SNS COLLEGE OF TECHNOLOGY

Coimbatore-35

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

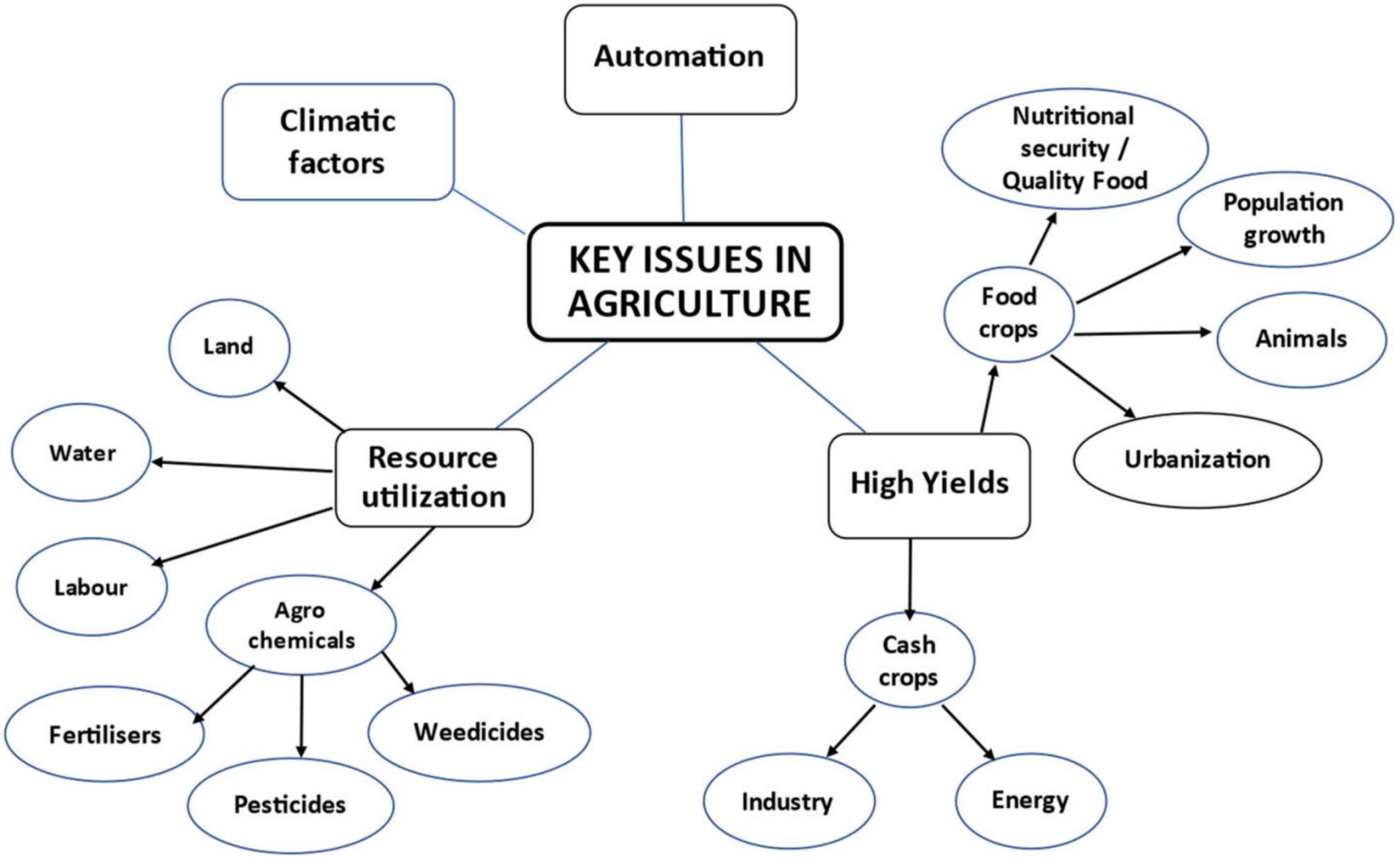
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECT213- IoT SYSTEM ARCHITECTURE

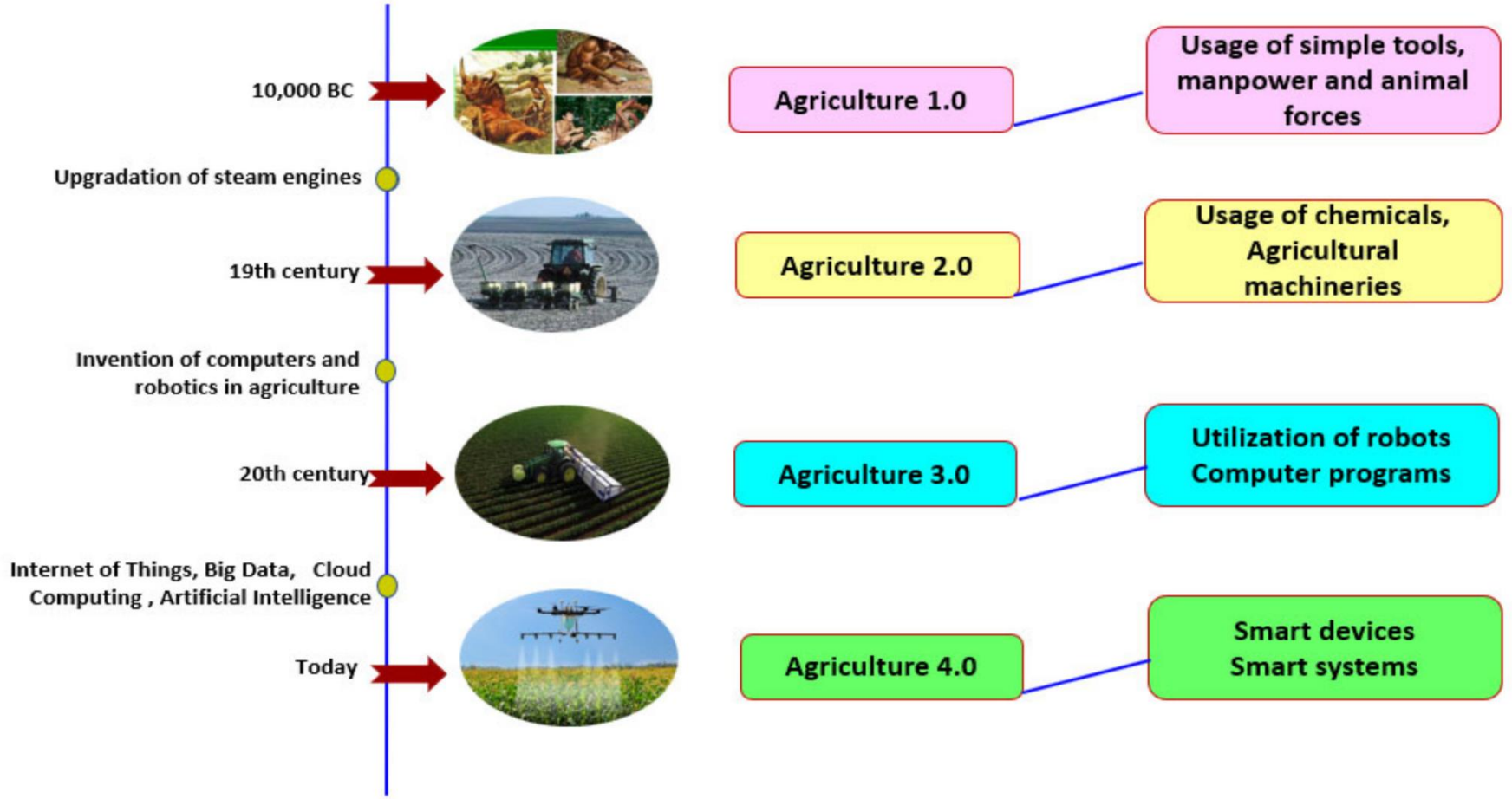
II ECE / IV SEMESTER

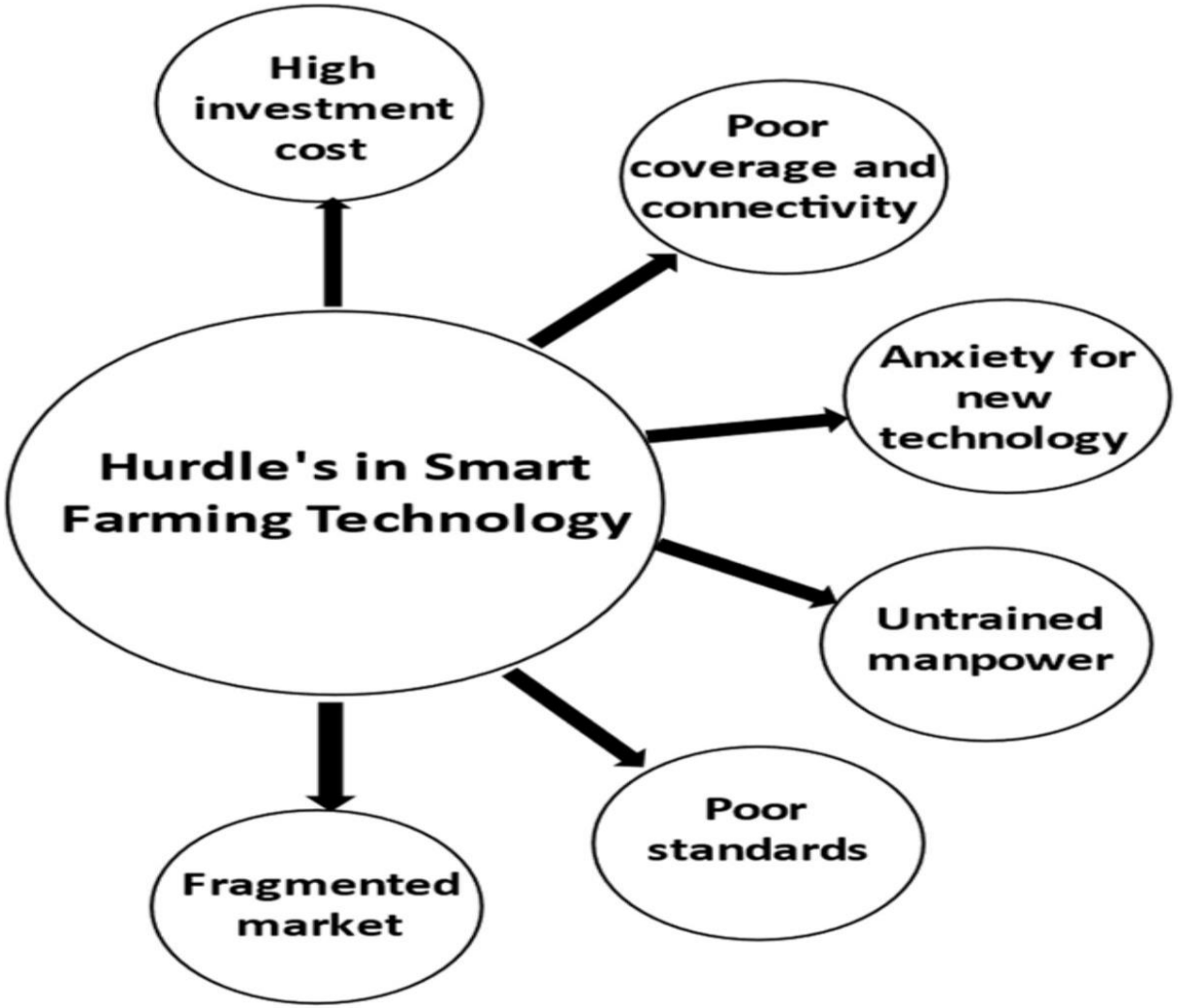
UNIT 1 – OVERVIEW OF INTERNET OF THINGS

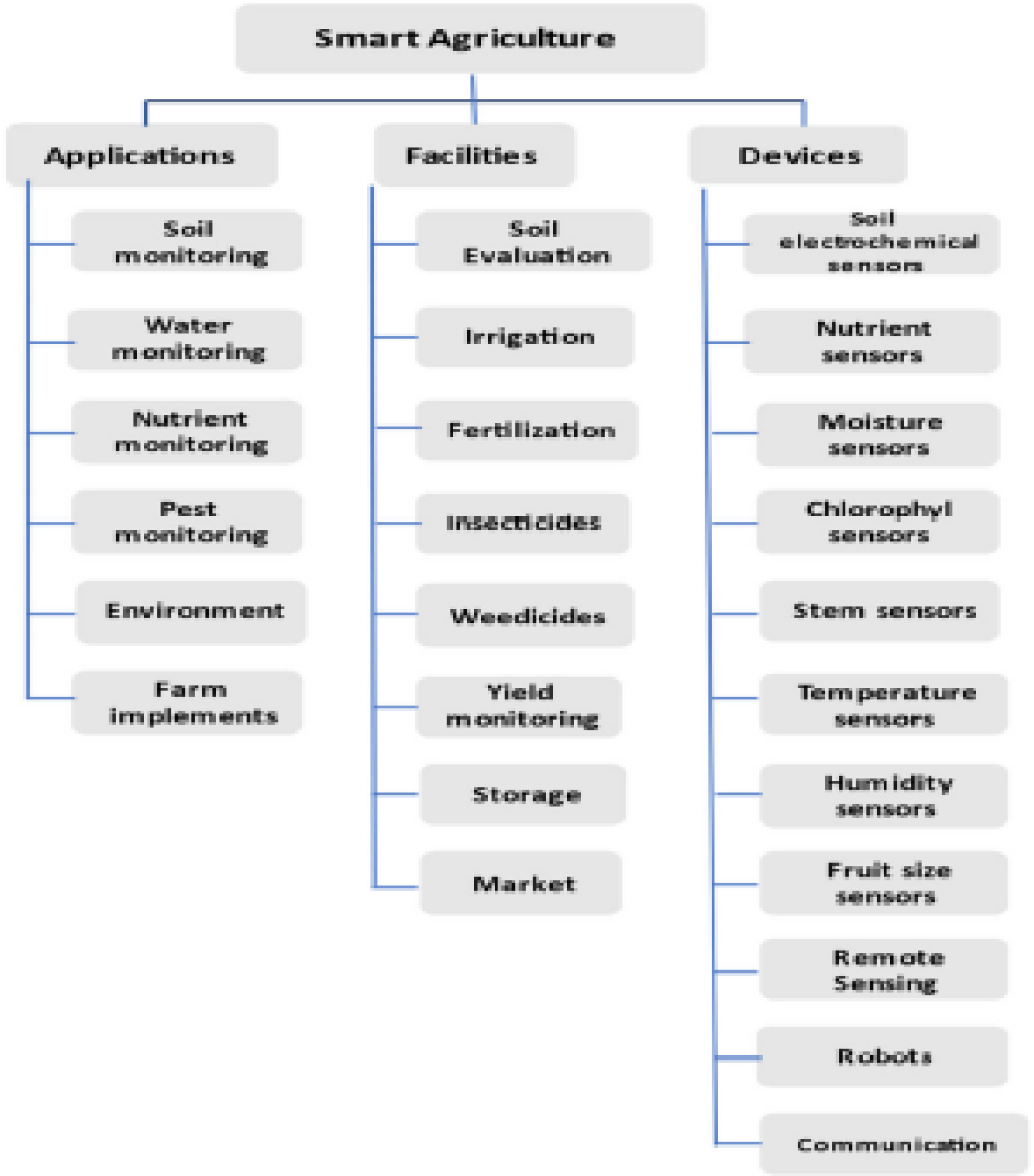
TOPIC 5 –Review of various IoT application domain including agriculture



Ref : https://www.mdpi.com/2077-0472/12/10/1745

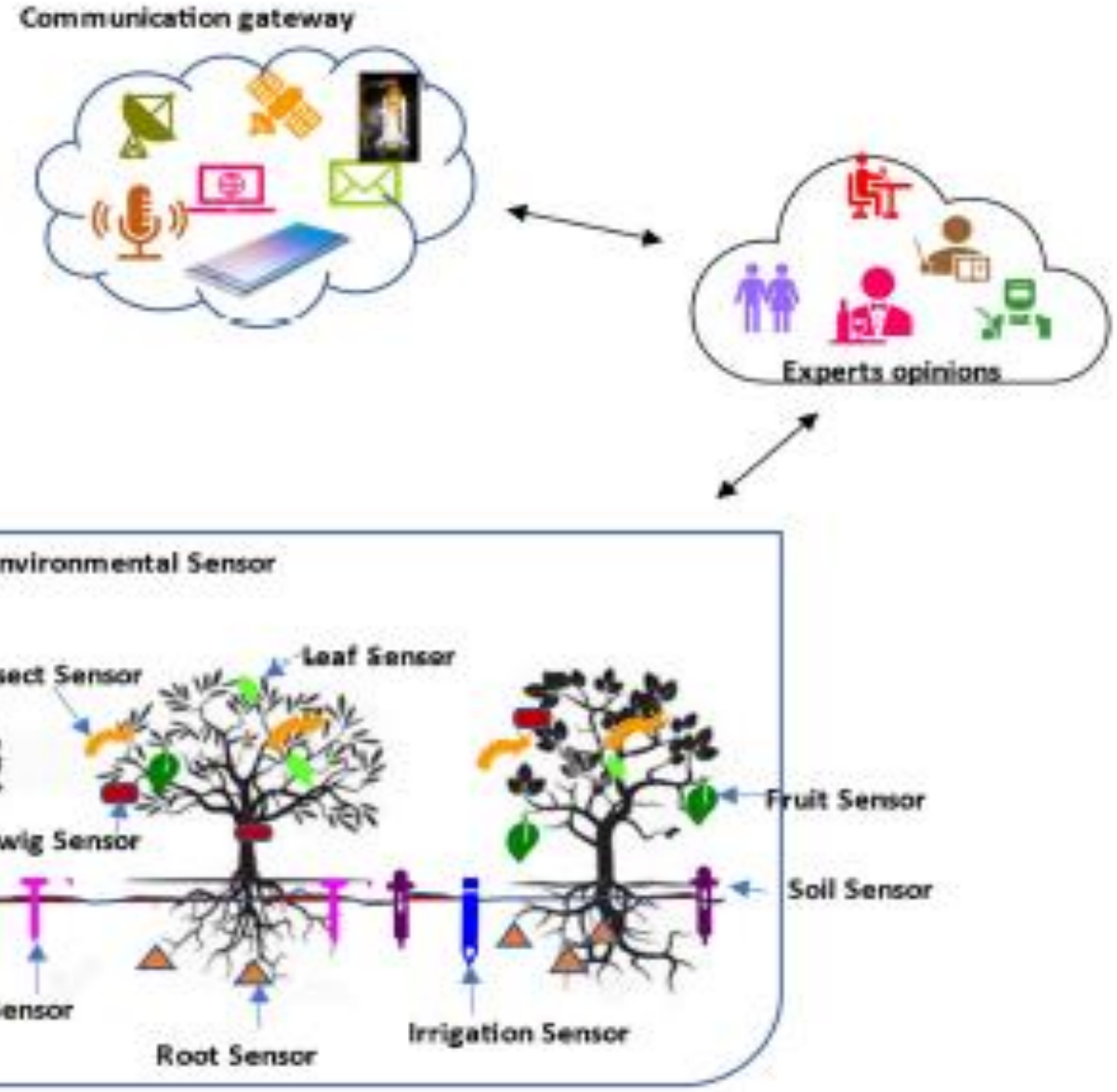

Ancillary aspects
Strategic features
10,000 BC
Upgradation of steam engines
19th century
Invention of computers and robotics in agriculture
20th century
Internet of Things, Big Data, Cloud Computing , Artificial Intelligence
Today
Agriculture 1.0
Usage of simple tools, manpower and animal forces
Agriculture 2.0
Usage of chemicals, Agricultural machineries
Agriculture 3.0
Utilization of robots Computer programs
Agriculture 4.0
Smart devices Smart systems

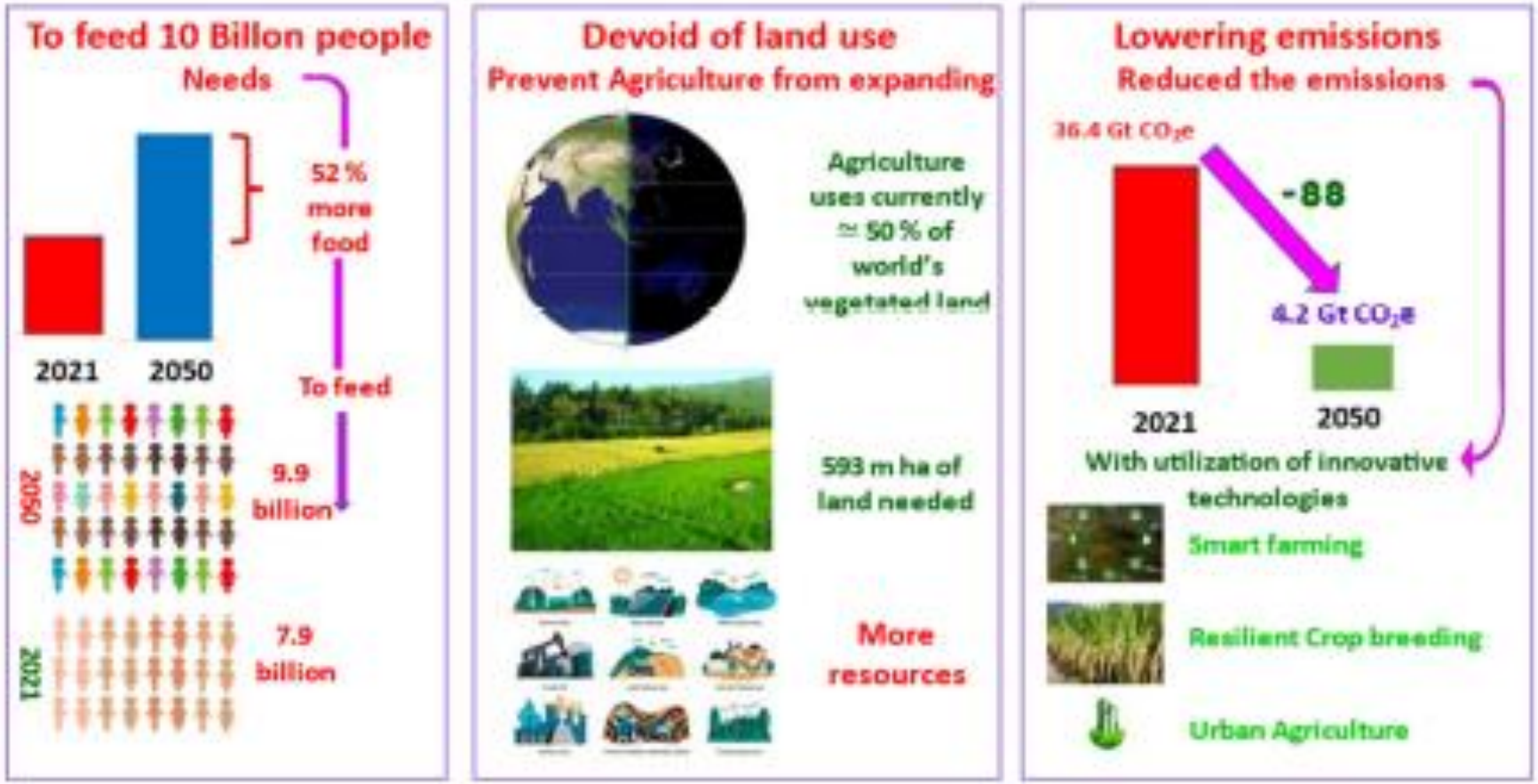

High investment cost
Poor coverage and connectivity
Anxiety for new technology
Hurdle's in Smart Farming Technology
Untrained manpower
Poor standards
Fragmented market


Smart Agriculture
Applications
Facilities
Devices
Soil monitoring
Water monitoring
Nutrient monitoring
Pest monitoring
Environment
Farm implements
Soil Evaluation
Irrigation
Fertilization
Insecticides
Weedicides
Yield monitoring
Storage
Market
Soil electrochemical sensors
Nutrient sensors
Moisture sensors
Chlorophyl sensors
Stem sensors
Temperature sensors
Humidity sensors
Fruit size sensors
Remote Sensing
Robots
Communication

Sensors	Applications	Working Procedure
Acoustic sensors	Pest monitoring and detection classifying seed varieties, fruit harvesting [36].	Measuring the variations in noise level when intermingling with other materials, i.e., soil particles [37].
Airflow sensors	Measuring soil air permeability, moisture, and structure in a static position or mobile mode [38].	Based on various soil properties, unique identifying signatures [38].
Eddy covariance-based sensors	Quantifying exchanges of CO_2, water vapor, methane, or other gases. Measuring surface atmosphere and trace gas fluxes in various agricultural ecosystems [39].	Measuring continuous flux over large areas [40].
Electrochemical sensors	To analyze soil nutrient levels and pH [41].	Nutrients in soil, salinity, and pH are measured using sensors [42]
Electromagnetic sensors	Recording electrical conductivity, electromagnetic responses, residual nitrates, and organic matter in soil [43].	Electrical circuits measure the capability of soil particles to conduct or accumulate electrical charge [44].
Field programmable gate array (FAAA) based sensors	Measuring real-time plant transpiration, irrigation, and humidity [45].	Programmable silicon chips and logic blocks are surrounded together by programmable interconnected resources of the digital circuit [46].
Light detection and ranging (LIDAR)	Land mapping, soil type determination, farm 3D modelling, erosion monitoring and soil loss, and yield forecasting [47].	Sensors emit pulsed light waves and bounce off when colliding with objects and are returned to the sensor. The time taken for each pulse to return is used for assessment [47].
Mass flow sensors	Yield monitoring based on the amount of grain flow through a combine harvester [48].	Sensing the mass flow of grain with modules, e.g., grain moisture sensor, data storage device, and an internal software [48]

Mechanical sensors	Soil compaction or mechanical resistance	Sensors record the force assessed by strain gauges or load cells [48].
Optical sensors	Soil organic substances, soil moisture, color, minerals, composition, clay content, etc. Fluorescence-based optical sensors are used to supervise fruit maturation [49]. Integrating optical sensors with microwave scattering to characterize orchard canopies [50]	Sensors use light reflectance phenomena to measure changes in wave reflections [44].
Optoelectronic sensors	Differentiate plant types to detect weeds in wide-row crops [51].	Sensors differentiate based on reflection spectra [51].
Soft water level-based (SWLB) sensors	Used in catchments to characterize hydrological behaviors (water level and flow, time-step acquisitions) [52]	Measuring rainfall, stream flow, and other water presence options [52].
Telematics sensors	Assessing location, travel routes, and machine and farm operation activities [53].	Telecommunication between places (especially inaccessible points) [53].
Ultrasonic ranging sensors	Tank monitoring, spray distance measurement, uniform spray coverage, object detection, monitoring crop canopy [54], and weed detection [55].	An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay information about an object's proximity [56].
Remote sensing	Crop assessment, yield modeling, forecasting yield date, land cover and degradation mapping, forecasting, the identification of plants and pests, etc. [57].	Satellite-based sensor systems collect, process, and disseminate environmental data from fixed and mobile platforms [57].


Communication gateway
Experts opinions
Environmental Sensor
Insect Sensor
Leaf Sensor
Twig Sensor
Fruit Sensor
Soil Sensor
Nutrient Sensor
Root Sensor
Irrigation Sensor

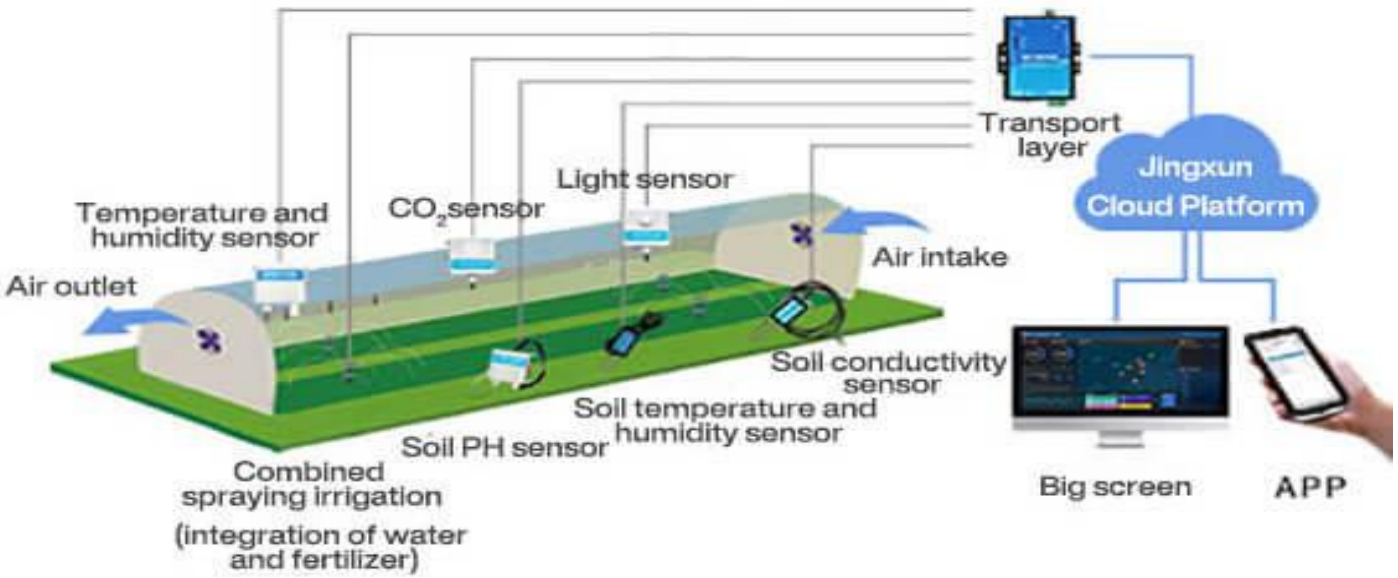

To feed 10 Billon people
Needs
52 % more food
2021
2050
To feed
9.9 billion
2050
2021
7.9 billion
Devoid of land use
Prevent Agriculture from expanding
Agriculture uses currently ≃ 50 % of world's vegetated land
593 m ha of land needed
More resources
Lowering emissions
Reduced the emissions
36.4 Gt CO_2e
-88
4.2 Gt CO_2e
2021
2050
With utilization of innovative technologies
Smart farming
Resilient Crop breeding
Urban Agriculture

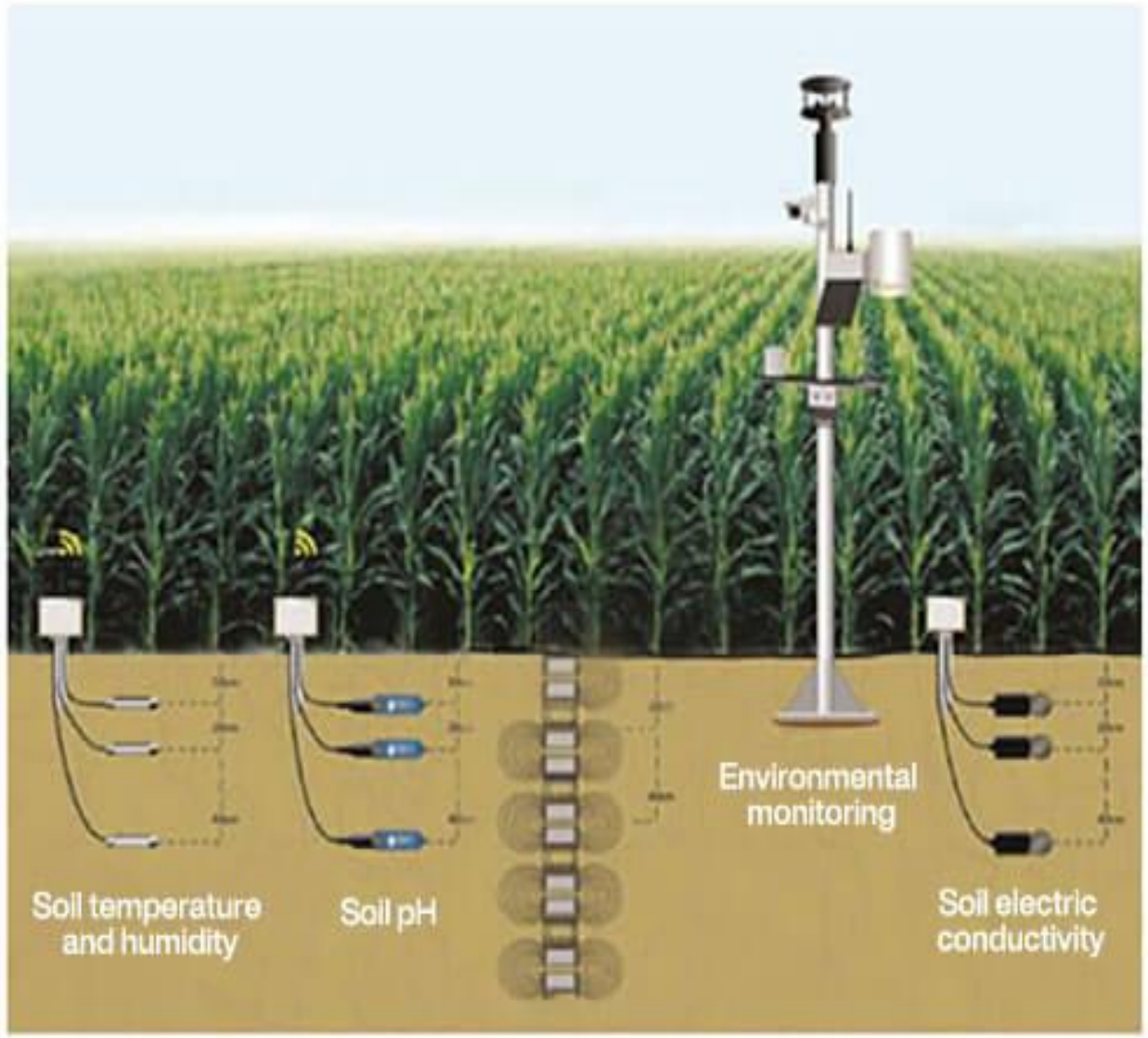
- **Real-time weather data:** Sensors inside and outside fields collect data on humidity, rainfall, temperature, and more.
- **Informed crop selection:** Choose crops that thrive in specific climatic conditions based on accurate data.
- **Precise monitoring:** Track crop health and surrounding weather for proactive management.
- **Alert system:** Receive notifications for potential threats from weather disturbances.
- **Increased productivity:** Eliminate need for constant physical presence and react quickly to changing conditions.
- **Enhanced benefits:** Reap greater agricultural benefits through informed decision-making.

Agricultural Environmental Monitoring

1 Soil temperature and humidity monitoring:

The sensor collects the soil temperature and humidity, and the system automatically determines whether to start irrigation according to the monitoring data; When the system determines that the soil temperature and humidity reach the threshold, the electronic valve automatically opens and automatic irrigation begins. When the temperature and humidity reach the standard value, the solenoid valve automatically closes and irrigation stops.



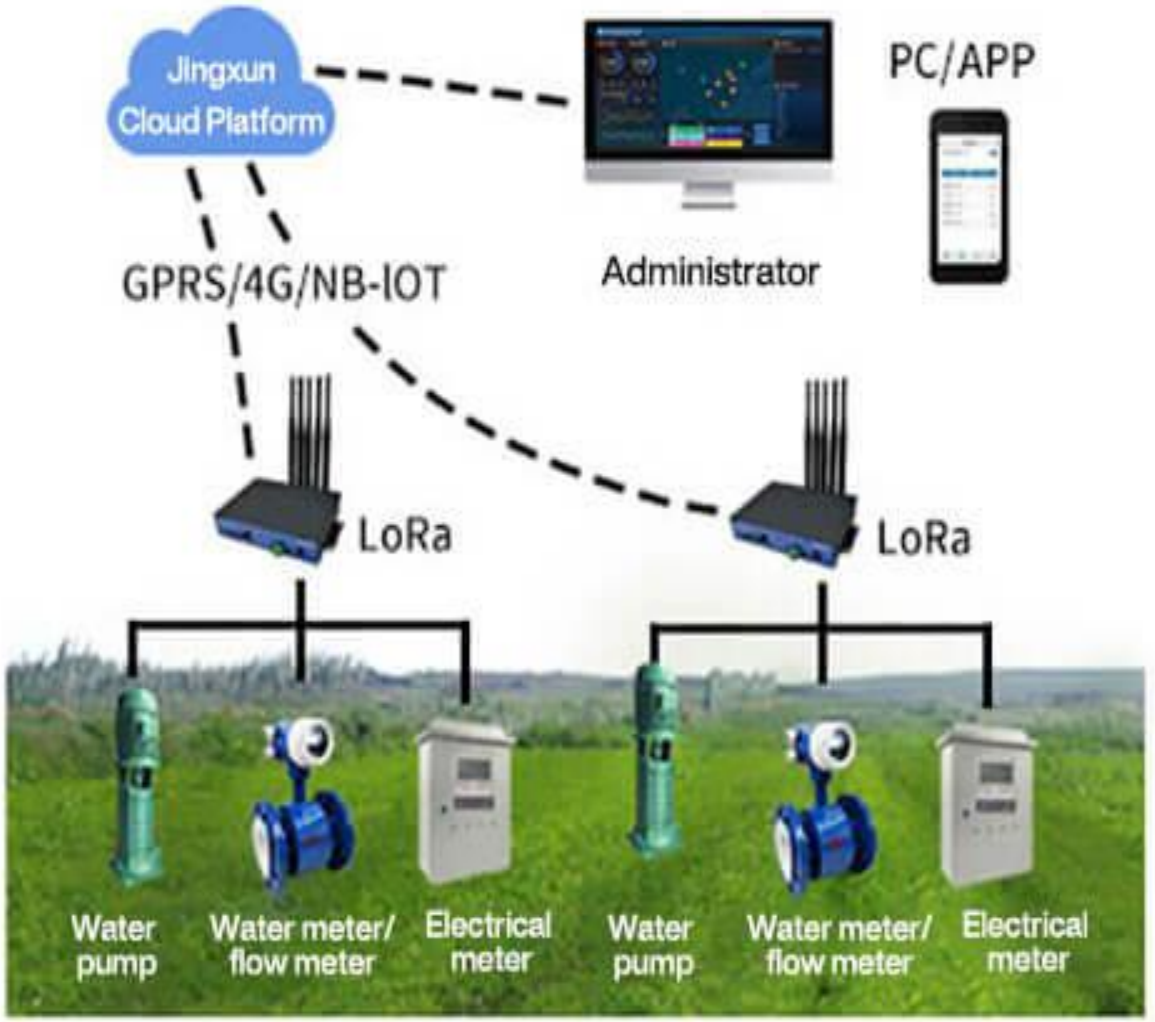


2 Soil moisture monitoring:

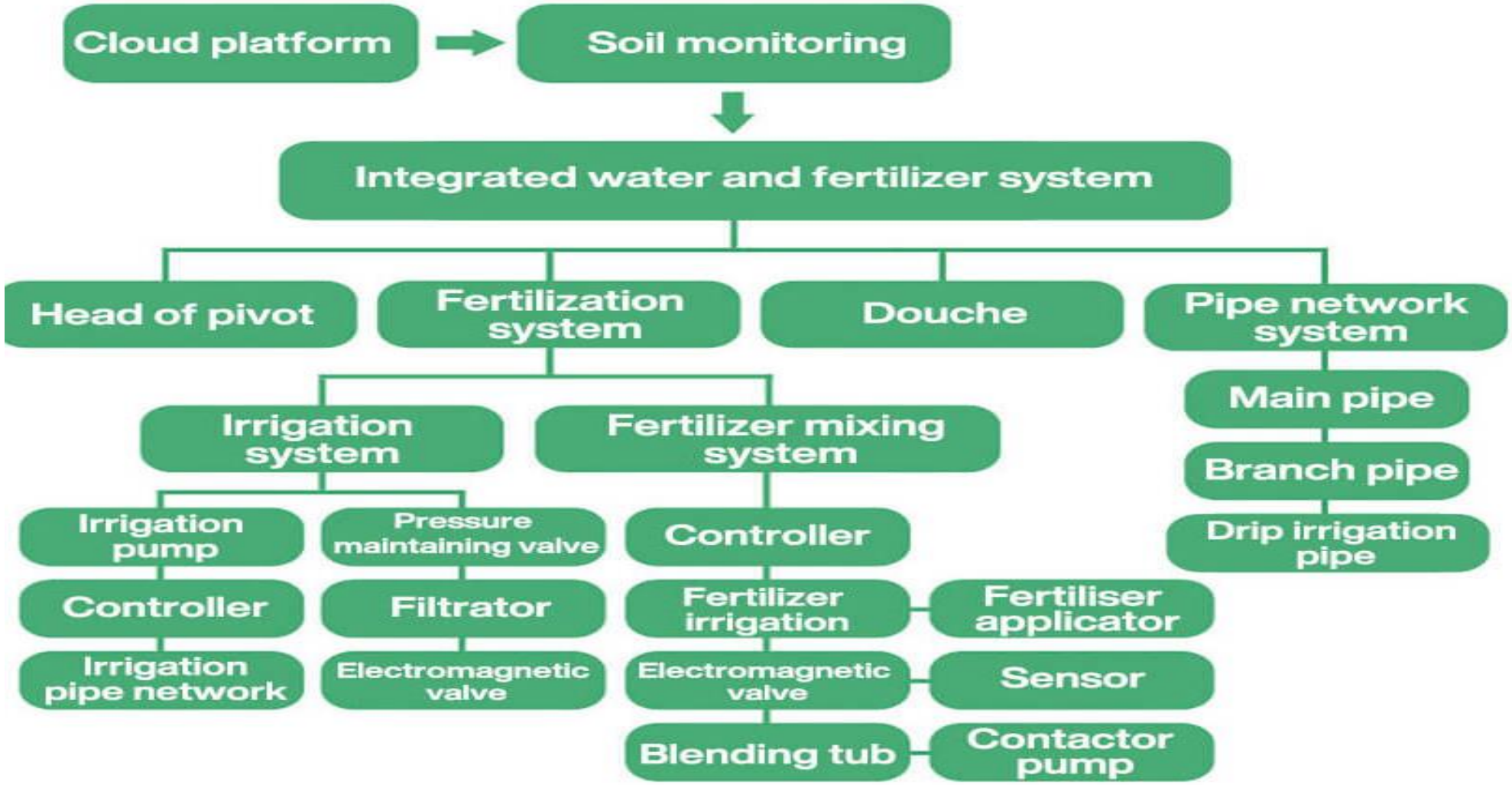
The information of soil conductivity, soil PH value, soil temperature and humidity can reflect the soil change in the monitored area comprehensively and truly, and can provide the soil moisture status of each monitoring point timely and accurately. Real-time remote monitoring of farmland irrigation according to the needs of crops through the platform.

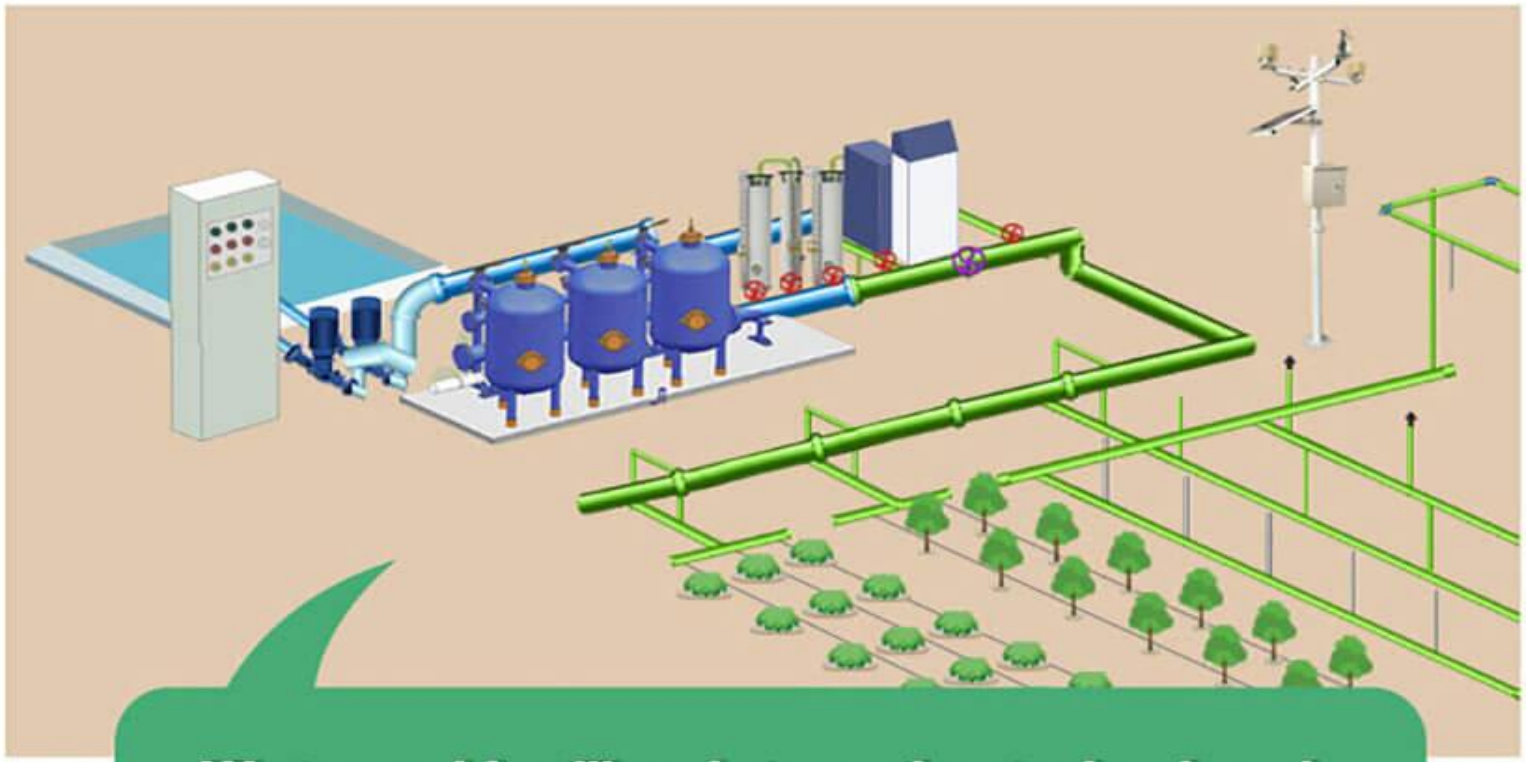
3 Water consumption monitoring:

For each irrigation and monitoring area, install LORA water meter, automatic meter reading, display the water consumption, according to different crops, different regions, no time to record and count the irrigation water.



Integration of Water and Fertilizer





Water and fertilizer integration technology is a new agricultural technology that integrates irrigation and fertilization

Water supply and fertilizer supply through the controlled pipeline system, and after the water and fertilizer melt, spray irrigation is carried out through the pipeline, spray gun or sprinkler, so that the soil in the main development and growth area always maintains loose and appropriate water content. At the same time, the water and nutrient are regularly quantified according to the fertilizer requirements of different crops, soil environment and nutrient content. Feed directly to the crop on a pro rata basis.

PIPE NETWORK MODEL

It consists of main pipe, branch pipe and drip irrigation pipe

The role of the water distribution network is to transport the first treated water to the irrigation unit and the irrigator according to the requirements.

The capillary pipe is the last stage of the micro-irrigation system. In the drip irrigation system, it is the drip irrigation pipe.

IRRIGATION MODES

SPRINKLER IRRIGATION MODE

Sprinkler irrigation uses machinery and power equipment to shoot water with a certain pressure into the air through the nozzle (or nozzle), and disperse into small water droplets or form mist to fall on the fields and plants.

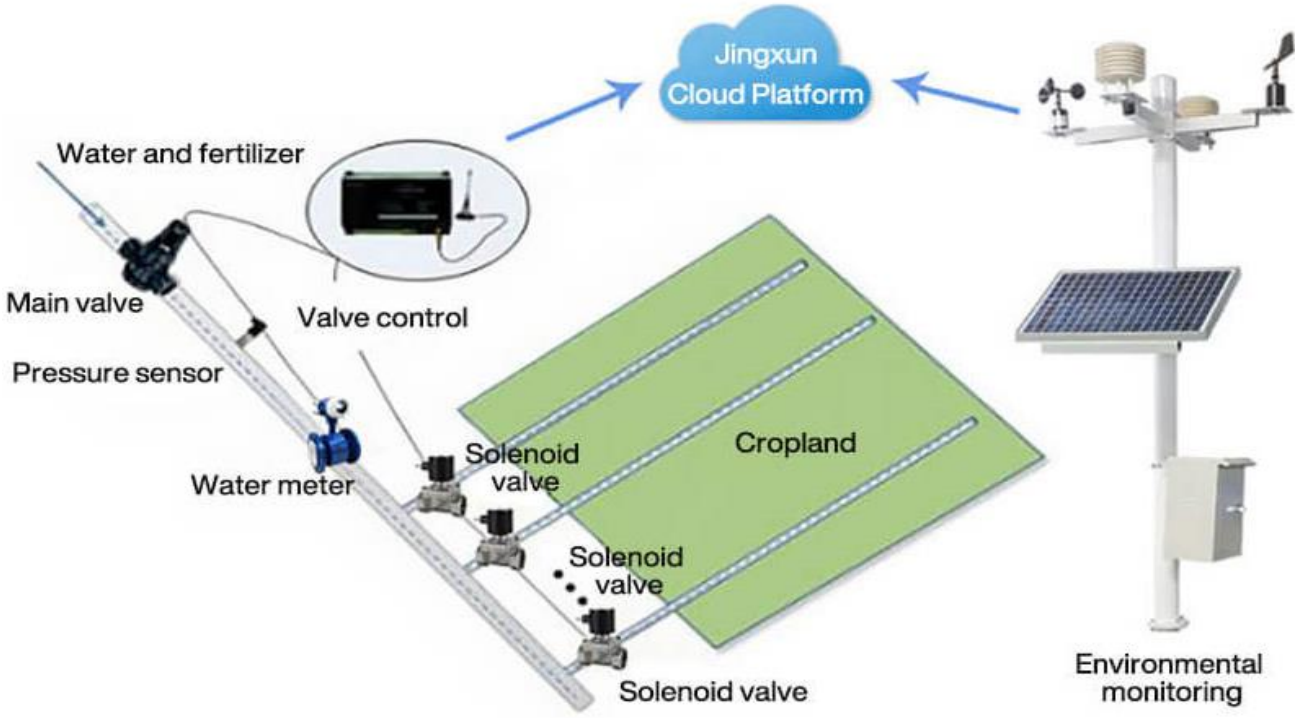
DRIP IRRIGATION MODE

Drip irrigation is an irrigation method in which water and the moisture and nutrients needed by crops are uniformly and slowly dripped into the soil in the root zone of crops through a pipe system and an irrigator mounted on the capillary.

Through the information collected by the soil moisture sensor, the soil water requirement is judged and analyzed, and the soil moisture is irrigated through automatic control. When the min value set by the soil moisture sensor is reached, the platform sends instructions to stop irrigating, so as to achieve the purpose of saving water and precision irrigation.

Linkage Solenoid Valve

In the smart irrigation system, the water can be directly connected to the solenoid valve



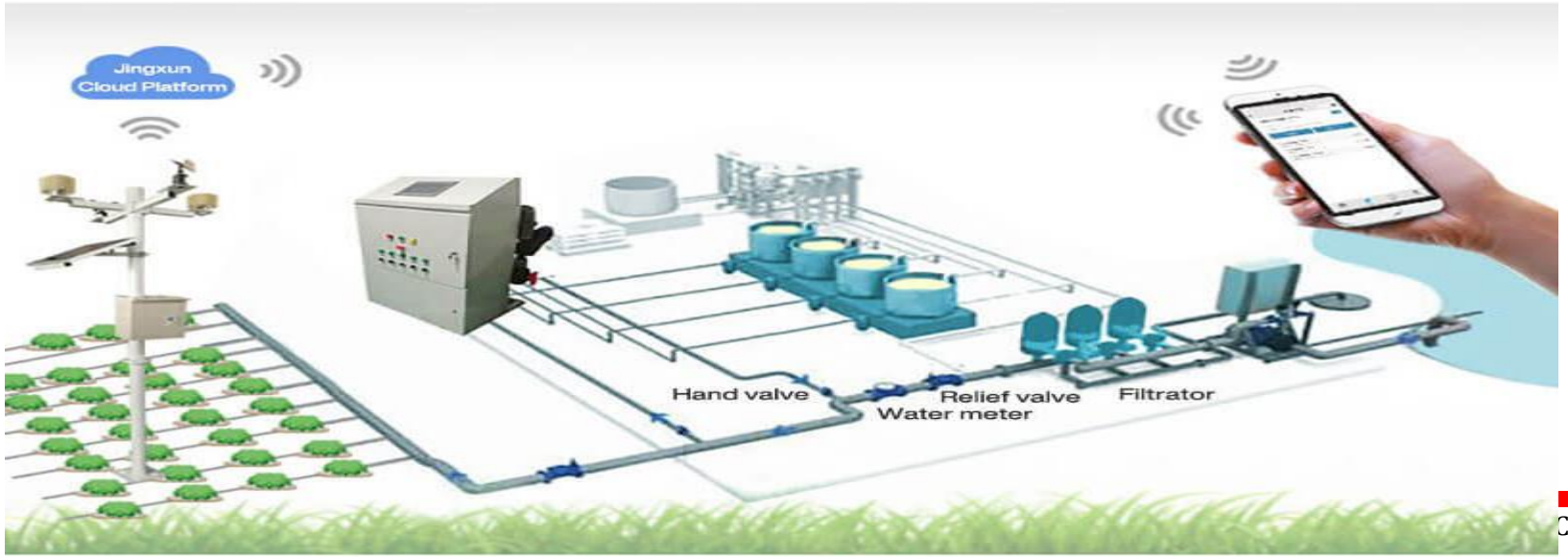
Monitor Mode

1. APP control:

Users can receive the required information push through the mobile APP, view real-time data and historical data, and realize remote irrigation management operation.

2. PC control :

Users can log in the cloud through computers, tablets and other terminals to view the farm situation in real time, and control the opening and closing of water and fertilizer facilities according to the data, and users can learn about the irrigation site through video in real time during the fertilization and irrigation process.



System Product

Thermometer screen

Soil pH

Evaporation capacity

Rainfall

Wind speed

Wind direction

Soil electric conductivity

Photosynthetically active radiation

Soil temperature and humidity

Control cabinet

Smart water and fertilizer machine