CGIAR INITIATIVE ON Digital Innovation

Introduction to Software Tools for Agricultural Applications

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Introduction

Data Generation Sources

- Sensors and IoTs
- Drones and satellites
- Farm machinery and equipment's
- Weather Stations
- Livestock monitoring systems

Data Types

- Time-series data
- Geospatial data
- Unstructured data

Data Storage and Management

- Cloud computing
- Data warehouses

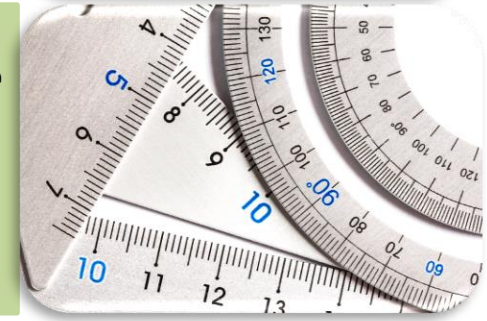
Data Analytics and Insights

- Artificial Intelligence
- Machine Learning
- Predictive Modelling
- Decision making
- Pattern Identification

Benefits

Speed

Accuracy



Scalability

Automation

Challenges

Data Privacy

Data Bias

Transparency

Access & Equity

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Why Software Tools for Analysis?

Manual analysis of data is often time-consuming, error-prone, and inadequate for handling the increasing complexity of data sets

Escalating Data Complexity

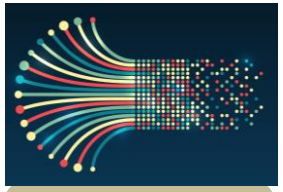
Insight Extraction

Time Efficiency

Precision and Accuracy

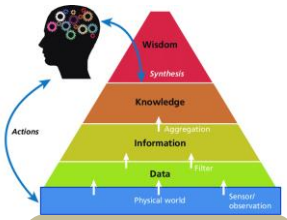
Handling Big Data

Real-time Insights



Complex Patterns Detection

Competitive Edge



Multi-dimensional Analysis

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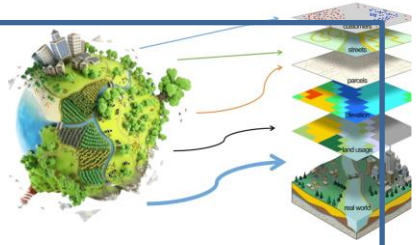
Software Tools for Agricultural Applications

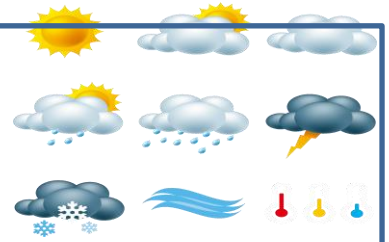
Farm Management

Precision Agriculture



GIS Software

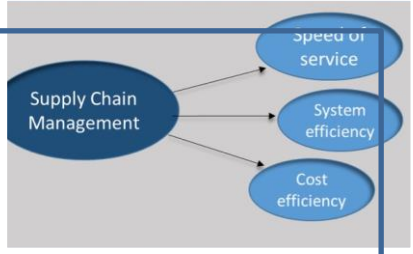
Crop Monitoring and Imaging



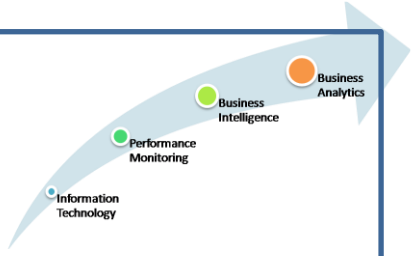
Weather Forecasting

Livestock Management

Soil and Crop Analysis



Supply Chain Management



Decision Support Systems

Mobile Apps

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https://forms.gle/aCF33e84bPnXn6Km9

Software Tools for Agricultural Applications

- These tools help farmers plan, manage, and monitor their operations.
- They include crop planning, task scheduling, resource allocation, and real-time monitoring.
- Farm management software enables farmers to make data-driven decisions, optimize resource usage, and improve overall productivity.

Why is farm management recognized as a highly challenging task?

- The complex environment (dealing with biological systems, uncertain weather conditions, market-related risks, financial risks, etc.);
- The complex inner farm structure and organization (involvement of numerous different processes and operations); and;
- The introduction of modern ICT technologies in the agricultural sector (computers: hardware & software, communications, the Internet ...).

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(Sørensen & Bochtis, 2010)

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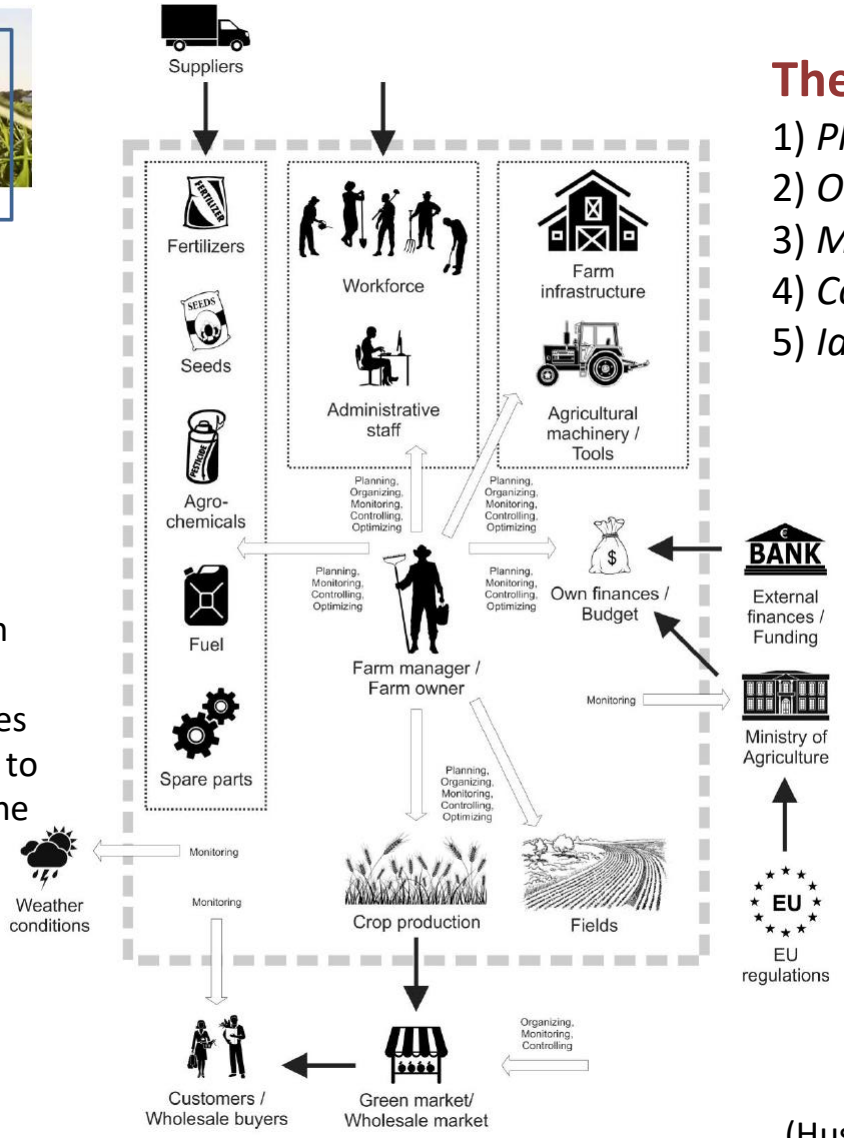
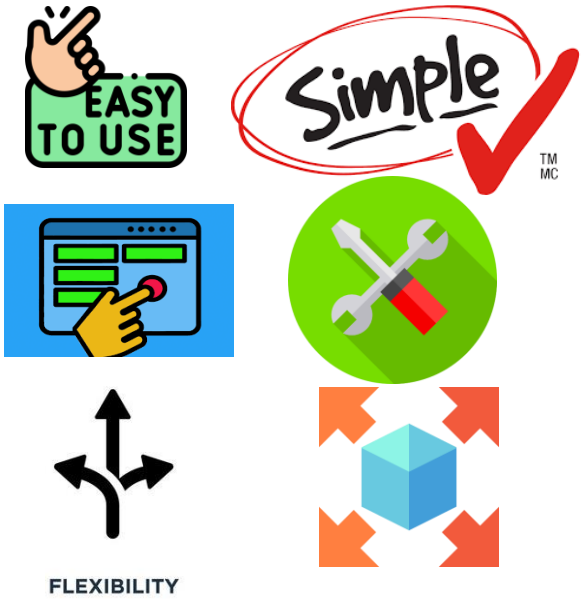


Figure: Key farm production and business processes that are expected to be managed by the farmer

The minimum requirement :

1) *Planning*
2) *Organization*
3) *Monitoring*
4) *Controlling*
5) *Identification of optimization potentials*



(Husemann & Novković, 2014; Novković et al. 2015)

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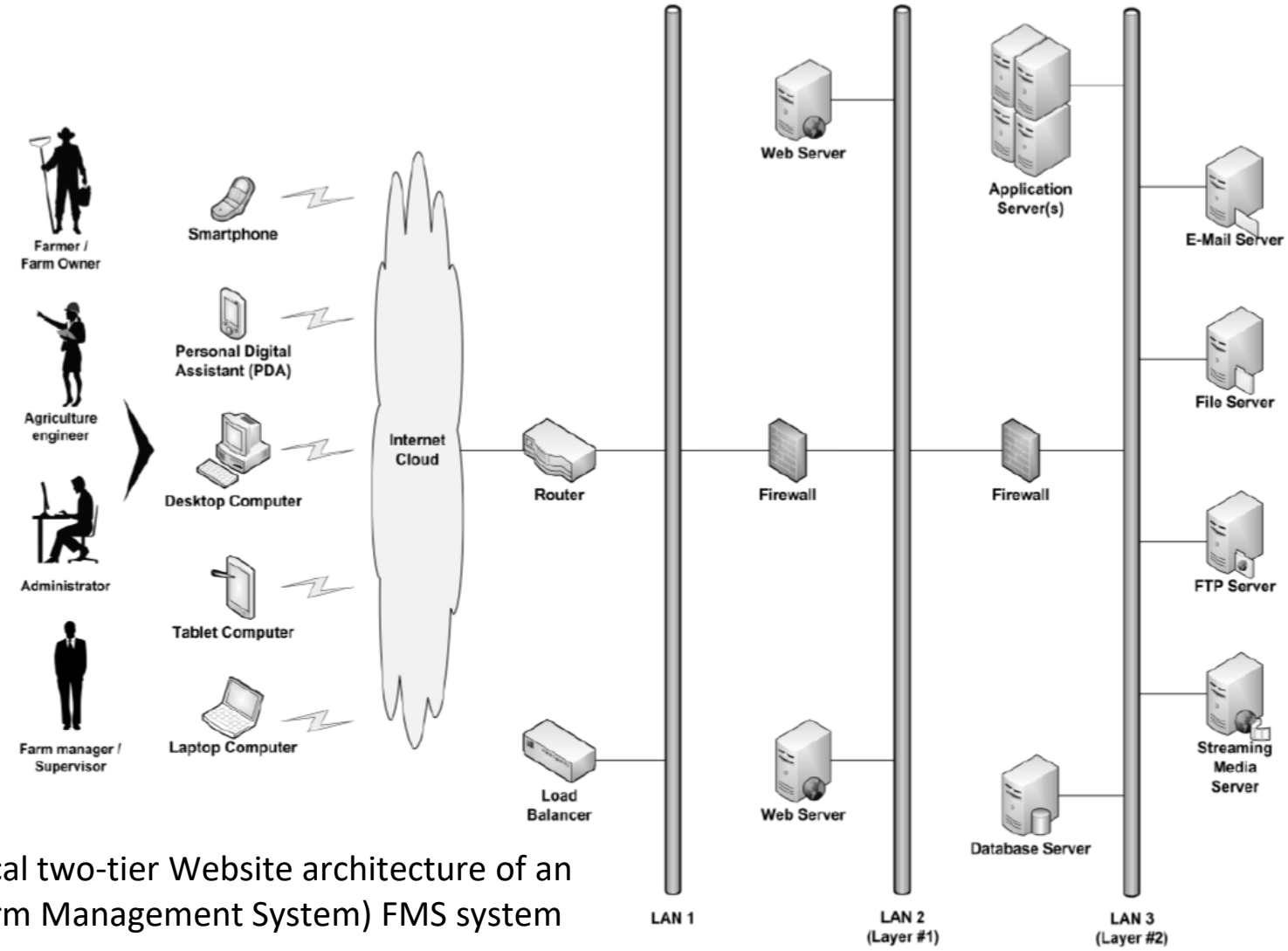
The first layer, also called the ***presentation layer***, embodies the user interface with the Web services.

The second layer embodies both the ***business logic layer***, also known as the ***application layer***, and the *data service layer*



Typical two-tier Website architecture of an (Farm Management System) FMS system

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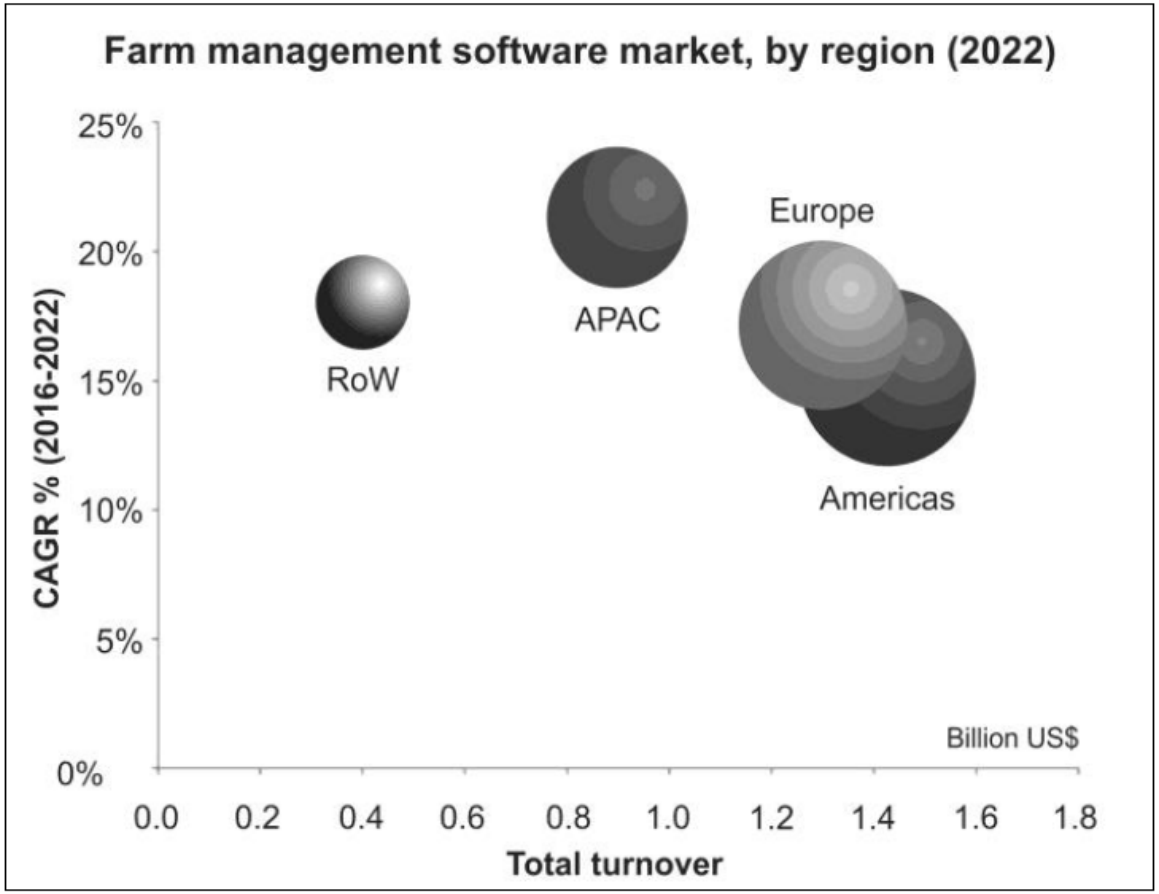
Farm Management



- In mature markets such as the Americas and Europe, the adoption rate of FMS is considerably higher as compared to emerging markets like Asia-Pacific (APAC) and the rest of world (RoW).
- This is due to the increasing awareness among agriculturists regarding advanced farming solutions and the presence of technology-supporting infrastructure.

(MarketsAndMarkets, 2016)

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Apps name	Features	Gap analysis	References
Connected Farm Scout (Trimble Inc.)	The app uses phone's GPS for mapping field boundaries, marking flags and entering scouting information for points, lines and polygon areas. It is flexible to use with any crop such as corn, wheat, soybeans, cotton, rice, vegetables and more.	App have some account verification problem. The app cannot synchronize data.	(Google Play, 2019; Growing Solutions, 2014; Trimble, 2019).
CropIn (Cropin technology)	This app technology used for complete farm management. Improve sales team productivity by miles. This app includes 265 crops, 30 countries and 2.1 million farmers globally.	Login issues. New users registration problem.	(Cropin, 2019; Google Play, 2019; The Hindu, 2019).
FarmHelp (PureForce)	The app gives Filipino farmers access to any information about plant and animal diseases, weather forecast. It also provide automatic geo-tagging which will immediately pinpoint the exact location of the farmer sending the message.	-	(Sunstar Philippines, 2019).
NaPanta (FarmGreenAgritech India Private Limited)	App is used to access real-time market prices, crop management techniques, cold storage services, soil testing etc. and also for crop geo-tagging. About 150000+ farmers across the state of Andhra Pradesh and Telangana used this app.	No search bar option. Language issues (not in English)	(Google Play, 2019).
eFARM (ELCOM PRIME)	The app used as a unified sensing tool to observe the timely information from the field, in terms of crop cover, crop growth etc.	Language problem.	(Google Play, 2019; Yu *et al.*, 2017).

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A. Balkrishna, J. Sharma; 2020

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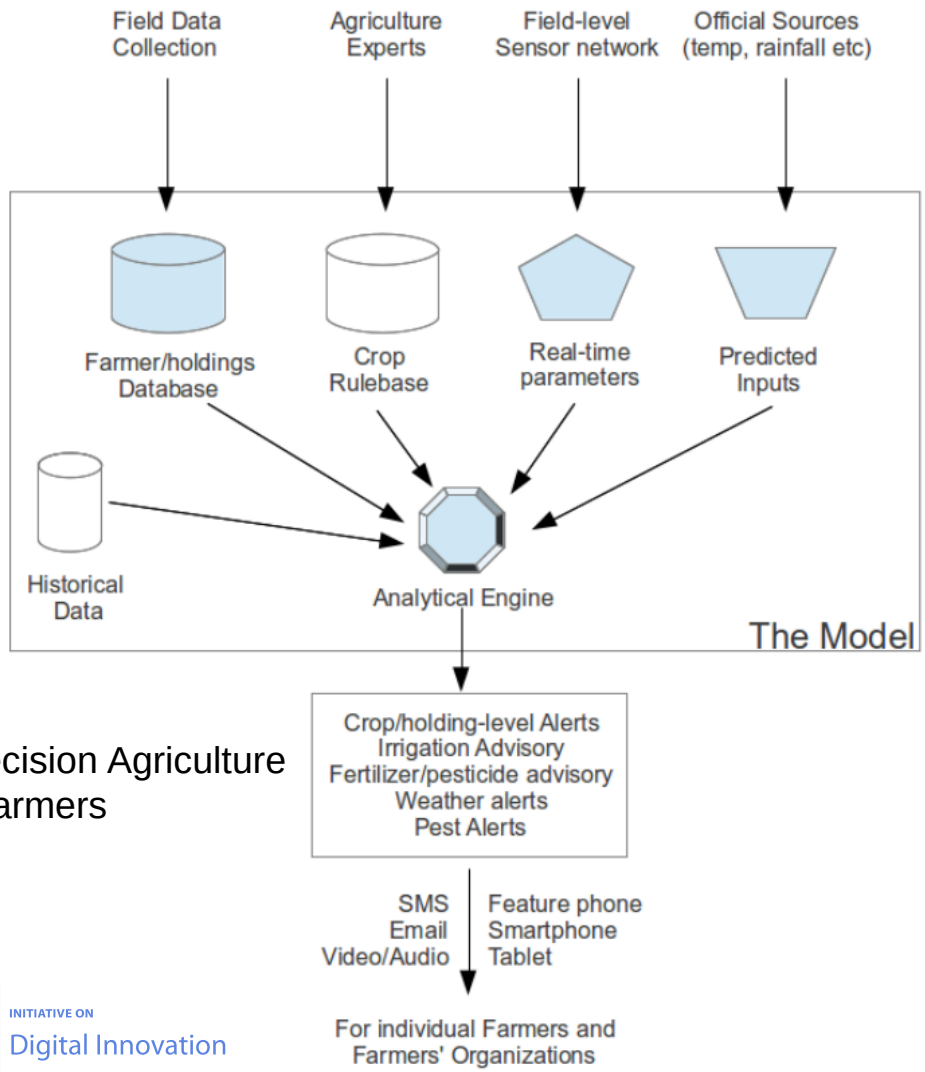

A Software Model for Precision Agriculture for Small and Marginal Farmers

Precision Agriculture employs multiple traditional and emerging technologies such as:

- Automation & robotics;
- Geographic Information Systems (GIS);
- Global Positioning Systems (GPS) and Remote Sensing (RS);
- Sensor Technologies;
- Wireless Sensor Networks
- Decision-support
- Modelling software

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Satish Babu; 2013

Software Tools for Agricultural Applications

Apps name	Features	Gap analysis	References
Soil Health Card Mobile App	The app launched by the Union Minister of Agriculture Shri Radha Mohan Singh. It benefits field-level workers by taking GIS coordinates automatically. Users: 10000+.	This app is only for the government officials and concerned person, who are working in soil health card scheme.	(Google Play, 2019; Soil Health Card, 2019).
Fertilizer Calculator Goa App (ICAR - Central Coastal Agricultural Research Institute, India)	It is completely offline app for making soil test based fertilizer recommendations to important crops of Goa. The results would help to use the fertilizer in appro--priate amount and in a balanced way. Users: 5000+.	The app has limited access, i.e. it allows to calculate fertilizer doses for the crops in state of goa only.	(Google Play, 2019; ICAR-CCARI, 2019; Soft112 Goa, 2019; Vota, 2019).
Kisan Suvidha	This app provides information on fertilizers, seeds with some other facts as current weather, forecast for the next five days, market prices of commodities/crops in the nearest town, machinery etc. Users: 500000+.	Information is not available in regional languages. App is not updated. This app is not reliable for weather.	(Claro, 2015; Google Play, 2019; Livemint, 2019; Vikaspedia, 2019).
Mridaparikshak	It is a digital mobile quantitative minilab/ soil test kit to provide soil testing service at farmers' doorsteps. It is highly compatible with soil health card.	-	(Government of India -Press Information Bureau, 2015).
Kheti Bari	It is a farmer guide app, aims to promote and support 'organic farming' and provide important information/issues related to	Some of the issues include lack of farming information, lack of logistics support and lack of demand forecast.	(APKPure, 2019; Klipinterest, 2016).

A. Balkrishna, J. Sharma; 2020

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Apps name	Features	Gap analysis	References
Farm-o-pedia (CDAC Mumbai)	The app is targeted for rural Gujarat and is useful for farmers and anyone involved in agriculture business. The app can be used to get suitable crops as per soil and season, crop wise information. Users: 11623+.	The app is state specific.	(Gandhian Young Technological Innovation Award, 2015; Mobile Seva Appstore, 2019; Sarkariyojana, 2019).
riceXpert (ICAR-NRRI)	This app provides information on insect pests, nutrients, weeds, nematodes and disease-related problems, farm implements for different field and post-harvest operations. Users: 10000+.	The effort is appreciable but lot of improvement is required. *It is better if it includes disease forecasting in rice.	(Google Play, 2019; ICAR-NRRI, 2019).
Plantix (Agriculture and Horticulture Department of the Government of Andhra Pradesh, India)	In India, it is also called mobile crop doctor. Plantix is reliable partner for best practices in agriculture, disease control and yielding better crops. Plantix already cooperates with international research institutes and inter-governmental organizations such as ICRISAT and CABI. Users: 5000000+.	This app forced on a very limited collection of crops.	(Google Play, 2019; Plantix, 2019).
Farm Calculater (University of Agricultural Sciences, Karnataka, India)	The app is used by the farming community to save costs by calculating exact quantity requirement of fertilizers, pesticides and seeds required for farm for sustainability in farming. Users: 100,000+.	Can't able to find different formulations for different crops.	(Google Olay, 2019).
IFFCO Kisan	The user can access a variety of informative modules including agricultural advisory, weather, imagery, audio and videos in the selected language at profiling stage. The app also offers helpline numbers to get in touch with Kisan Call Centre Services. Users: 500,000+.	Assam and entire North-East is excluded in the app.	(Claro, 2015; Google Play, 2019).

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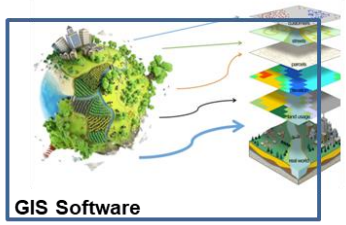
Software Tools for Agricultural Applications



- **QGIS:** **Open-source GIS software** that is widely used for various agricultural applications. It provides tools for **mapping, spatial analysis, and data visualization**, making it useful for tasks like **land use planning, crop monitoring, and resource management.**

- **ArcGIS:** Developed by Esri, ArcGIS is a comprehensive GIS software suite that offers advanced capabilities **for spatial analysis, mapping, and data management**. It is used in various industries, including agriculture, for tasks such as **precision farming, watershed management, and crop modeling.**

- **SuperMap:** SuperMap is a GIS software that offers a range of geospatial solutions, including those tailored for agriculture. It provides tools for **spatial data analysis, remote sensing integration, and agricultural planning**.

- **MapInfo Professional:** It is a desktop GIS software that enables users to create and analyze maps and spatial data. It can be utilized for tasks such as **land parcel mapping, soil analysis, and yield estimation in agriculture.**

- **GeoAgro GIS:** Designed for agriculture and natural resource management. It offers tools for **precision agriculture, field mapping, and data collection**, helping farmers and agronomists make informed decisions.

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Software Tools for Agricultural Applications


Crop Monitoring and Imaging

Cropin: Combines **satellite imagery, weather data, and field-level information** to provide insights into crop health, growth, and yield.

AgroStar: A mobile app that offers **crop monitoring and advisory services** to farmers. It uses **satellite imagery and data analytics** to give farmers real-time insights into **crop conditions, disease detection, and pest management.**

Fasal: An AI-powered platform that uses IoT devices and satellite data to monitor and manage crops. It offers insights into **weather conditions, soil moisture levels**, and other factors affecting crop health.

SatSure: It uses **satellite data and machine learning algorithms** to provide actionable insights for agriculture. It offers services like **crop health assessment**, yield prediction, and risk assessment.

Rice Crop Manager (RCM): Developed by IRRI, RCM is a mobile app that offers rice farmers in India guidance on crop management based on satellite and weather data. It provides recommendations for optimal planting, irrigation, and fertilization.

Bhuvan: Bhuvan, developed by ISRO, provides free satellite imagery and thematic maps that can be useful for crop monitoring. Farmers can access and analyze this data to make informed decisions.

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Sprayer Drone in rice crop at **NRRI, Cuttack**

Imaging Drone for rice crop mapping at **NRRI, Cuttack**

Crop Monitoring and Imaging

Mapping and Imaging at **CIFA**

In association
with ICAR-IARI

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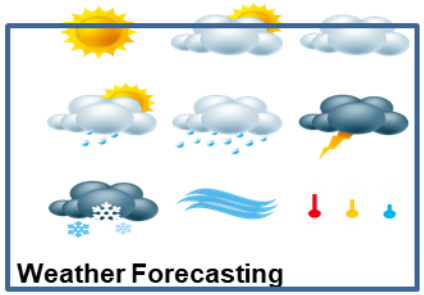


- In India, millions of **livelihoods depend on agriculture**, the variability of the monsoon and other weather patterns makes weather forecasting especially critical.
- The ability to receive timely and accurate weather information helps Indian farmers **mitigate risks, enhance crop yields, and contribute to overall food security**.

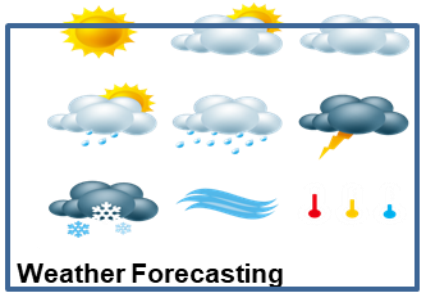
Skymet Weather: It provides detailed **weather forecasts, including temperature, humidity, rainfall predictions, and more**. The app also offers specialized services for agriculture, including **crop-specific weather alerts and advisory information.**

Weather Underground: Weather Underground provides real-time weather data and forecasts. It allows users to access **hyper-local weather information**, which can be beneficial for farmers who need accurate weather insights for specific locations.

AccuWeather: AccuWeather is a widely recognized weather forecasting app that offers **hourly and daily forecasts, as well as radar maps and weather news**. It provides location-based weather information for different parts of India.

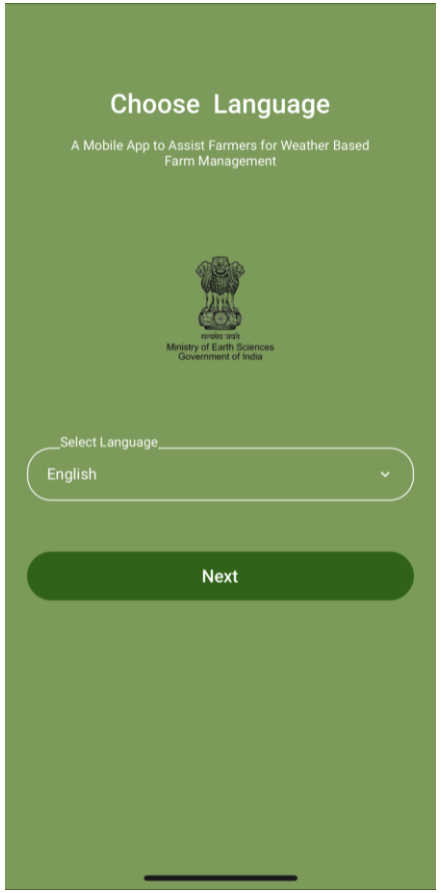
India Weather: AccuWeather: This is a localized version of the AccuWeather app, customized for Indian users. It provides **weather forecasts, alerts, and information relevant** to different regions of India.

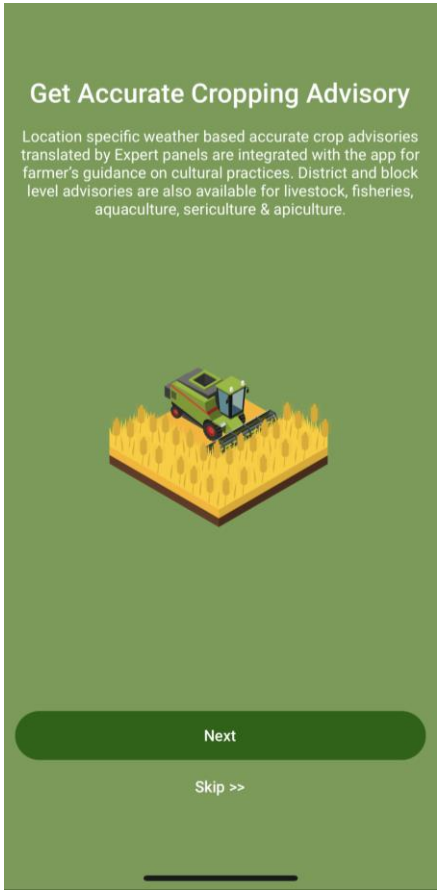
WeatherBug: WeatherBug offers **real-time weather forecasts**, radar maps, and weather alerts. It provides comprehensive weather information for users across India.



Mausam: Launched by the Indian Meteorological Department (IMD), Mausam provides official weather forecasts for various regions of India.

Meghdoot: It is an initiative by the IMD. The app is designed to cater specifically to the needs of farmers by providing **weather forecasts, advisories, and agricultural information to aid in farming decisions**.





Livestock Management

Livestock farming involves the rearing of animals such as **cattle, buffalo, sheep, goats, poultry**, and more. It plays a significant role in providing **meat, milk, eggs, wool, and other products** to meet the nutritional and economic needs of the population

Apps name	Features	Gap analysis	References
Poultry Farming (Dev Galaxy Store)	Monitoring the conditions inside the chicken houses, including temperature, humidity and air quality. Users 50000+.	Should be works offline because every person not be able to get internet all the time.	(Google Play, 2019).
Cluck-ulator (Chicken Waterer.com)	Helps to choose chicken breeds and manage flock. Users 5000+.	Egg estimator shuts down the app when go to change breed every time. It is not properly work in any phones.	(Google Play, 2019; Hobby Farms, 2019).
iHatch-Chickens (iHatch-Apps)	To track of growing chicks, iHatch-Chickens allow to manage multiple hatches.	-	(Hobby Farms, 2019).
Poultry Pal (Southern States Cooperative Inc.)	App provide tracking system. This is not the app for the small-scale farmer planning on making a living raising poultry, but it's perfect for urban/suburban dwellers with backyard micro flocks.	-	(Hobby Farms, 2019).
Poultry Farming (Starkode Limited Company)	App is designed for tracking eggs, feed consumption and performance right on the poultry farming.	Not compatible for android phone.	(App Store, 2019).
FeedMix (Frenik Marketing Group)	To determine the nutritional quality of a particular feed and ingredients. Users 10,000+	All the ingredient is not listed. Not user friendly.	(Akinbobola, 2019; Google Play, 2019).
Poultry Batch Manager (SideWorks)	App provide sales, mortality, feeding records, vaccination schedules with reminder. Works entirely off line. Users 5,000+.	Changed currency format. User activity tracking not available.	(Google Play, 2019).

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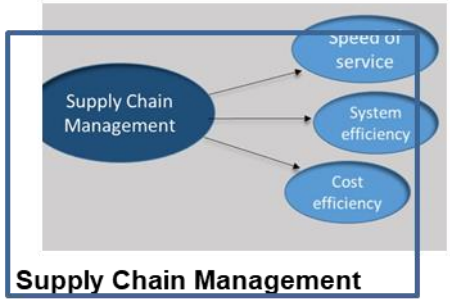

Supply Chain Management

- Supply chain management (SCM) in agriculture involves the **planning, implementation, and monitoring of various processes** that contribute to the efficient movement of agricultural products from farm to consumer.
- It encompasses a range of activities including **production, processing, distribution, and retail.**

AgriChain: AgriChain is a supply chain management platform that helps **farmers, processors, distributors**, and retailers manage their operations more efficiently. It provides tools for **order management, inventory tracking, quality control, and traceability.**

FarmERP: FarmERP is an integrated farm and supply chain management software that covers various aspects of agriculture. It offers features such as **crop planning, procurement, production management, inventory tracking, and sales management.**

CropIn: While primarily known for its crop monitoring capabilities, CropIn also offers supply chain solutions. It helps in **traceability, quality control**, and ensuring transparency across the supply chain.

Agribolo: Agribolo is an app that aims to connect farmers with buyers and suppliers. It assists in managing the agricultural supply chain by **facilitating transactions and communication between stakeholders**.

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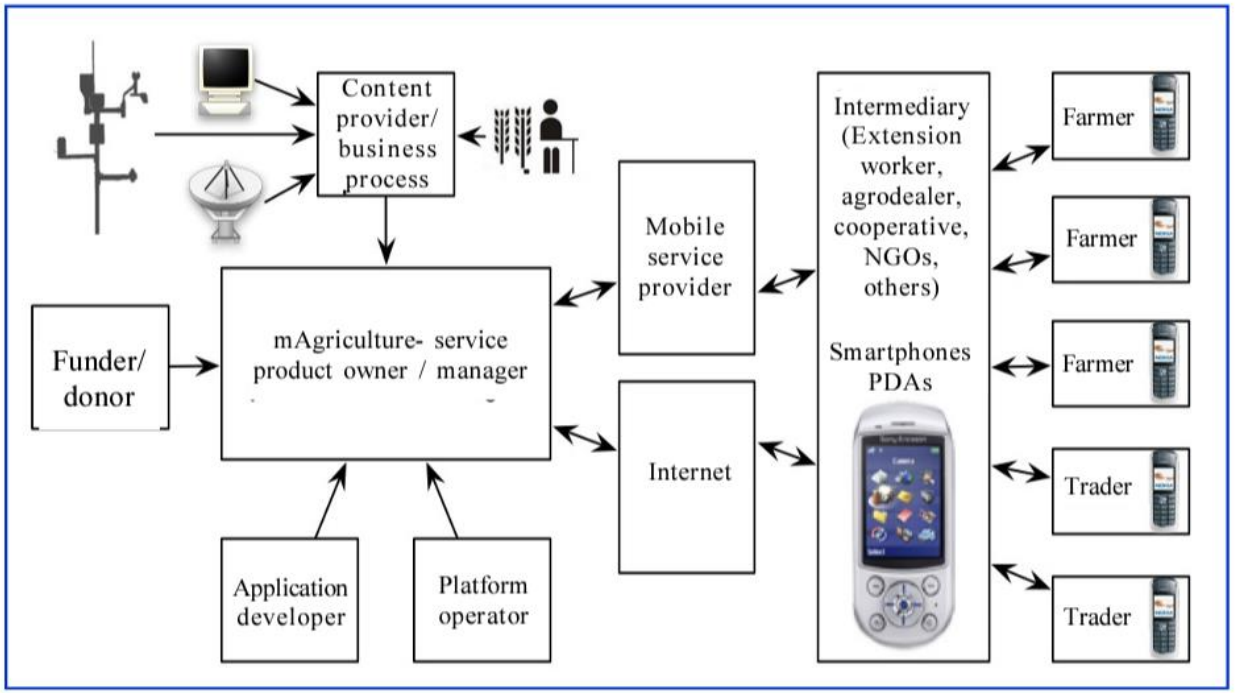
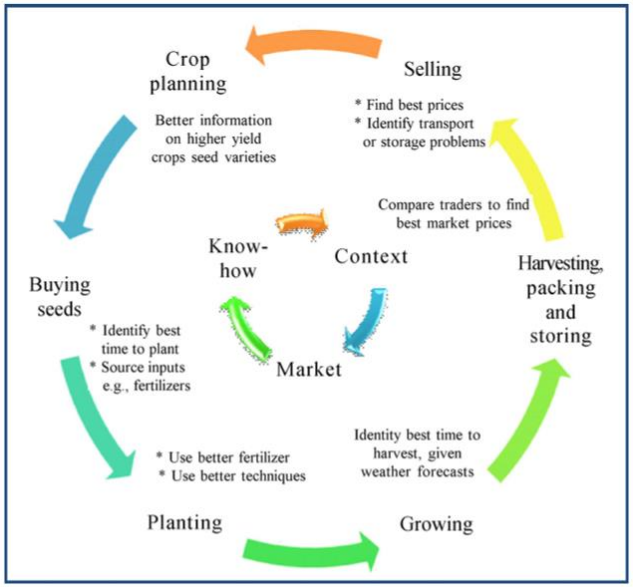
Apps name	Features	Gap analysis	References
Food Safety Connect (Food Safety and Standards Authority of India)	This app allows the consumers to report any malpractices pertaining to food safety along with its related images. Provides a direct link to the FSSAI complaint redressal system. Track the status of concern. Users: 10,000+	App crashes. Difficulty in registering complain.	(Google Play, 2019).
FBO10 (Food Safety India, Pune)	Gives the access to various legislations, acts, regulations, notifications. Helps to food business operators to get the latest information in the field of food safety. Users: 50+	-	(Google Play, 2019).
Smart Consumer (Ministry of Consumer Affairs; Food and Public Distribution in association with GS1 India)	App connects consumers digitally with manufacturers/suppliers using their customer care contact details for speeding redressal of complaints. Users: 50,000+	So many fields are blank as Date of Expiry is blank. Gives only the details of the manufacturers. No MRP etc.	(FSSAI, 2017; Google Play, 2019).
Food Safety app (DOST-NCR)	Provides information on potential biological hazards associated with particular food materials and recommendations to prevent and control these hazards. Users: 500+	Sometime not working.	(Google Play, 2019).

Mobile Apps





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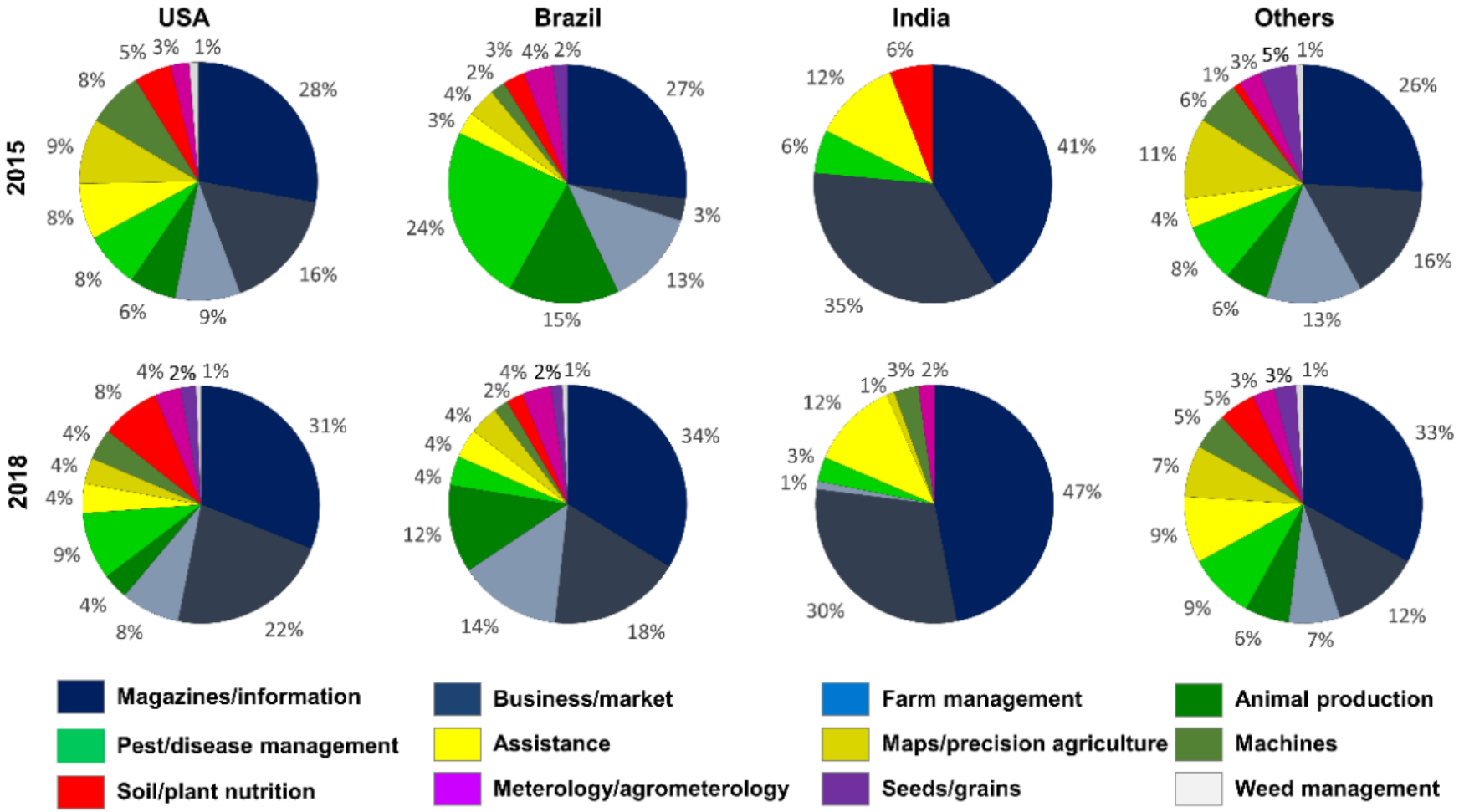
Information needs of farmers (Mittal et al., 2010)

Percentage of apps per agricultural category in 2015 and 2018 for the USA, Brazil, India, and other countries



Barbosa et al.(2020)

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ACTIVITY

Write some of the mobile apps/software solutions based on Remote Sensing in the chatbox!

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Which software tools you are currently using or want to use in future.

57 responses