry, fertilizer industry, irrigation equipment industry, agro-chemical industry, and farm machinery industry. These made immense contributions including the Green-Revolution in India to the overcome the land and resource constraints in agriculture. It would be unthinkable feeding the world today without the contribution of this science, technology and these vital industries

Precision farming, often referred to as Agriculture 3.0, emerged to address the growing need to monitor and efficiently manage inputs in crop production. The advanced approach combines innovative farming methods and tools with modern technology to optimize resource use and enhance sustainability. The Global Positioning Satellite System (GPS) technology allows farmers to manage variations in agricultural production spaces, facilitating the effective use of resources. This was very important for sustainable agriculture and the way farmers manage their operations.

Crops such as soybean and maize benefited from these precise techniques, which ensure optimal growth conditions and resource use, and precision farming systems now extend beyond field crops to include fruit crops, where sowing, watering, fertilizing, and harvesting can be computer-controlled. Micro-irrigation is a vital component of precision farming, applying water through drippers, sprinklers, foggers, and other emitters directly to the surface or sub-surface of the land. This method delivers water efficiently to the base of each plant, minimizing waste. Sub-surface irrigation systems are particularly beneficial for high water-consuming crops like rice, offering long-term sustainability. Soil moisture, a key variable in managing water and heat exchange between the land and atmosphere, is carefully monitored using advanced soil moisture sensors. These sensors measure the volumetric water content in soil, ensuring precise irrigation.

Systems integrated with soil moisture sensors automate the supply of water and fertilizers, delivering them to crops at the right time and in the right quantities. This integration of technology not only conserves resources but also promotes higher yields and sustainable farming practices, making precision farming a cornerstone of modern agricultural innovation.

The leap from smart farming to connected farming or Agriculture 4.0 shows how fast technology used in agriculture has moved forward at the turn of the 21st century. Technology like the Internet of Things (IoT), drones, satellites, autonomous machines, sensor-equipped robots, augmented reality are all part of the new agricultural environment, named Agriculture 4.0. Decision-making in the agricultural sector can now be based on data that is stored in the cloud and accessible via digital equipment. With the help of this analyzed data, farmers and other major players in the agricultural industry can make better decisions. All developments in agricultural technology are becoming more integrated and networked, to optimize all stages of the production process and enhance its monitoring, management, and control.

Agriculture 5.0, or simply put, “digital agriculture,” refers to the next generation of farming methods and tools for maximizing crop yields and other agricultural outcomes. One such technology is 5G will improve the reach and access to the latest agritech knowledge around the world.

Compared to prior farming methods, digital agriculture technology excels in the data collection efficiency: how much data can be collected in a given amount of time or space; data accuracy: how close a measurement is to the truth; Timeliness: how quickly the data can be processed into practical information and reported to end users.

With the advent of digital technologies, agricultural producers will be able to far better manage weather, pests, and diseases impacts. Digital agricultural technologies will also allow farmers to greatly improve decision-making and returns to factors they control such as:

- What types of crops to grow;
- How to rotate crops for the best results;
- When and how much water to use for irrigation;
- When, how much, and what kind of nutrients and plant protection products to apply;
- What kind of tillage works best with a given type of soil?

Valuable tools and technologies of digital agriculture that can enhance competitive advantage are cutting-edge farm management software, space-based solutions (especially those that provide high-resolution satellite images), proximal sensors, connectivity instruments, and use of data-driven algorithms for prediction.

The revolution of Generative Artificial Intelligence is now leading to Agriculture 6.0, with its massive power to access and quickly process huge volumes of information in response to queries. Generative or Predictive AI automates human-like decision-making through pattern recognition. Generative AI can generate new content or answers at the command of a human query. It can use all available knowledge/ information to give answers or create content including text, images and charts. ChatGPT is the most popular generative open AI application today, is immensely powerful and is already being very widely used.

4) Applications of Geographic Information Systems (GIS)

Geographic Information Systems (GIS) is a system designed to capture, store, manipulate, analyze, and display spatial or geographic data. It combines cartography, statistical analysis, and database technology to provide actionable insights. It is a transformative tool providing a framework and approach for gathering, analyzing, and visualizing spatial data. By integrating geographic data with management strategies, GIS enhances decision-making, resource optimization, and sustainability.

GIS involves the gathering, storage, analysis, and visualization of spatial data for precision agriculture needs. One of the most important ways that GIS-based agriculture technology is used in farming is to gather information about a region's crops, soil, climate, and topography by using satellites and drones. GIS enables the use of GPS apps in conjunction with smart tools to optimize agricultural operations such as the application of fertilizer and pesticides.

With the help of remote Crop Monitoring's GIS capabilities, you may generate field productivity maps utilizing the basic NDVI index over a few years. By using these yield maps, it's easy to pinpoint the most productive parts of your field, as well as low-yielding places that would benefit from additional fertilizer or other methods to boost field productivity. Applying the correct quantity of fertilizer to the soil might be a challenge, but yield mapping can help; farmers will not only save money on fertilizer but also ensure that they don't pollute the soil and groundwater with the excess chemicals.

4.1) Applications of GIS in Agriculture

1. **Precision Farming & Yield Mapping:** GIS allow farmers to **divide their fields into zones** based on soil type, fertility, and past yield performance. This helps apply the right amount of fertilizers, pesticides, and water, minimizing wastage and maximizing productivity.
2. **Soil Health Monitoring & Management:** GIS-based soil analysis helps track **organic matter, nutrient content, and erosion risk**. This enables **smart fertilizer application**, preventing soil degradation and enhancing productivity.
3. **Crop Health Monitoring & Pest Detection:** GIS-integrated **satellite and drone imagery** helps detect crop stress, diseases, and pest infestations **before visible symptoms appear**. This allows farmers to take early action.
4. **Irrigation Planning & Water Resource Management:** With **80% of India's freshwater used in agriculture**, efficient irrigation is critical. GIS-based systems monitor groundwater levels, rainfall patterns, and soil moisture to **optimize irrigation** and prevent overwatering.
5. **Climate-Smart Agriculture & Weather Forecasting:** GIS-integrated weather models help farmers adjust sowing, irrigation, and harvesting based on **real-time climate conditions**, minimizing crop losses.
6. **Agricultural Supply Chain & Logistics Optimization:** GIS optimizes **storage, transportation, and market connectivity**, reducing food wastage and ensuring timely deliveries.
7. **Crop Insurance & Risk Assessment:** GIS helps insurance companies **assess farm risks based on historical climate data, soil conditions, and past disasters.**
8. **Smart Farming & Internet of Things (IoT) Integration:** IoT devices combined with GIS and GPS offer **real-time monitoring of farm activities**, helping farmers adjust irrigation, fertilizer use, and equipment movement automatically.
9. **Digital Soil Mapping & Land Capability Classification:** GIS enables high-resolution **digital soil mapping**, helping classify land based on **its suitability for different crops**. This prevents land misuse and promotes sustainable farming.
10. **Carbon Farming & Climate Mitigation:** GIS is crucial for monitoring **carbon sequestration** in farmlands and predicting how different farming practices impact greenhouse gas emissions.
11. **Smart Greenhouses & Controlled Environment Farming:** GPS and GIS automate **climate-controlled greenhouses**, optimizing conditions for growing high-value crops like exotic vegetables, herbs, and medicinal plants.

12. **Agricultural Market Intelligence & Price Forecasting:** GIS maps supply-demand trends across different regions, helping farmers decide **what to grow** and **where to sell** for maximum profit.
13. **Nutrient Management:** GIS enables **spatial analysis of soil nutrient levels**, guiding farmers to apply **customized doses of fertilizers** rather than using a one-size-fits-all approach.
14. **Cold Chain & Perishable Crop Logistics:** GPS allows real-time tracking of **temperature-sensitive goods** such as fruits, vegetables, and dairy. GIS is used to **map cold storage locations** and optimize transportation routes.
15. **Water Table Monitoring & Aquifer Recharge Planning:** GIS tracks **groundwater depletion**, helping policymakers and farmers plan **rainwater harvesting and aquifer recharge projects.**
16. **Pesticide Spray Drift Control:** GIS and GPS help **control pesticide drift**, reducing contamination of non-target areas. **Drones with GPS mapping** ensure precise spraying, preventing excessive chemical use.

4.2) Application of GIS in Agri-allied Sectors

1. **Smart Dairy Management & Precision Livestock Tracking:** Dairy farmers are using GIS mapping to track livestock health, grazing patterns, and milk production. Heat stress, disease outbreaks, and breeding cycles can now be monitored spatially, improving overall yield.
2. **Precision Fisheries & Marine Resource Management:** GIS helps identify optimal fishing zones (OFZs) using satellite data on ocean currents, temperature, and chlorophyll levels. This enables sustainable fishing practices and better resource planning.
3. **Sustainable Forestry & Biodiversity Conservation:** GIS is crucial in mapping forest cover, tracking deforestation, and monitoring wildlife corridors. Geospatial models also predict forest fire risks and support planning for conservation.
4. **Beekeeping & Pollination Mapping:** GIS helps identify floral availability zones for bees, ensuring better honey production and supporting pollination services for various crops.
5. **Poultry Health Monitoring & Disease Control**: GIS tracks disease outbreaks in poultry farms, helping in early detection and containment of infections such as bird flu.
6. **Veterinary & Animal Health Services:** GIS maps disease-prone regions for livestock and helps plan and monitor vaccination drives, aiding in the prevention of epidemics like foot-and-mouth disease (FMD).

7. **Silkworm Rearing & Sericulture Planning:** GIS helps locate ideal mulberry plantation zones for silkworms, supporting high-quality silk production through better environmental matching.
8. **Floriculture & Export-Oriented Flower Farming:** GIS-based climate modeling helps identify ideal growing conditions for flowers like roses, orchids, and marigolds.
9. **Mushroom Cultivation & Climate Control:** GIS-based microclimate mapping helps identify optimal regions for mushroom farming.
10. **Agro-Tourism & Rural Economy Development:** GIS helps map potential agro-tourism hotspots by identifying regions with scenic landscapes, traditional farming practices, and heritage sites.
11. **Agro-Forestry & Carbon Credit Mapping:** GIS maps tree-based farming systems, helping farmers earn carbon credits for reforestation efforts.

Questions for Policy-makers?

- If GIS-based soil health mapping in Punjab reduced fertilizer use by 15% and increased yields by 18%, why hasn't this become *mandatory across India's major cropping zones*? *(Source: Punjab Agricultural University)*
- How long will we wait to make GIS irrigation planning standard, when Karnataka showed a **40% reduction in water usage**? *(Source:)*
- Post-harvest GIS route optimization in Uttar Pradesh cut food wastage by 24%. Then why is 30-40% of our produce *still* rotting before reaching markets? *(Source: Allied Business Academies)*
- Why isn't GIS disease surveillance integrated into all livestock hubs, when Rajasthan proved it can cut animal mortality significantly? *(Source: Iasaarthi)*
- Shouldn't GIS be a **core component of PM-Fasal Bima Yojana**, instead of relying on outdated damage estimation methods?

5) Applications of GPS

While GIS tells us where to look, **GPS (Global Positioning System)** tells us exactly **where we are**. Together, they create a digital twin of the farm, but GPS brings unmatched accuracy—right down to a few centimeters. In India's diverse and complex agricultural landscape, this precision is a game-changer.

Let's take a real-world example: In Punjab, GPS-enabled tractors now help wheat farmers reduce overlaps in tilling and sowing, which has resulted in **10–15% savings on diesel and 5–7% increase in yield** (ICAR, 2023). For smallholders in Maharashtra, GPS-based irrigation timers have helped reduce water wastage by **up to 30%**, especially in sugarcane fields (FAO, 2022).

5.1) Application of GPS in Agriculture

1. **Precision Farming – Optimized Sowing & Fertilizer Application:** GPS-enabled tractors and seeders allow accurate sowing, ensuring optimal seed spacing and fertilizer placement—reducing input costs and increasing yield.

2. **Farm Machinery Guidance – Reduced Fuel & Labour Wastage:** GPS auto-steering systems guide tractors, harvesters, and sprayers in straight, overlapping-free lines—saving time, fuel, and labour.

3. **Land Levelling & Surveying:** GPS helps in accurate land measurements, boundary disputes resolution, and laser-based land levelling, improving water usage and crop uniformity.

4. **Irrigation Scheduling & Water Resource Management:** GPS-integrated systems monitor farm layout and topography to design water-efficient irrigation—especially drip and sprinkler systems.

5. **Crop Scouting & Pest Mapping:** With GPS, farmers or agronomists can mark exact coordinates of pest-affected zones, enabling localized pesticide application.

6. **Yield Mapping:** Harvesters with GPS and yield sensors record exact yield data per location, helping farmers analyze field variability and improve future cropping strategies.

7. **Weather-Responsive Decision Making:** GPS enables geo-tagged weather updates and localized advisories via mobile apps for sowing, harvesting, and fertilization.

8. **Post-Harvest Logistics Optimization:** GPS helps track transport vehicles carrying harvested crops to reduce delays, spoilage, and theft, especially for perishables.

9. **Crop Insurance Verification & Claim Settlement:** GPS is used to geo-tag fields, monitor crop growth, and assess real-time damage—making insurance more transparent and efficient.

10. **Soil Health Monitoring & Geo-tagged Testing:** GPS is used to geo-tag soil samples and create fertility maps for tailored nutrient recommendations.

11. **Precision Weed Management:** GPS-integrated sensors and drones help identify weed-infested zones for spot spraying, reducing chemical usage.

12. **Smart Crop Rotation Planning:** GPS enables long-term recording of cropping patterns and productivity across field sections, aiding in scientific crop rotation.

13. **Organic Farming & Traceability:** Geo-tagged certification via GPS helps track origin, practices, and movement of organic produce for traceability and consumer trust.

14. **Geo-Fencing to Prevent Crop Theft or Animal Intrusion:** Farmers can set up GPS-based geo-fences that alert them when animals or unauthorized vehicles enter fields.

15. **Digital Farmer Profiling & Advisory Services:** GPS-tagged farms enable agritech platforms to offer personalized crop advisory, financial support, and supply chain integration.

5.2) Application of GPS in Agri-allied Sector:

1. **Dairy Farming – Livestock Monitoring & Grazing Management:** GPS collars track cattle movements, helping optimize grazing patterns, monitor health, and prevent livestock theft or straying. This improves milk yield and animal welfare.
2. **Fisheries – Vessel Tracking & Marine Safety:** GPS enables real-time tracking of fishing vessels, reducing the risk of illegal fishing, overfishing, and sea accidents. It also aids in mapping fish-rich zones.
3. **Poultry – Smart Shed Management:** GPS-linked temperature and humidity sensors in poultry sheds help automate ventilation, feed timing, and disease monitoring, especially in high-density production zones.
4. **Sericulture (Silk Farming) – Mulberry Crop Management:** GPS tracks optimal mulberry plantation zones by mapping altitude, slope, and microclimate. This ensures healthy silkworm breeding and higher cocoon yield.
5. **Animal Husbandry – Disease Surveillance:** GPS-tagged livestock and field vets enable geo-fencing of disease outbreaks and faster vaccination deployment in rural areas.

6. **Forestry & Agroforestry – Wildlife & Plantation Monitoring:** GPS helps map forest boundaries, track wildlife movements, and plan plantation drives in community forestry programs.
7. **Livestock Health Monitoring & Grazing Optimization:** GPS collars track livestock movement to ensure they graze in optimal areas, preventing overgrazing and monitoring animal health in real time.
8. **Aquaculture Site Mapping & Movement Tracking:** GPS is used to map fish farms, track feeding zones, and monitor the movement of boats and aquatic livestock.
9. **Poultry Farm Management:** GPS-enabled systems track delivery vehicles, optimize egg/meat supply routes, and monitor waste disposal.
10. **Sericulture: Mulberry Field Monitoring:** GPS helps monitor mulberry cultivation and traceability of cocoons for better pricing and export compliance.
11. **Dairy Cold Chain & Milk Route Tracking:** GPS trackers in milk vans ensure real-time temperature monitoring and optimized routes to maintain milk freshness.
12. **Veterinary Services & Mobile Clinics Routing:** GPS is used to route mobile vet vans efficiently to reach rural and remote areas faster.
13. **Apiculture (Beekeeping) & Pollination Mapping:** GPS trackers on hives monitor movement patterns of bees, helping minimize colony collapse and optimize pollination.

Questions for Policy-Makers

- GPS-enabled grape logistics in Maharashtra led to high compliance with EU export norms. So what stops us from *mandating GPS monitoring for all export-linked horticulture clusters*? *(Source: Tridge)*
- If GPS-controlled drip systems raised sugarcane yield by 9%, why aren't these technologies subsidized like tractors? *(Source: SpringerLink)*
- Why aren't APMC mandis using GPS tracking for produce logistics, especially when it slashed post-harvest losses by 20% in Nashik and 24% in Uttar Pradesh? *(Sources: Academia+1APMC Mandi+1)*
- When GPS-tracked mobile veterinary units in Rajasthan improved response time during outbreaks, why aren't such systems rolled out nationwide? *(Source:)*
- Why are only elite agri-entrepreneurs using GPS for cold chains while smallholder farmers remain excluded from this digital revolution?

6) Real-World Success Stories: Innovation on the Ground

Across India, numerous pilot initiatives have showcased the transformative power of innovation in agriculture. From smart irrigation to precision mapping, these localized success stories have demonstrated tangible benefits in productivity, sustainability, and profitability. However, most of these breakthroughs remain confined to specific regions or projects, with limited scaling beyond their initial test areas. The following examples highlight how technology has driven real impact on the ground – and the potential that awaits broader adoption.

6.1. Precision Farming in Punjab: Boosting Wheat & Rice Yields

Punjab, India's agricultural powerhouse, has seen remarkable improvements in productivity using GIS and GPS. The **Punjab Remote Sensing Centre (PRSC)** collaborated with state agricultural universities to implement GIS-based soil health mapping. Farmers received **real-time data on soil fertility**, helping them optimize fertilizer use.

■ **Impact:**

- Fertilizer consumption reduced by **15%**, lowering costs and preventing soil degradation.
- Wheat and rice yields increased by **12-18%** due to better resource allocation.
- Water conservation improved by **25%**, mitigating groundwater depletion.

6.2. Maharashtra's Grapes Export Success with GIS & GPS

Maharashtra's grape farmers, particularly in **Nashik**, faced **export rejections due to pesticide residue and poor quality grading**. To counter this, the Maharashtra Grape Growers Association integrated **GIS mapping with GPS tracking** to monitor vineyards in real-time.

■ **Impact:**

- Farmers optimized pesticide application based on GIS-based weather analysis, reducing chemical use by **30%.**
- **98% of exported grapes met EU quality standards**, increasing export revenue.
- GPS-enabled supply chain tracking **reduced post-harvest losses by 20%**

6.3. Smart Water Management in Karnataka's Sugarcane Belt

Karnataka's sugarcane industry struggled with **water-intensive farming practices**, exacerbating water scarcity. The **ICAR-Indian Institute of Sugarcane Research (IISR)** deployed GIS-based irrigation scheduling and GPS-controlled drip irrigation systems.

■ **Impact:**

- Water usage decreased by **40%**, reducing dependency on borewells.
- Sugarcane yield increased by **22%**, with higher sucrose content.
- Farmers adopting the system reported a **30% increase in profit margins.**

6.4. GIS-Powered Cold Chain Logistics in Uttar Pradesh

Post-harvest losses in Uttar Pradesh were a significant challenge, particularly for perishable crops like **potatoes and tomatoes**. The **Food Corporation of India (FCI)** implemented **GIS-powered route optimization for cold storage transportation**, combined with GPS-monitored refrigeration trucks.

■ **Impact:**

- **Food wastage reduced by 35%**, increasing market availability.
- Transportation costs lowered by **20%**, benefiting both farmers and consumers.
- Farmers saw **a 25% rise in income** due to better price realization.

Source: FCI & National Horticulture Board, 2023

6.5. Rajasthan's Livestock Health Monitoring System

Rajasthan, home to **India's largest livestock population**, faced frequent disease outbreaks, leading to heavy losses in dairy and meat production. The **State Animal Husbandry Department**, in collaboration with ICAR-NIVEDI, launched a **GIS-based livestock disease surveillance system.**

- **Impact:**
- Early detection of diseases reduced mortality rates by **60%.**
- Dairy farmers **increased milk production by 15%** due to healthier livestock.
- The system was expanded to include **GPS tracking of veterinary mobile units**, reducing response time to disease outbreaks by **50%.**

6.6. Israel-India Collaboration on Smart Farming

Israel, a global leader in precision agriculture, partnered with India under the **Indo-Israel Agricultural Project (IIAP)**. In Haryana, GIS-based monitoring systems for **polyhouse vegetable farming** helped small farmers improve yield efficiency.

- **Impact:**
- **Greenhouse-grown tomatoes yielded 250% more** compared to open fields.
- Farmers reduced pesticide use by **40%** with precision pest control.
- Water efficiency improved by **50%** through smart drip irrigation.

7) The Way Forward: Enabling GPS and GIS for Indian Agriculture

The transformative potential of GPS and GIS in Indian agriculture is undeniable – from precision farming and yield forecasting to crop insurance and natural resource management. However, the path to widespread adoption is riddled with structural, economic, and institutional hurdles. A coordinated and inclusive approach led by the government can unlock these technologies for the benefit of millions of farmers.

Startups face major hurdles in scaling GPS and GIS technologies due to high data acquisition costs, fragmented landholdings, and lack of standardized digital land records. The need for region-specific customization makes these solutions expensive and hard to replicate across geographies. Additionally, low digital literacy and limited willingness to pay among small farmers restrict adoption. As a result, many startups either pivot to B2B models or abandon geospatial tools altogether. Without government support in infrastructure, open data, and farmer aggregation, scaling remains a challenge.

7.1. Strengthening Foundational Infrastructure for GPS & GIS Integration

- The government must first address foundational gaps – starting with the completion of digitization of land records (DILRMP) . Accurate and updated digital land records serve as a base layer for mapping farms and linking spatial data with individual holdings.
- Now this data can be integrated with GPS-enabled devices and GIS platforms to enable location-specific advisory, crop tracking, and input application.

7.2. Building Capacity and Access Through Local Institutions and Public Data

- A major bottleneck in using GPS and GIS technologies at scale is the lack of access to high-quality spatial data and the limited capacity of institutions to use it. The government can intervene by creating a centralized, open-access agri-GIS platform that combines data from ISRO, ICAR, and state departments – covering weather, soils, crop patterns, and irrigation assets.
- These platforms should be accessible to startups, FPOs, and academic institutions. To ensure last-mile delivery and on-ground use, the government should strengthen Krishi Vigyan Kendras (KVKs), Common Service Centres (CSCs), and Farmer Producer Organizations (FPOs) with basic GPS tools, training modules, and offline-compatible GIS systems.
- Programs such as the Digital Agriculture Mission and RKVY can be used to fund the rollout of such tools at the district and block level, while also subsidizing drone-based mapping and GPS-enabled farm machinery for collective use.

7.3. Embedding GPS and GIS in Agricultural Schemes and Policy Design

- For long-term sustainability, the government must institutionalize the use of GPS and GIS across flagship agricultural schemes. For instance, in the Pradhan Mantri Fasal

Bima Yojana (PMFBY), satellite-based crop monitoring and GPS-tagged crop-cutting experiments can make insurance more transparent and scalable.

- Under PM Krishi Sinchai Yojana (PMKSY) and the Soil Health Card scheme, GPS-enabled mapping of irrigation networks and nutrient zones can optimize resource use.
- The government should encourage PPP to co-develop localized GPS/GIS tools in regional languages, making them more relevant and user-friendly for small and marginal farmers.

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Notes

Governing Council: KRISHI ANUSANDHAN & KISAN VIKAS FOUNDATION

Vijay Sardana
Chairman, Governing Council

IIMA Alumnus & Advocate, Supreme Court of India, NGT & Delhi High Court; Spl. in Techno-legal, IPR & Contracts Matters; Corporate Governance Trainer for Independent Directors; Member-Corporate Boards & Expert Committees

N.K. Arora
Secretary, Governing Council

An accomplished professional with 45 years of experience in Agri Input industry with having diverse leading role. Holding unanimously elected position of President-Agri Alumni Association of Pantnagar since its inception in 2008

Dr. Atanu Purkayastha
Agriculture & Farmers Welfare

MBA from the University of Strathclyde, Glasgow, UK and PhD from IIT Kharagpur on Land Reforms and Livelihood Generation. Served with the Government of India as Director and Joint Secretary in the Ministry of Home Affairs, Ministry of Agriculture and Cooperation and as Secretary, Central Information Commission.

Anil Jaysing Ghanwat
Farmer Representative

Anil Ghanwat (B.Sc. Agriculture), 63 years old, is a farmer from SriGonda in Ahmednagar district in Maharashtra. Since 1985 he has been involved with the Shetkari Sanghatana

Dr. Arvind Kapur
Seed Expert

Ph. D in Plant physiology bearing over 3 decades of experience in National and Multinational Seed Industry. He is also a prominent member of various business associations like CII, FICCI, Assocham, and PHDCCI, chairs of the APSA IP Committee

Dr. Ramendra Singh
Crop Nutrition

Dr. Ramendra Singh, a Soil Scientist, has over 45 years' experience in Natural Resource Management (NRM) for sustainable agriculture .

Dr. R.K. Malik
Agronomist

Dr. Ram Kanwar Malik, Ph.D in Agronomy is a renowned Agronomist with more than 45 years of experience. He has successfully implemented many projects in association with CIMMYT, IRRI, ACIAR, DFID, ICAR (NATP and NARP) and FAO

Dr. Vasant P. Gandhi
Economist

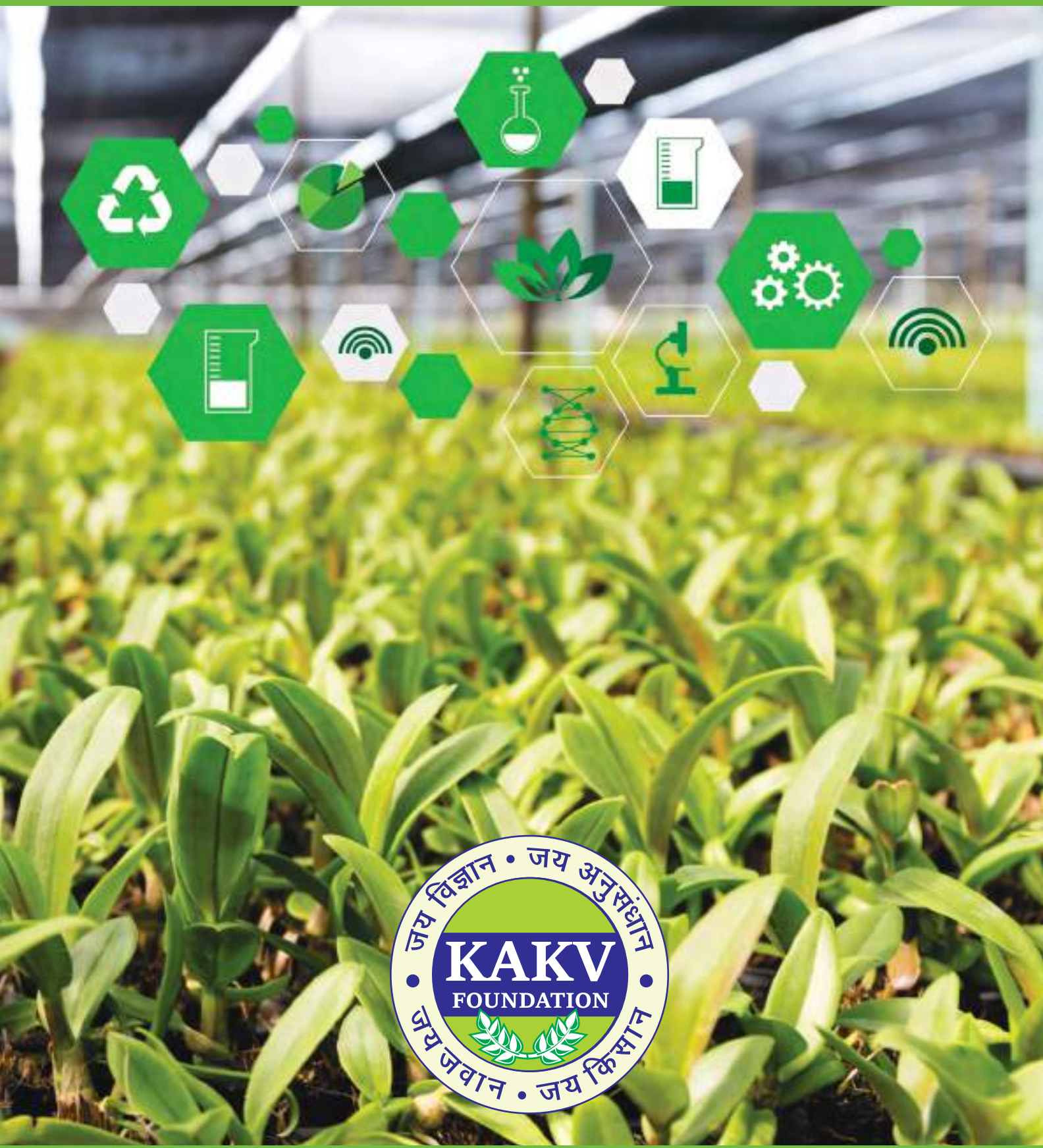
Ph.D. from Stanford University, MBA (PGP) from IIM Ahmedabad (IIMA), formerly he was Professor and NABARD Chair Professor at IIMA, and Founder Chairman Post-Graduate Programme in Food and Agribusiness Management, which is currently ranked no.1 in the world

Dr. R.S. Sodhi
Dairy & Co-operative

Dr. R.S Sodhi, President, Indian Dairy Association, Delhi .
Ex Managing Director GCMMF (Amul)
Chairperson, NIFTEM -T

Nimish Gangrade
Media Representative

Nimish Gangrade is an experienced professional in the field of Agriculture. He is currently Director at Krishak Jagat – The National Agriculture Newspaper. He is an accredited journalist by the Government of India.



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