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Mobile and decision support application for farmers

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Abstract

Mobile applications and decision support systems (DSS) have become essential tools in transforming agriculture from a traditional knowledge-driven practice to a modern, data-driven enterprise. By integrating technologies such as artificial intelligence, the Internet of Things (IoT), remote sensing, and cloud computing, these tools support precision farming, optimize resource use, and improve sustainability. Mobile platforms now enable farmers to access timely information on crop management, weather, irrigation, pest control, and market trends, thereby increasing productivity while reducing costs and risks. DSS further enhances decision-making by processing large datasets into actionable insights, enabling real-time responses to challenges such as climate variability and disease outbreaks. This review highlights the evolution of digital tools in agriculture, the diverse categories of mobile applications, and the critical role of DSS in precision farming. It also presents case studies demonstrating the effectiveness of these technologies, outlines key benefits for farmers, and discusses the barriers to adoption including digital literacy, infrastructure gaps, and affordability. Future prospects point toward greater integration of AI, blockchain, and personalized advisory systems, with a focus on scaling adoption among smallholder farmers. Strengthening digital agriculture through mobile apps and DSS is vital for ensuring global food security, enhancing sustainability, and empowering rural communities.

Keywords: Mobile applications, decision support systems, precision agriculture, digital farming, artificial intelligence, IoT in agriculture, sustainable agriculture

1. Introduction

Agriculture has always been crucial to human society, but digital technologies have changed it dramatically in recent decades. The rapid spread of mobile phone networks, internet connectivity, and other ICTs in rural areas has revolutionised how farmers obtain data, make decisions, and run their enterprises (Shapa, 2021) ^[1]. Intelligent tools and data-driven insights are replacing traditional farming methods that rely on human observation, seasonal cycles, and expertise. Because smallholder farmers in developing nations face unpredictable weather, pest infestations, changing market prices, and limited resources, they are leading this digital change in agriculture. Precision agriculture now uses decision support systems (DSS) and mobile apps to give farmers personalised, real-time advice. Mobile apps and DSS in farming are needed as agricultural systems become more complex and food production becomes more vulnerable to climate change, environmental degradation, and global market fluctuations. Modern farmers must make quick, informed decisions on crop selection, irrigation, fertiliser, post-harvest management, pest and disease control, and other issues (Mohamed *et al.*, 2023) ^[2]. These issues make traditional wisdom insufficient. Mobile apps give farmers access to digital markets, crop advisories, weather forecasts, and market prices. In contrast, decision support systems use sensors, IoT devices, satellite imagery, and predictive algorithms to make individualised recommendations that improve efficiency, safety, and sustainability. These resources can bridge the knowledge gap, encourage farmers to adopt modern practices, and boost agriculture when used together (Aletdinova *et al.*, 2020) ^[3]. This analysis examines the current state of DSS and mobile apps in agriculture, including their benefits, drawbacks, and growth potential. This study examines the history of these technologies, their applications, and their impact on precision agriculture and resource optimisation. Digital literacy, infrastructure, and cost issues are discussed, along with possible remedies. Success stories and case studies demonstrate how these technologies are employed in real life. This review draws on current literature to help

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researchers, policymakers, and tech developers improve digital agriculture and ensure that decision support and mobile apps help farmers in all situations.

2. Evolution of Mobile and DSS in Agriculture

Data-driven and tech-based farming has been replacing traditional ways for years. Decision support systems (DSS) have evolved from outdated ICT tools, mobile apps, and cutting-edge technologies like cloud computing, AI, and the Internet of Things (Schulz *et al.*, 2022). At each level, farmers improve information availability, knowledge processing, and decision-making, increasing sustainability and production.

2.1 Early ICT Tools in Farming

With the development of ICT technology in the late 20th century, agriculture saw its first digital transformation. In this age, farmers needed agricultural extension helplines, community information centres, and radio broadcasts. These devices provided weather updates, crop advice, and market pricing to help farmers make decisions (Sennuga *et al.*, 2023) [5]. Rural extension services and Kisan Call Centres gave millions of Indian farmers telephone-based expert advice. However, most ICT tools were one-way communication conduits that couldn't manage customisation or real-time engagement. More complex and farmer-friendly platforms were needed because a lack of localised and timely information reduced their efficacy.

2.2 Transition to Mobile-Based Applications

Mobile phones and internet connection in rural areas became common in the early 2000s as the second wave of technological progress began. Mobile apps' dynamic, accessible, and location-specific solutions changed agricultural consulting services. Farmers' phones might receive instant weather forecasts, bug warnings, soil test results, and crop management advice. Smallholder farmers liked mKisan, Plantix, and iCow (Kamal & Bablu, 2023) [6]. These mobile apps also introduced digital markets, allowing farmers to sell directly to consumers and increase profits. Two-way communication was previously unavailable with ICT tools until mobile apps. Farmers could share photos, find solutions in real time, and participate in knowledge-sharing forums. This stage gave farmers more control over their farming decisions and made information more accessible.

2.3 Integration of AI, IoT, and Cloud in DSS

The latest agricultural technology combines AI, IoT, and cloud computing with DSS. These systems go beyond information transmission to give personalised decision-making support, real-time monitoring, and predictive analytics. Soil moisture sensors, weather stations, and drones are IoT devices that collect data continuously. This data informs artificial intelligence systems' fertilisation, irrigation, and pest management suggestions (Kukar *et al.*, 2019) [7]. Researchers, policymakers, and farmers can easily store and interpret enormous data sets with cloud computing. DSS powered by AI can predict insect outbreaks weeks in advance, allowing farmers to respond sooner rather than later. IoT and DSS help precision irrigation systems use water efficiently, especially in drought-prone areas. These technologies show the shift from advisory services to fully integrated decision-support ecosystems to maximise yields, minimise risks, and promote sustainable agriculture. Technology's role in tackling agricultural problems has evolved

from simple ICT tools to mobile apps and complex DSS (Nikam *et al.*, 2020) [8]. Mobile apps expanded access to information and services by expanding on early ICT tools that raised awareness and provided basic access. With artificial intelligence and the internet of things, DSS can provide farming systems unprecedented resilience and sustainability. But there are also challenges and research possibilities about digital literacy, affordability, and rural infrastructure, which affect their effectiveness.

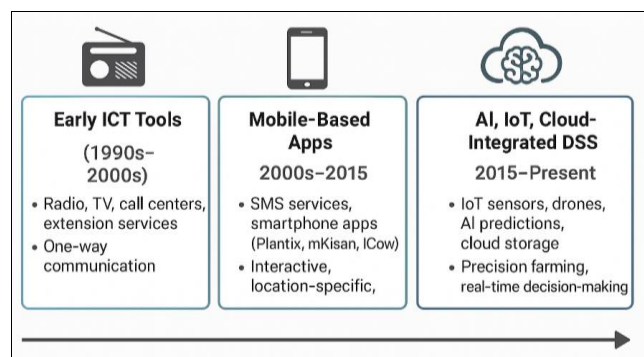


Fig 1: Timeline/flowchart of evolution of mobile apps & DSS in agriculture. [source: (Thar *et al.*, 2021) [9]]

3. Types of Mobile and Decision Support Applications

Decision support systems (DSS) and mobile apps are essential for farm management and decision-making. They provide practical insights to improve sustainability, efficiency, and productivity by merging real-time data collection with predictive modelling and user-friendly interfaces. These platforms are getting better at personalising solutions to specific locales, crops, and farmers rather than delivering generic advice (Kunlerd *et al.*, 2024) [10]. They influence the entire agricultural value chain, from seeding to marketing. The primary categories of these apps include crop and pest management, price and market tracking, irrigation and fertiliser management, and weather and climate advisory services. Each group improves farmers' data-driven decision-making, risk mitigation, and resource efficiency in its unique way (Puška *et al.*, 2025) [11].

3.1 Farm Management Applications

Farm management apps help farmers organise their farming activities and are the foundation of digital agriculture. Farmers used to make judgements based on gut instinct or inadequate record-keeping. Digital technology like mobile-based farm management tools enable farmers track field-level data such crop type, sowing dates, input costs, labour consumption, and expected yields (Thar *et al.*, 2021) [12]. These apps provide a complete view of agricultural activities, helping farmers evaluate profitability and make informed planting cycle decisions. FarmLogs, AgriWebb, and Kisan Suvidha simplify precision farm management, crop development, and sustainability indicators. Advanced platforms offer financial planning, supply chain management, inventory tracking, and more in addition to record keeping. Export-focused farmers benefit from carbon footprint calculators and sustainability certification tracking. Farm management systems benefit both large commercial enterprises and small farms by improving efficiency, waste reduction, and accountability (Anand *et al.*, 2024) [13].

3.2 Weather and Climate Advisory Applications

The farming industry relies on steady weather, thus precise weather predictions are essential. Farmers use real-time, location-specific weather and climate advice applications to plan planting, watering, fertilising, and harvesting. These apps use simple data from climate models, weather stations, and satellite photos to forecast and alarm. The Indian mKisan portal sends SMS weather updates in several regional languages, and Weather Underground and AccuWeather for Agriculture provide short- and long-term climate projections (Duraimurugan *et al.*, 2025) ^[14]. These technologies help farmers make daily decisions and increase climate change resilience by alerting them of coming droughts, floods, heatwaves, and frost. Weather apps reduce crop losses and optimise water and fertiliser use, reducing risk and increasing agricultural productivity. These applications will become increasingly vital for smallholder farmers in climate-vulnerable locations.

3.3 Pest and Disease Management Applications

Diseases and pests can cut yields by 40%, making crop loss a major issue in farming. Image recognition, AI, and predictive modelling are used in pest and disease management apps to identify and control threats. After farmers upload photos of damaged plants, the app diagnoses and suggests solutions in seconds. The Plantix app uses AI-based image identification to detect over 400 crop illnesses, pest infestations, and nutritional deficits (Singh *et al.*, 2023) ^[15]. Satellite surveillance helps the CropIn platform detect insect infestations and crop health. These apps excel at encouraging IPM. They encourage farmers to use crop rotation, organic pesticides, and biological control agents. Pest and disease management apps that notify farmers and tailor management save crops, the environment, and money.

3.4 Market Information and Price Forecasting Applications

Farmers, especially smallholders without much negotiation power, depend on middlemen for accurate market data. Market

data and price projection apps cover this gap by delivering real-time commodity pricing, demand, and supply patterns (Borrero & Mariscal, 2022) ^[16]. These platforms promote pricing transparency and allow farmers to choose the most profitable marketplaces or negotiate better terms. AgriMarket, AgriCentral, and M-Farm in India and Kenya provide daily pricing information, digital marketplace platforms, and demand estimates. Several of these apps boost profitability by linking farmers directly with purchasers. These platforms facilitate direct trading, giving farmers economic power and better agricultural value chain integration. These tools' predictive analytics can also assist farmers plan harvest and sales by predicting market and weather-based pricing changes (Kerdsriserm *et al.*, 2024) ^[17]. So, market apps assist farmers become financially stable and secure while delivering information.

3.5 Irrigation and Fertilizer Decision Support Systems

Sustainable agriculture requires water and nutrient efficiency. DSS irrigation and fertiliser treatments use soil sensors, remote sensing, and weather forecasts to make personalised recommendations. These technologies maximise water use, minimise over-irrigation, and reduce fertiliser waste for farmers (Thothela *et al.*, 2020) ^[18]. RML AgTech and CropWat DSS recommend watering and fertilising based on field circumstances. These technologies enable precision irrigation equipment that distribute water precisely where it is needed, especially in places with acute water constraint. In contrast, fertiliser DSS platforms assess soil health data and propose crop-specific dosages for balanced nutrient supply. This increases harvests and reduces soil erosion and chemical contamination. Beyond short-term resource optimisation, DSS for fertiliser and irrigation promote sustainable use of natural resources and reduce agriculture's ecological impact. Many countries want DSS because soil fertility is declining and freshwater is scarce (Okoroji *et al.*, 2021) ^[19].

Table 1: Comparative Overview of Agricultural Mobile and DSS Applications [source: (Manobharathi & Anandaraja, 2021)] ^[20]

Category	Key Features	Purpose	Examples
Farm Management Apps	Record keeping, cost analysis, crop planning, financial tracking	Improve farm efficiency, track inputs & outputs	FarmLogs, AgriApp, CropIn
Weather & Climate Advisory Apps	Localized forecasts, alerts for drought/flood/frost, climate-smart tips	Risk reduction, planning of farm activities	Skymet, Weather Underground, aWhere
Pest & Disease Management Apps	Image recognition, pest/disease advisory, integrated pest management (IPM)	Early detection, reduced crop losses	Plantix, eSagu, PlantVillage
Market & Price Forecasting Apps	Real-time price updates, demand forecasting, digital marketplaces	Improve market access, ensure fair pricing	mKisan, AgroStar, AgriBazaar
Irrigation & Fertilizer DSS	Soil data integration, IoT sensor input, precision irrigation/fertilization tips	Optimize water & nutrient use, sustainability	RML AgTech, SmartFarm, Nutrient Expert

4. Role of DSS in Precision Agriculture

Precision agriculture revolutionised modern farming by optimising yields while limiting resource use and environmental impact. Due to Decision Support Systems (DSS), farmers can acquire practical insights by combining data sources, processing them through complex models, and acting on the results (Mathenge *et al.*, 2022) ^[21]. Unlike intuition and experience-based methods, DSS allow real-time, evidence-based decision-making for irrigation, fertilisation, pest control, and crop management. DSS in precision agriculture relies on huge data collection and analysis. Drones collect high-resolution photos of stressed crops, pest infestations, soil moisture and nutrient levels, and field sensors assess microclimate. These technologies are enhanced by IoT networks that send field data to centralised

platforms. DSS uses many data streams to provide a complete digital profile of the farm's conditions for accurate monitoring and quick responses. The DSS can create fertiliser maps from soil sensors that detect nutrient deficits (Paparrizos *et al.*, 2023) ^[22]. Drones can also detect insect infestations before they spread, allowing pesticides to be applied selectively while minimising financial and ecological damages. Real-time irrigation and fertilisation decisions are one of DSS's main precision agriculture applications. Traditional irrigation causes water loss and soil damage, while irresponsible fertiliser application raises input costs. DSS proposes site-specific solutions. Smart irrigation systems with soil moisture sensors can save water by turning on only when needed. Fertilisation DSS considers soil test data, crop kind, and growth stage when

recommending nutrients. This prevents fertiliser misuse and improves soil (Huang *et al.*, 2022) ^[23]. These competences promote sustainable agriculture, climate resilience, and productivity. Data science tools are great at turning raw data into actionable suggestions. The DSS uses advanced algorithms and AI models to assess weather predictions, yield records, satellite photos, and ground sensor readings. Farmers get simple instructions via maps, alerts, and push notifications. A DSS may alert a farmer of oncoming rain and propose delaying irrigation to prevent waterlogging. Yield prediction algorithms help harvest scheduling and market timing, reducing post-harvest losses. Farmers may make economic and environmental decisions with less guesswork using this knowledge (Ginige *et al.*, 2020) ^[24]. Precision agriculture's decision support systems (DSS) promote "smart farming," where facts, not guesswork, guide farming. They simplify input optimisation, climatic adaptation, and pest, disease, and market volatility risk mitigation. These technologies will transform global agriculture and create more sustainable food systems as more people buy and utilise them.

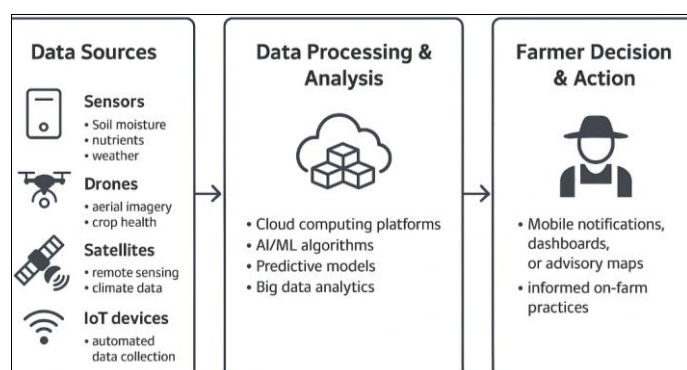


Fig 2: Conceptual Diagram of DSS in Precision Agriculture [source: (Manobharathi & Anandaraja, 2021)] ^[20]

5. Benefits for Farmers

Farmers, especially in poor and resource-limited areas, benefit greatly from mobile apps and DSS. One of the main benefits is that farmers may increase productivity by getting real-time data on crop management, weather, pests, and fertiliser needs. Real-time data and customised advice can help farmers improve crop

yields by optimising planting, watering, and fertilising. Saving money is another benefit. Precision agriculture with DSS support reduces water, fertiliser, and pesticide waste. Mobile DSS for site-specific fertiliser management can save money and maintain soil healthy by applying only what is needed (Kumar *et al.*, 2023) ^[25]. Efficiency reduces resource waste, which helps farms meet sustainability goals. Mobile and DSS applications help manage climate change, pest infestations, and market price fluctuations. Farmers can better prepare for severe weather and avoid crop failure with accurate weather and climate forecasts. Early diagnosis and intervention by pest and disease alarm systems reduces broad harm. Price prediction tools help growers understand the market and when to sell their crops. Lastly, these improvements enable more efficient market penetration (Michels *et al.*, 2020) ^[26]. Mobile systems connect farmers directly to cooperatives, e-markets, and customers, eliminating middlemen. This ensures pricing transparency and increases profits. These benefits improve rural food security, economic growth, and farmer incomes.

6. Challenges and Limitations

Mobile and DSS apps have immense potential but face many difficulties. Farmers in less-educated rural areas struggle with computer skills. Many farmers lack the IT skills to utilise smartphones and grasp DSS advice. In impoverished places, poor infrastructure is another issue. Slow internet, poor cell network coverage, and frequent power outages reduce mobile and DSS platform reliability and accessibility. Without good infrastructure, these tools fail. Concerns remain regarding data privacy and trust (Rware *et al.*, 2020) ^[27]. Many farmers are reluctant to share farm data due to data ownership and control issues and concerns about misuse. Without strong regulatory frameworks and open standards, farmers are unlikely to trust digital platforms. Adoption and cost barriers matter most. Some advanced DSS apps are free, but most require subscriptions or devices and sensors. If smallholder farmers, who dominate many countries, cannot afford digital solutions, digital advantages may be unequally distributed.

Table 2: Challenges vs. Possible Solutions for Mobile and DSS Adoption [source: (Mössinger *et al.*, 2022)] ^[28]

Challenges	Possible Solutions
Digital literacy gaps among farmers	Conduct training programs, local-language interfaces, use of audio-visual instructions
Poor internet & electricity infrastructure	Investment in rural connectivity, offline-enabled apps, use of solar-powered devices
Data privacy & trust issues	Strong data protection laws, transparent policies, farmer data ownership rights
High cost & affordability barriers	Government subsidies, public-private partnerships, community-based shared DSS services
Resistance to adoption	Demonstration projects, farmer success stories, peer-to-peer learning networks

7. Case Studies / Success Stories

The transformative potential of mobile applications and decision support systems (DSS) in agriculture is best understood through real-world case studies where these tools have been successfully adopted. These examples not only highlight the innovative use of technology but also demonstrate the tangible benefits for farmers in terms of productivity, profitability, and resilience (Shapa, 2021) ^[1]. From government-led initiatives to private sector innovations and international organization-driven programs, the following case studies illustrate the diverse approaches to digital agriculture and the key factors contributing to their success.

Example 1: mKisan Portal (India)

The Indian government launched the mKisan Portal in 2013, one of the most significant mobile-based agricultural advisory platforms worldwide. The idea is to give farmers real-time location-specific SMS and IVR information. The bilingual website gives advises in over 12 regional languages, making it accessible to novice farmers. Data offered through the portal includes crop management, weather information, fertiliser dosage instructions, pest control guidance, and market pricing data. New data shows that the mKisan Portal has connected agricultural research institutes with rural farming communities, reaching over 40 million Indian farmers (Mohamed *et al.*, 2023) ^[2]. Farmers with the simplest mobile phones may utilise the

service, which is its strength. Because of its universality, mKisan has helped most Indian farmers, who are smallholders. Successful mKisan requires two-way communication between farmers, experts, and extension personnel. Farmers ask agricultural specialists questions, who provide quick and valuable replies. Because of this, decision-making is better and intermediaries are used less. Through its integration with other government digital agriculture programs like the Soil Health Card Scheme and Pradhan Mantri Fasal Bima Yojana, mKisan has become more useful. Overall, mKisan shows how government-driven digital platforms may boost resilience, productivity, and information availability.

Example 2: Plantix App (Global)

Government portals like mKisan demonstrate the public and private sectors' contributions to digital agriculture. German startup Progressive Environmental & Agricultural Technologies (PEAT) invented Plantix, a prime example. Plantix, a smartphone app, detects plant nutritional deficiencies, pests, and illnesses using AI. Farmers can quickly diagnose and treat sick crops with the app. The program is popular internationally because millions of smallholder farmers in Latin America, Africa, and Asia lack timely access to agricultural specialists (Aletdinova *et al.*, 2020) [3]. Free, expert diagnosis makes Plantix stand apart. The software offers yield projections, weather reports, and crop ailment prevention tips. Due to machine learning, its recommendations become more accurate and trustworthy as its user base grows. Plantix helps diagnose and supports a community-centered paradigm. Farmers can share and learn from each other on the app's discussion boards. Without or inadequate traditional extension services, peer-to-peer knowledge exchange helps. Plantix's cooperation with worldwide organisations and governments has expanded its reach, proving AI-powered solutions' scalability (Schulz *et al.*,

2022). Where pests and diseases cause significant agricultural losses, Plantix will have a disproportionate impact. Early diagnosis and management via the app encourages sustainable and eco-friendly farming methods by reducing pesticide use. It shows how new technology designed for people may help farmers worldwide, especially in resource-poor countries.

Example 3: FAO's AgroDSS Initiatives

FAO has helped promote DSS-based platforms in disadvantaged countries, especially in Asia and Africa. Smallholder farmers can use FAO's AgroDSS databases of regional soil, meteorological, and market data to make decisions. These DSS technologies help farmers adapt to changing weather and limited resources to practise climate-smart agriculture. FAO-led DSS platforms in Sub-Saharan Africa have helped farmers become drought-resistant. AgroDSS systems can optimise water consumption by proposing when to irrigate crops, reducing rainfall uncertainty. Farmers receive pest infestation notifications and crop rotation advice to maintain soil fertility. FAO's DSS initiatives in Asia use market forecasting tools to help farmers afford food (Sennuga *et al.*, 2023) [5]. Critical to FAO's AgroDSS is its ability to integrate global and regional data. FAO platforms are built with regional agricultural agencies and farmer associations, unlike many commercial programs that may not consider local conditions. This ensures contextual adaptation, essential for adoption. FAO wants women farmers and other marginalised groups to use DSS technologies in mainstream digital activities. FAO's successful AgroDSS programs demonstrate the importance of international organisations in increasing DSS use in areas with poor infrastructure, low literacy rates, and limited financial resources (Kamal & Bablu, 2023) [6]. The FAO disseminates information, provides technical assistance, and holds educational programs to promote long-term use of digital agriculture instruments.

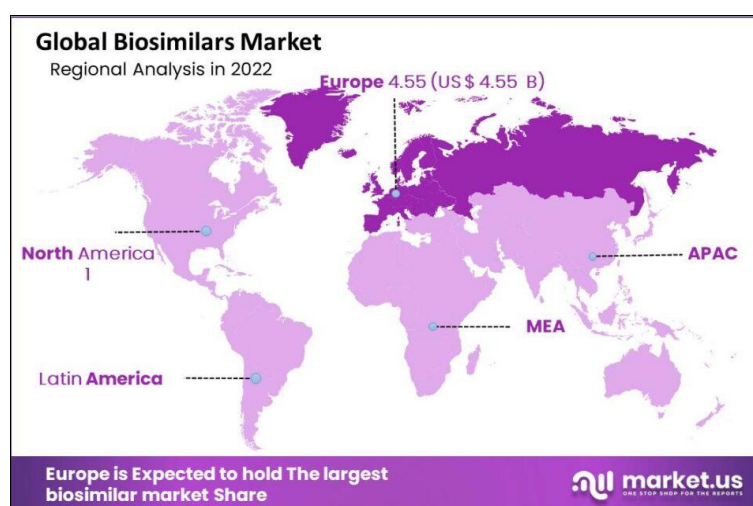


Fig 3: Regional Adoption of Mobile Apps/DSS in Agriculture [source: (Kukar *et al.*, 2019)] [7]

8. Future Prospects and Research Gaps

Predictive analytics, machine learning, and AI are rapidly developing, which will affect agricultural mobile apps and decision support systems. These solutions use real-time data from IoT devices, drones, and satellites to forecast pest infestations, disease outbreaks, and crop stress to improve agricultural decision-making. Predictive capabilities protect productivity by minimising uncertainty and empowering farmers to prevent. Another promising new study field is using blockchain technology to improve food supply chain trust,

transparency, and traceability (Duraimurugan *et al.*, 2025) [14]. Blockchain technology offers safe, decentralised farm-level transaction and data recording, making food purchases more reliable and producers fairer. Personalised guidance systems are also becoming more important. Future DSS platforms will make recommendations based on crop variety, soil type, microclimate, and local resource availability. This will help overcome "one-size-fits-all" methods and make advice more applicable for smallholder farmers. Despite these advances, scaling up these solutions across agricultural landscapes remains difficult. Cost,

digital literacy, linguistic accessibility, and infrastructure issues disproportionately affect smallholder farmers (Borrero & Mariscal, 2022) ^[16]. Thus, future researchers must create accessible, low-cost DSS platforms, mix ancient wisdom with cutting-edge technology, and encourage public-private cooperation to narrow the adoption gap. Digital agriculture must fill these gaps to become a sustainable farming tool for all, not just the wealthy.

9. Conclusion

Decision support systems and mobile apps have revolutionised agriculture by combining data-driven insights with hands-on methods. By integrating real-time data collection with powerful analytics and interactive guidance platforms, these technologies can enhance productivity, save costs, and make farmers more resilient to climate change and insect outbreaks. India's mKisan Portal, the Plantix app, and FAO's AgroDSS initiatives demonstrate these technologies in various farming settings. The report also highlighted barriers to widespread adoption, such as a lack of digital literacy, infrastructure, data privacy concerns, and financial limits for farmers with minimal resources. To solve these problems, governments, academia, and tech corporations must collaborate on accessible, inclusive solutions. We're developing hyper-localized advising systems that use AI, blockchain, and predictive analytics, affordable multilingual platforms, and rural connectivity initiatives. Digital agriculture requires social and economic empowerment as well as technical growth. As farming advances from intuition to evidence, mobile and DSS platforms can help ensure food security, sustainability, and smallholder empowerment. Digital agriculture ushers in a new era when tradition and technology work together to produce sustainable and equitable agricultural systems.

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