

Tender schedule For Selection of Service Provider for Design,  
Development and Maintenance of AP Agriculture Information &  
Management System (APAIMS 2.0) for a period of 5 years



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## Critical Dates of Tender



### DEPARTMENT OF AGRICULTURE

RFP for Selection of Service Provider for Design, Development and Maintenance of AP Agriculture Information & Management System (APAIMS 2.0) for a period of 5 years

Time schedule of various tender related events:

Bid calling date	07.01.2025
Pre-bid conference date and time	17.01.2025
Last Date of Technical Bid Submission (Offline @ IHC Corporate, Bus Depot Road, Mangalagiri, Guntur Dist, AP)	<a href="#">30-01-2025@11.00</a> AM. The representative of bidder should submit the sealed documents and show them to the Committee during verification. Presentations as per the technical evaluation shall be done by the bidders on the during 31 <sup>st</sup> Jan 2025
Communication to technically qualified bidders	On or before 04-02-2025 through mail or Mobile
Financial Bid closing Date /Time (Online through e Procurement portal only)	10-02-2025 @ 2.00 PM
Department of Agriculture Contact person	Superintending Engineer (DAC) Contact No: 73373 46678
Department of Agriculture Reference No.	Department of Agriculture/AGC02-30021(35)/4/2024

The tender details and specifications can also be seen on

[www.apecurement.gov.in](http://www.apecurement.gov.in) and <http://www.apagrisnet.gov.in>

Sd/-  
Director of Agriculture  
Agriculture Department  
Andhra Pradesh, Guntur

## 1. Introduction

Department of Agriculture invites Request for Proposal (RFP) from the prospective Bidders meeting the qualification criteria specified in this RFP for selection of Service Provider (Agency) for Design, Development and Maintenance of AP Agriculture Information & Management System (APAIMS 2.0) for a period of 5 years.

### 1.1. Solution

The Government of Andhra Pradesh, department of Agriculture, decided to identify a Service Provider (Agency) through Open Competitive Bidding Process for Design, Development and maintenance of Andhra Pradesh Agriculture Information and Management System (APAIMS 2.0) for a period of 5 years and also to develop additional features required by the Department of Agriculture from time to time during 5 years for smooth delivery of departmental services to the public, hence this RFP.

Department of Agriculture invites bids from the prospective Agencies having already experience in Development of Information Management Systems in any State/central Governments or any organizations in India or abroad as per the detailed scope of work mentioned in this RFP.

### 1.2. Important Dates and Contacts

Bid calling date	07.01.2025
Pre-bid conference date and time	17.01.2025
Last Date of Technical Bid Submission (Offline @ IHC Corporate, Bus Depot Road, Mangalagiri, Guntur Dist, AP)	<a href="mailto:30-01-2025@11.00">30-01-2025@11.00</a> AM. The representative of bidder should submit the sealed documents and show them to the Committee during verification. Presentations as per the technical evaluation shall be done by the bidders on the during 31 <sup>st</sup> Jan 2025
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Department of Agriculture Reference No.	Department of Agriculture/AGC02-30021(35)/4/2024

Intending bidders are advised to visit e-procurement website: [www.apeprourement.gov.in](http://www.apeprourement.gov.in) for submission of tender for any corrigendum/ addendum/ amendment. If not followed the website, Department of Agriculture is not responsible and individual communication will not be provided to the intending bidders.

### 1.3. Award of Contract

The proposals received will be evaluated, by a committee, based on Quality cum Cost Based Selection (QCBS) as per evaluation criteria mentioned in subsequent sections of this RFP. Proposals will be ranked in terms of the Overall Scores obtained from Highest to Lowest. The bidder with the highest overall score will be considered for award of contract

towards Design, Development and maintenance of Andhra Pradesh Agriculture Information and Management System (APAIMS) for a period of 5 years.

#### 1.4. Contract Period

The contract period is for Five (5) years initially from the effective date of Go-Live of the APAIMS 2.0 application (As detailed below) and shall be extended further for a period of additional two / three years on mutual consent and there on, as per the financials decided by the Department of Agriculture, in agreement with the service provider.

Date of Contract or work order : T days

Design, Development and Go-Live : T+ 15 months = T1 (Go-Live date. (Service Provider has to complete all the modules as per the milestones)

(Development of all the tasks as per the milestones to be completed within 15 months of award of contract)

Maintenance for 5 years : T1 + 5 years = T2

Note: The bidder shall quote Commercials for T2 including basic cost, Tax and all other costs that are incurred, to be incurred during this period(T2).

Additional period of Contract after T2 for 2 or 3 years and there on, the maintenance cost shall be negotiated and finalized based on the requirement and mutual consent and the decision of the department is final.

#### Activities during Development

- Design, Development and Go-Live of Web application for all the users as per the Scope of work and milestones.
- Design, Development and Go-Live of Mobile application for the applicable department officials and cultivators in the state as per the scope of work and milestones.
- Security Audit (by APTS, Vijayawada) of the application before Go-Live (The cost of Security Audit will be borne by the department)
- Agency to host the application on cloud servers during development phase of 15 months (At their own cost), UAT to be conducted at each stage of the Milestone and after completion and satisfactory certificate issued by the department, the application must be security audited by APTS, Vijayawada. After receiving security audit certificate, the application is to be moved/migrated and hosted in the servers of AP State Data Centre provided by the department.

#### Right of Monitoring, Inspection and Periodic Audit

- The Department reserves the right to conduct an audit, either directly or through a third party of its choice, to assess the performance of the Service Provider in fulfilling its obligations and functions in line with the standards established by the Department of Agriculture, GoAP. The Service Provider agrees to cooperate fully and provide all necessary documents and information required by the Department of Agriculture, GoAP, or any other agency appointed by the department for this purpose. Any identified deviations or non-compliance discovered during such audits communicated by the department must be corrected by the Service Provider. Failure to do so may



result in issuance of a notice of default by the department, without prejudice to any other rights the client may have.

Activities after Go-Live during 5 years period:

- Attend all support calls and assist all the users as and when required.
- Ensure that the system is fully functional and up time is 99.99%
- To take up any changes apart from the scope of work immediately as and when requested by the department with no additional cost to the department.
- Required Servers will be provided by the department at AP State Data Centre, Mangalagiri. The successful bidder shall coordinate with the APSDC from time to time for meeting their requirements, data support, server maintenance etc., and it is the part of Scope of work.
- To provide data through APIs, as approved by the department, to integrate APAIMS application to other existing software's of the department/ other departments/GOI vice-versa as and when required.
- To consume APIs from the other software's of the department / other departments/GOI applications etc., for preparation of reports, analysis etc in the dashboard.
- To take up and complete any kind of changes that are required for betterment of the application as per the requirement of the department from time to time during the 5 years period (T2) by the service provider as and when requested by the department without any additional cost.
- To attend the departmental review meetings as and when requested by the department during 5 years period.
- To maintain complete confidentiality and integrity regarding the application, database, user's information and all other related information etc.
- Any part of the data or information should not be shared to any other agency, organization without the approval of the department.

1.5. Effective date of contract  
As mentioned in 1.4.

1.6. Project Deliverables and Timelines

- The Director of Agriculture, Department of Agriculture issues Letter of Intent (LoI) to the successful bidder. The successful bidder has to submit 1. Acceptance letter regarding L1 quoted price, Terms and conditions of the Tender and completion of work as per the milestones mentioned in the Tender, 2. Price break up letter (for L1 Price) on their Letter Head to the Director of Agriculture as per milestones and 3. Performance Bank Guarantee (For T2 days i.e for 75 months) 4. Detailed action plan for the tasks and deliverables with clearcut timelines in the form of either weekly or monthly chart duly mentioning the months/weeks (Start date and End date of each Task/Milestone). On receipt of the above from the bidder, Director of Agriculture issues the Work Order (WO) to the successful bidder.
- The selected bidder should take up the work immediately upon receipt of Work Order. Immediately after the receipt of work order from the department, the bidder shall attend to a meeting with their Technical and Admin team at IHC Corporate Mangalagiri on the mutually agreed date to discuss on the action plan and Service Level Agreement before moving forward.

- Required manpower is to be identified for system study, taking requirements, designing and development and maintenance of Andhra Pradesh Agriculture Information and Management System (APAIMS 2.0) for a period of 5 years (T2).
- Signing of SLA: A Service Level Agreement shall be signed with a clear mention of the Tasks/Modules along with detailed Price break up (Module wise) as mentioned in the 1<sup>st</sup> para of Clause 1.6

### 1.7. Payment Milestones

Payment will be on as per agreed terms & conditions of this RFP. Details of the milestone are defined below.

Development		Payment Schedule
On signing of SLA for Go-Live of the application	:	10%
Milestone -1: Initialisation and meeting the infrastructure Requirement	:	10%
Milestone -2: Farmer oriented Services & Advisories	:	10%
Milestone -3: Weather event alerts and Inputs	:	10%
Milestone -4: Deep Tech Analysis	:	10%
Milestone -5: Departmental workflow and integration	:	10%
At the end of Year 1 (T1+12 months)	:	8%
At the end of Year 2 (T1+24 months)	:	8%
At the end of Year 3 (T1+36 months)	:	8%
At the end of Year 4 (T1+48 months)	:	8%
At the end of Year 5 (T1+60 months)	:	8%

- The successful bidder shall submit their claim for payment to the Director of Agriculture, along with details of work executed, operation and maintenance of the portal with evidence of accomplishment of the scope of the work. The work done report shall include the quantifiable deliverables with specific timelines.
- The work done will be evaluated by the department critically and eligible amount will be paid, either full or partial, depending on the evaluation of work done report duly deducting the IT/GST if any, at source as per IT/GST act and other guidelines.

## 2. Project Overview

### 2.1 Introduction

Andhra Pradesh is known as "Rice Bowl of India." The state has six Agro climatic zones and five different soil types. The State of A.P, basically being Agro-Based economy, Agriculture & Allied sectors contributes more than 29% of the GSDP as against 17% in All India GDP.

- Climate: Andhra Pradesh, characterized by semi-arid, moist to dry, sub-humid climate, with annual rainfall of the State is 940 mm, varying from about 520 mm in Anantapur

District to 1160 mm in Vizianagaram and East Godavari districts. The state is endowed with a variety of natural resources for irrigation and is popularly known as the "River State" of Southern India. The important rivers which are harnessed for irrigation include Godavari, Krishna, Pennar, Tungabhadra, Vamsadhara and Nagavali.

- **Soils:** Andhra Pradesh is endowed with a wide variety of soils, ranging from less fertile poor coastal sands to highly fertile and productive deltaic alluvia (entisols/vertisols) of the Godavari, Krishna and Penna rivers, and the red (alfisol) and black (vertisol) soils, developed from different parent materials.
- **Land Utilization:** The total geographical area of the State is 162.97 lakh hectares. The net cultivated area is 80 lakh ha. The area under cultivable waste, other than current fallow and current fallow is around 30 lakh ha. In view of the increasing area for non-agriculture purpose, need to bring the uncultivated area into cultivation in a phased manner.

Important Agriculture crops grown in Andhra Pradesh:

- **Rice:** Andhra Pradesh's main crop is rice, and the state is one of the biggest rice growers in India. It is mostly grown in the delta areas along the coast, where the land is rich and there is enough water.
- **Millets:** Jowar (sorghum), bajra (pearl millet), and ragi (finger millet) are common millets grown in Andhra Pradesh's dry and semi-dry areas. These crops are very healthy and can survive in dry places because they don't need much water.
- **Pulses:** Important crops in Andhra Pradesh include red gram (pigeon pea), black gram, green gram, and Bengal gram. These legumes are very important because they provide protein-rich food and make the land more fertile by fixing nitrogen.
- **Oilseeds:** Andhra Pradesh is a big producer of oilseeds like peanuts, sesame, sunflower, and castor. Cultivators can make money by growing oilseeds, which helps make food oils and gives cultivators a way to make money.
- **Cotton:** The state is known for making high-quality cotton fibres that are used in the textile business. Cotton is one of the major cash crops that is extensively grown in Andhra Pradesh. The state has favourable agro-climatic conditions for cotton cultivation, including a long growing season, hot summers, and medium rainfall.
- **Tobacco:** Andhra Pradesh is a major producer of tobacco, and places like Prakasam, Guntur, and West Godavari are known for growing tobacco. The state's tobacco is often used to make cigarettes and other goods with tobacco.
- **Sugarcane:** In Andhra Pradesh, sugarcane is an important cash crop. The state is known for making sugar and jaggery. It has a number of sugar plants.

Production constraints

- **Water Scarcity:** The availability of water for irrigation is a major challenge in many parts of Andhra Pradesh. Dependence on monsoon rains and the limited

availability of surface and groundwater resources pose significant challenges for cultivators, especially during dry spells and drought conditions.

- **Climate Change:** Climate change has led to erratic weather patterns, including unpredictable rainfall, heatwaves, and extreme weather events. These changes affect crop growth, water availability, and overall agricultural productivity, posing challenges for cultivators in planning and managing their agricultural activities.
- **Soil Degradation:** Soil erosion, nutrient depletion, and soil salinity are common issues in certain regions of Andhra Pradesh. Improper land management practices, excessive use of chemical fertilizers, and inadequate soil conservation measures contribute to soil degradation, impacting crop yields and long-term sustainability.
- **Pest and Disease Management:** Cultivators face challenges in managing pests and diseases that affect their crops. Outbreaks of pests, insecticide resistance, and the spread of new diseases pose risks to crop health and productivity. Ensuring effective pest and disease management practices can be demanding for cultivators.
- **Natural calamities:** Andhra Pradesh is one of the most vulnerable States in India to multiple natural disasters like Cyclones, Heavy Rains and Floods, Hailstorms, Tsunamis on one hand and Drought on the other hand, because of its widespread and peculiar geographical location.
- **Market Access and Price Volatility:** Cultivators often struggle with limited market access and price fluctuations for their produce. Lack of proper market infrastructure, transportation facilities, and market information hinders cultivators' ability to sell their crops at fair prices and obtain optimal returns for their efforts. Fluctuating crop prices, input costs, and market uncertainties contribute to income instability for cultivators. This makes it difficult for them to plan investments, manage debt, and achieve financial stability.
- **Dependence on Monoculture:** In some regions, cultivators rely heavily on monoculture, growing a single crop or a few crops. This practice makes them vulnerable to market uncertainties, price crashes, and crop-specific risks. Diversification of crops and income sources can help mitigate these challenges.
- **Technology Adoption and Extension Services:** The adoption of modern agricultural technologies, improved farming practices, and access to extension services can enhance productivity. However, many cultivators in Andhra Pradesh face challenges in accessing and adopting new technologies and benefiting from extension services.

## 2.2 Andhra Pradesh Agriculture Information and Management System (APAIMS 1.0)

A unified portal called the Andhra Pradesh Agriculture Information and Management System (APAIMS 1.0) was implemented during 2017-18 and 2018-19 in the state. The primary objective of the system was to address the challenges posed by climate change and promote

sustainable agriculture at mandal, district and State level. The main focus was on increasing the crop production, productivity and overall GVA in agriculture. The advisories to cultivators were disseminated through the field extension officers.

The following components were developed under the APAIMS 1.0-Decision Support System

#### A. Farm Advisories Module

- Field Preparation Advisories
- Date of Sowing Window
- Crop Stress Advisory
- Pest/disease alert advisory

#### B. Analytics Module

- ACZ analysis for identifying the most suitable crops at village level
- Dynamic ACZ based on changing weather conditions.
- Nursery timing based on MI Tank runoff estimation for paddy grown under rainfed tanks.
- Crop wise production, price forecast and market linkage
- Nutrient recommendation based on soil analysis
- SHC Recommendation vs. Aadhar based usage
- Ongoing Crop sown analysis based on e-panta weekly data
- Farm Mechanization

#### C. Drought Manual Automation

#### D. Agricultural Geo Portal Module

Now the Department is focussing directly on the cultivator, who actually cultivates the crop, and extending all support to them for getting sustainable income through agriculture.

The Agriculture Department intends to improve the APAIMS 1.0 to address all the production constraints mentioned in the previous chapter for increasing the cultivators income and improve GVA contribution in the State from agriculture sector.

As the above modules were developed in 2018-19, to further enhance the system and to support Department stakeholders and cultivators, and to leverage the technological advancements in the field of Remote sensing, Artificial Intelligence further Modules are envisaged to enrich the existing system and provide the near real time advanced Decision Support System - APAIMS 2.0 for all the stakeholders of Agriculture ecosystem.

### 2.3 Re-hosting and Maintenance of APAIMS 1.0

#### Re-hosting and Maintenance of APAIMS 1.0 Modules

- System should be ensured that the Field Preparation Advisories, Date of Sowing Window, and other Agro-advisory services within APAIMS 1.0 mentioned in the previous section continue to function effectively.
- It should be ensured that all functionalities of the analytics modules, including those dependent on near real-time data, are fully operational and functioning effectively.

- There should be regular updates to ensure advisories remain relevant and accurate, taking into account latest datasets.

#### Leveraging components of APAIMS 1.0 in APAIMS 2.0

- APAIMS 2.0 should leverage the robust data frameworks from APAIMS 1.0, particularly the analytics and advisory modules, to maintain consistency and reliability in the transition to APAIMS 2.0.
- APAIMS 2.0 should build on the existing data structures and analytics methodologies established in APAIMS 1.0, ensuring consistency and continuity in the data-driven advisory services.
- APAIMS 2.0 should utilize the foundational advisory modules from APAIMS 1.0, such as Field Preparation Advisories and Pest/Disease Alerts, while expanding their scope and integrating them with more advanced AI/ML engines and real-time data feeds.
- APAIMS 2.0 should utilize existing system methodologies, especially within the Farm Advisories and Analytics modules, ensuring that these continue to support decision-making and advisory services in APAIMS 2.0.
- Enhanced Farm Advisories: Existing advisories in APAIMS 1.0 should be leveraged for APAIMS 2.0's new modules like the Gen-AI Cultivator Helpdesk and Soil Health Card-Based Advisories to provide a more comprehensive decision-support system for cultivators.
- Advanced Analytics: Expand the capabilities of the APAIMS 1.0 Analytics Module to APAIMS 2.0 by integrating it with the new AI/ML Engine, enabling more analysis and predictions for modules such as Crop Sown Analysis, Crop Health Monitoring, Harvest Assessment etc.

#### Migration of APAIMS 1.0 to APAIMS 2.0

- Aggregate all relevant data from APAIMS 1.0, including analytics, farm advisories, and geospatial data, ensuring this information is fully integrated into APAIMS 2.0.
- Leverage the source code of APAIMS 1.0, particularly for the Farm Advisories and Analytics modules, to retain effective features while customizing them for the expanded scope of APAIMS 2.0.
- It should be ensured that the database schema and existing data in APAIMS 1.0 is migrated and the functional capabilities of APAIMS 1.0 modules such as Agro-advisories and Analytics are migrated and enhanced within APAIMS 2.0.
- While maintaining core functionalities, APAIMS 2.0 should enhance the capabilities of APAIMS 1.0 modules, incorporating AI/ML algorithms, better user interfaces, and integration with new systems.

#### 2.4 Vision of APAIMS 2.0

APAIMS 2.0's goal is to create an authoritative single Digital Agriculture Platform catering to entire Agriculture ecosystem impacting cultivators with better access to government schemes & benefits, practice climate-resilient agriculture, increase their yield, and earn better

prices for their fresh produce. APAIMS 2.0 will further help the Agriculture Department with real-time monitoring of the state's agriculture status in scheme adaptations and its impacts, management of agri-inputs and providing management and information system.

During the design and development of the envisaged APAIMS 2.0 platform, it should comply and adopt the guidelines provided by Ministry of Agriculture & Cultivator welfare through its various programs and schemes (such as Agri-Stack) as well as other relevant center-level programs as well as State government guidelines. The design & architecture of the APAIMS 2.0 platform shall comply the guidelines given by various Central Govt departments and State Government departments and shall ensure desired integration with various center/ state level programs and platform.

APAIMS 2.0 should address the below critical interventions and develop support systems for overall enhancement of production and productivity at crop level. This should help in increasing the cultivator's net income through agriculture.

#### State-wide Unified Cultivator & Agriculture Database:

There is no comprehensive, centralized database that consolidates information on all cultivators across the state. A unified database of owner cultivator and tenant cultivator is crucial for efficient resource allocation, advisory services, and policy implementation. This database will ensure that every cultivator's (including tenant cultivator) information is accurately recorded and easily accessible, enabling targeted support and interventions. Such a system will streamline the process of delivering customized advice, facilitate better planning and resource management, and enhance the overall effectiveness of agricultural programs.

#### End-to-End Online Support System for Cultivators:

A complete end to end online support mechanism that assists throughout their seasonal agricultural activities needs to be developed which shall support continuous assistance from field preparation, the pre-sowing stage to post-harvest activities. This system shall offer guidance on best practices, pest management, market trends, and financial planning, etc., ensuring that cultivators have access to all necessary information and support at every stage.

#### Digital Support System – Farm to Trade Approach:

There is lack of integrated digital platform that supports the entire crop lifecycle, from cultivation to market trade. To address this gap, there is a need for development of a digital support system that facilitates seamless transitions from pre-sowing to post-harvest. This platform would incorporate features such as market price updates, trading opportunities, and logistics support, aiming to empower cultivators to optimize their profits and minimize post-harvest losses.

#### Increase in Cultivated Land

The total geographical area of the State is 162.97 lakh hectares. The cultivable land (i.e net area sown, current fallow and other fallow lands) was 84.22 lakh hectares and it accounts for 51.68 percent of the total geographical area of the State during 2022-23. Land available for cultivation but not cultivated (i.e. culturable waste, permanent pasture and

other grazing lands and miscellaneous tree crops and groves not included in net area sown) was 7.61 lakh hectares and it accounts for 4.67 percent and land not available for cultivation (forests, barren and uncultivable land and land put to non-agriculture uses) was 71.14 lakh hectares and it accounted for 43.65 percent during 2022-23. The gross area sown or gross cropped area during 2022-23 is 67.44 lakh hectares as against 73.28 lakh hectares in 2021-22, showing a decrease of 7.97 percent.

Utilization of these culturable lands including fallows and cultivable wastes, through rainwater harvesting, digital extension support system, timely advisories on crop plan, growth and health (pests & diseases alerts), weather forecast e-marketing etc., can help to overcome production & marketing constraints.

#### Learning and Capacity Building:

There is a need to educate cultivators on modern agricultural practices, new technologies, and sustainable farming methods. These initiatives will empower cultivators with the knowledge and skills needed to enhance productivity and adopt innovative solutions and the same is envisaged through this system.

The key user groups and their services of APAIMS 2.0 are given below:

- Cultivator Services (Owner / Tenant): Sowing advisory, crop selection, pest & disease alerts, water stress advisory, extreme event alerts, pictorial analysis for pest and disease and remedial advisory, Gen-AI, scheme enrolment (proactive subsidy availing mechanism), schemes eligibility, cost benefit calculation and location-based services.
- FPOs/ Cultivator Groups: Unified data base of the members of each specialised groups like FIG, FPOs, FPCs etc. Sowing advisory, crop selection, pest & disease alerts, water stress advisory, extreme event alerts, pictorial analysis for pest and disease and remedial advisory, Gen-AI, scheme enrolment, schemes eligibility, cost benefit calculation and location-based services. Market linkages, market intelligence and e-commerce are main support systems for the groups.
- Department Officer's ERP: Extreme weather event service (drought & flood), season wise real time crop coverage, Crop health monitoring, crop loss reporting, carbon assessment, scheme monitoring, cost benefit calculation, big data analytics, Analytical dash boards, GIS dash boards etc
- Cultivable Waste: Identification of such lands periodically and suggesting suitable crop to increase the area under cultivation.
- APAIMS 2.0 Platform: Unified Database, Satellite Engine, GIS Engine, AI/ML Engine, Map Data Service Engine, Weather Data Engine, Model Engine and Manager, IoT Engine, GEN-AI Engine, Voice and Translation Engine.
- Integration with any Central or State existing systems: All existing systems and upcoming systems of Central, State and/or other organisations to be integrated with APAIMS 2.0.



The components have been detailed out in the subsequent sections.

## 2.5 Project details

The project aims to address specific organizational needs through a meticulously planned series of tasks, ensuring that every phase from initial assessment to final support is executed efficiently and effectively.

The project's overarching goal is to deliver a robust solution that aligns with the strategic objectives of the organization. This involves conducting a thorough needs assessment, designing a tailored solution, developing the necessary software or hardware components, rigorously testing these components, implementing the solution, providing ongoing support, and managing resources and risks throughout the project's lifecycle.

### 2.5.1 User Enabled Services

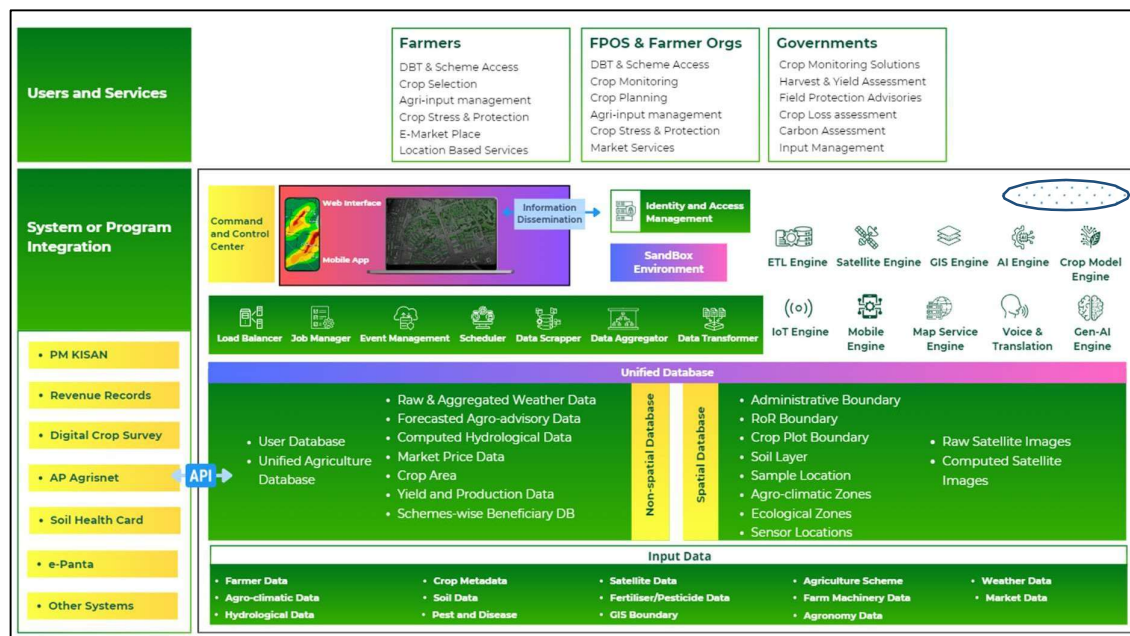
The proposed project aims to enhance various aspects of agricultural management and support stakeholders across the agricultural value chain. Through innovative IT solutions, the project seeks to address key challenges faced by stakeholders, mainly cultivators, government agencies, and agricultural businesses. Below is a detailed description of how the project is helping each stakeholder group:

- **Cultivator (Owner / Tenant):** Cultivators stand to benefit significantly from the system's user-friendly interfaces and tailored advisory services aimed at enhancing agricultural productivity, profitability, and sustainability. By accessing modules such as Sowing Advisory, Water Stress Advisory, Pest & Disease Management etc., cultivators can receive timely guidance on optimal planting times, irrigation scheduling, and pest control measures, thereby minimizing risks, increasing yields, and improving farm income. Additionally, features like Location-Based Services and Extreme Weather Event Alerts should enable cultivators to mitigate the impact of adverse weather conditions, natural disasters, and market fluctuations, enhancing resilience and ensuring sustainable agricultural practices.
- **FPOs / Cultivator Groups:** Each member of the cultivator groups shall get all the benefits and advisories similar to cultivator. In addition, the groups shall also get the information on eligibility for special central and state government schemes. They shall also get information on market intelligence and trading through e-commerce platforms. The FPO management shall be able to deliver all services duly aggregating requirements, produce availability etc., and market the produce using market intelligence through e-commerce platforms also.
- **Agriculture Department & Government Agencies:** For Agriculture Department and Government Agencies, the APAIMS 2.0 should offer a comprehensive suite of modules designed to enhance data-driven decision-making and policy formulation. The Unified Cultivator Database and Unified Database for Agriculture containing Soil, Climate, Crop, Agronomy, Pest, and Market data provide crucial insights into cultivator demographics, land use patterns, and agricultural trends, empowering department and agencies to allocate resources effectively, implement targeted interventions, and monitor agricultural

performance at regional and national levels. Modules like Crop Classification & Acreage, Crop Health, and Harvesting Assessment should enable authorities to assess crop distribution, monitor health status, crop yield forecasting and evaluate harvest outcomes, facilitating informed policy decisions, and supply chain management strategies. The bidder shall develop required modules, analytical dash boards, as requested by the department.

### 3.0 Scope of Work of APAIMS 2.0 Application Modules

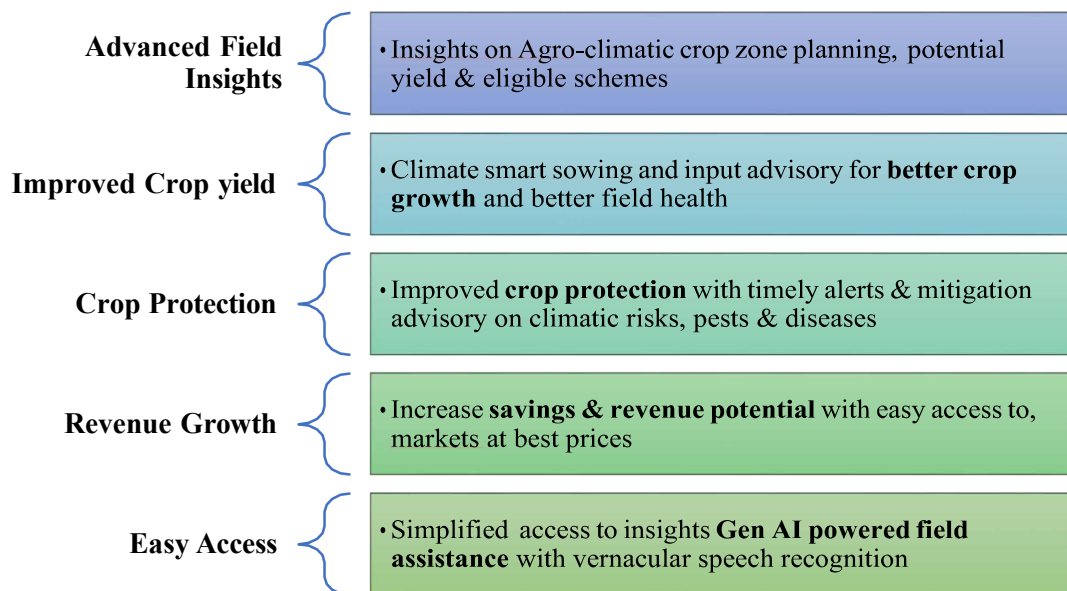
The overall data, modules, systems that should be integrated into APAIMS 2.0 for the enabled users are detailed (list is not exhaustive but inclusive) in the below diagram



### 3.1 Intended Outcome and Benefits of APAIMS 2.0

#### 3.1.1 Intended Outcomes and Benefits to Cultivators

- **Access to Schemes & Benefits:** Improve cultivators’ knowledge of and access to the schemes and benefits they are eligible for, thus reducing their burdens.
- **Improved Crop yield:** Climate smart sowing and input advisory for better crop growth and better field health
- **Risk Mitigation:** Improve crop protection with timely alerts & mitigation advisory on climatic risks, pests & diseases
- **Increase Market Access:** Increase cultivator savings & revenue potential with easy access to agri-input traders, buyers at best prices.
- **Capacity Building:** Improve cultivator knowledge on latest agriculture methods and practices with vernacular and voice enabled advisories



### 3.1.2 Intended Outcomes and Benefits to FPOs & Cultivator Organizations

- **Centralized Data Management:** Unified digital database, reducing the need for paper documentation and efforts in managing multiple information systems.
- **Improved Decision Making:** Tailored field and market insights and advisory that will enable improved crop planning, input planning and financial planning
- **Improved Market Access and Pricing:** Enable agriculture yield to be sold at the best price to agriculture traders through e-commerce platforms also
- **Efficient Scheme Access:** Access eligible govt schemes seamlessly through the platform. Monitor scheme impact and ensure disbursement of benefits amongst individual cultivators
- **Enhanced Collaboration:** Enabling transparent data driven collaboration with agriculture traders and government bodies.
- **Adoption of Sustainable Practices:** Access latest information and advisories on sustainable practices to improve resource utilization. Assess cost benefit for each crop of their stake holders, every season and take needy decisions.

### 3.1.3 Intended Outcomes and Benefits to Agriculture Department & Government Agencies

- **Data-Driven Policy Making:** The Agriculture Department in Andhra Pradesh benefits from the wealth of data collected by APAIMS 2.0, allowing for more precise and effective policy formulation and implementation through big data analytics. This can lead to better-targeted subsidies, resource allocation, and agricultural programs.
- **Efficient Programs and Schemes Management:** The department can monitor and evaluate the effectiveness of various agricultural schemes in real time, making it easier to adjust and improve them as and when needed.
- **Better cultivator Outreach:** APAIMS 2.0 serves as a direct communication channel between the agriculture department and cultivators ensuring that information about government initiatives, subsidies, schemes etc., reaches the intended beneficiaries promptly.

- Departmental Response Coordination: The Agriculture Department uses APAIMS 2.0 to coordinate responses to agricultural crises, such as droughts or pest infestations, etc more effectively.

### 3.2 One Unified Cultivator & Agriculture Database

The "Unified Cultivator (Owner / Tenant) Database" module will serve as a comprehensive, real-time repository of cultivator data, ensuring seamless integration with various government systems. The system will facilitate two-way communication and continuous data updates, while maintaining compatibility with future databases and external systems.

The unified cultivator database should contain comprehensive data of all cultivators within the state, including their identity, personal details, family information, bank account details, land records, season-wise crop data, and information on subsidies and benefits they are eligible for or have received.

Each cultivator should be identified by a unique ID, as allotted through Cultivator Registry by DA&FW, GoI, that remains consistent over time. The database should be dynamic and capable of integrating with other relevant systems to stay up to date, reflecting changes in land ownership, tenancy, and cultivation activities while maintaining the same Cultivator ID.

Below are the functional requirements of this module:

#### Data Integration from Existing Systems:

Seamless Integration with Government of India (GoI)/ State Govt Systems and other organisations:

- The system should integrate data from GoI such as PM-KISAN, PM-FBY, iFMS, iPMS, Soil Health Cards etc and systems with state-level Agriculture Department such as, e-PANTA, d-KRISHI, InSight, Annadata Sukhibhava, etc providing a unified database of cultivator information, land ownership, associated cropping patterns etc.
- The unified cultivator database should have the capability to integrate with other relevant databases as required. It should establish connections and data synchronization with systems such as scheme databases, financial systems, and other databases to ensure the database remains dynamic and up to date.
- APIs and FTP protocols shall be used to enable data retrieval and updates from multiple systems, ensuring real-time synchronization.

#### Continuous Data Updates:

- The database will be continuously updated, if possible, in real time, to reflect any changes in land ownership, tenant status, and crop details.
- Any modifications made in connected systems (GoI, Agriculture Department and other organisations) should be reflected instantly in APAIMS 2.0, maintaining a single source of truth for all departments.

#### Farmer Registry - Unique Farmer ID:

- The system should integrate with the unique individual ID (Farmer ID) generated from the Farmer Registry application of DA&FW, GoI. The generated Farmer ID and the associated bucket details should also be stored within APAIMS 2.0, ensuring easy access and tracking.
- These IDs should remain unchanged over time, updating changes in land ownership, tenancy, or cultivation details. The unique IDs will serve as a primary identifier for all cultivators.

#### Two-Way Data Communication:

- APAIMS 2.0 should facilitate two-way communication between the cultivator database and external systems. This allows APAIMS 2.0 to both receive updates from external agencies and push updated cultivator data back into other systems.
- This will ensure a real-time exchange of updated information, fostering collaboration across platforms.

#### External Agency Access:

##### Provision for External Agencies to Pull Data related to schemes:

- Authorized external agencies will have access to pull relevant cultivator, land, and crop data from APAIMS 2.0 via secure APIs, ensuring that they can integrate with the latest data for various purposes like scheme validation or service delivery.
- Access controls shall be in place to ensure that only permitted entities can access specific data sets.
- The system shall Share the necessary APIs and datasets with Real-Time Governance Society (RTGS) to facilitate integration and analytics to the RTGS projects viz., Data Lake and Data lens, as per the government orders.

#### Unified Data Source for the Department:

##### Single Source of Truth:

- The cultivator database should act as the central, unified source of all relevant cultivator and land data for the department, avoiding duplication or conflicts between various systems.
- All departmental operations, including scheme monitoring, resource allocation, and beneficiary identification, shall be powered by this single, authoritative database.
  - Historical & Current Data Tracking:
  - Tracking of benefits availed and current season tracking

#### Unified Cultivator Dashboard (Card):

- The system shall integrate data for each cultivator, including records of previous benefits received (subsidies, support programs), animal husbandry details, livestock ownership, and farm mechanization support.
- This historical tracking will help department officials make informed decisions about future schemes and resource distribution, providing a complete picture of a cultivator's past interactions.
- The cultivator's dashboard will show an integrated view on status on current schemes / benefits availed, land details, crop details, other allied agriculture activities by the cultivator etc.
- The system will also show the schemes/benefits availed by the cultivators in the current/ongoing/ previous season for the respective land, crop details.

#### Future-Proof and Compatible with Other Databases:

##### Compatibility for Future Integrations:

- The system will be designed with compatibility for future integration with other databases, ensuring adaptability as new systems or requirements emerge.
- APAIMS 2.0 will be interoperable with other evolving national or state-level systems for better data exchange and collaboration.

#### Hosting of One Unified Cultivator Database in State Data Centre:

##### Secure Hosting within the State Data Centre:

- The entire APAIMS 2.0 cultivator database will be hosted securely within the State Data Centre, ensuring compliance with government regulations and security protocols.
- No external hosting (e.g., private servers or cloud solutions) will be used, ensuring the data remains within state control and jurisdiction.

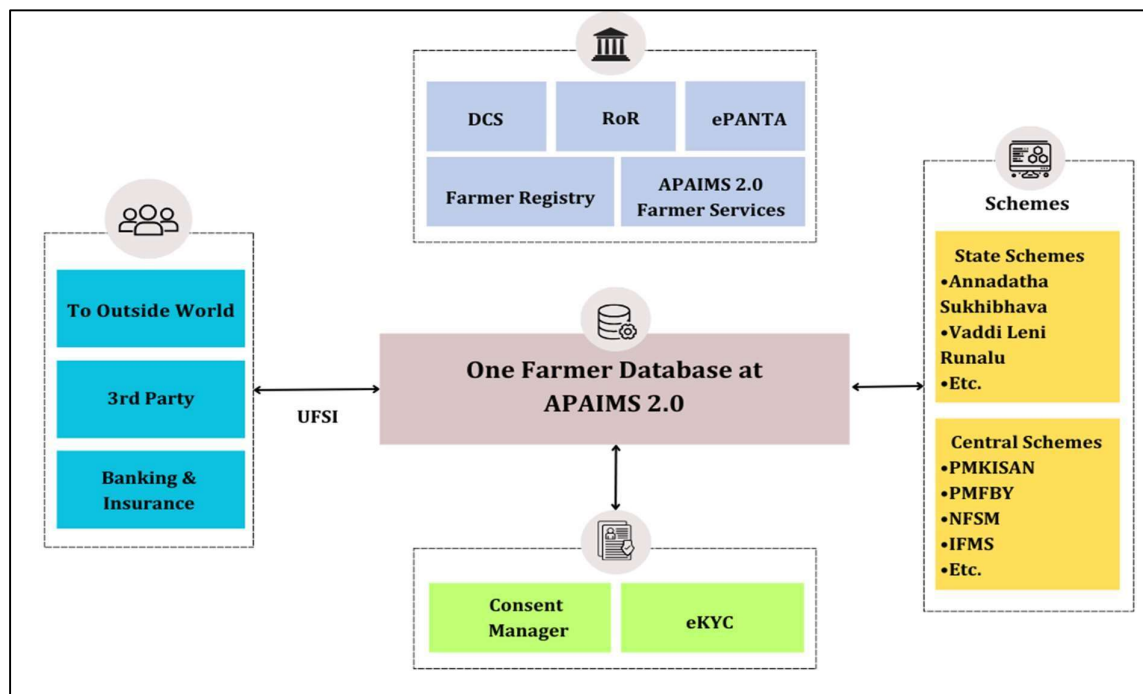


Figure 1 : One Unified Cultivator Database

#### Unified Agriculture Database:

The digital platform shall combine spatial and non-spatial data from different data sources into one unified agriculture database. This should include real-time data from sensors, data from forecast models, data from satellites, data from hydrology and crop models, data from state and central government agencies integrated through APIs, file uploads, FTP and web portals, crowdsourced data and data generated through digitization. The data related to each of these stacks may be already available in various digital infrastructure or state agriculture information systems and other Departmental apps must be pulled using APIs. The data pertaining to other fields shall be entered by the respective users based upon their authorization levels. Facility for entering profile, land, crop, asset details soil type and soil health, digital elevation model and slope shall be provided as part of registration. Data entry option to submit all his farm details along with details of interacting agencies involved in providing inputs like planting materials, machineries, equipment's, fertilizers, PPCs and credit shall be provided. Relevant financial data, Aadhar, etc should be captured in the system through APIs.

Below is a tentative list (not exhaustive but inclusive) of systems which shall be integrated:

- Pradhan Mantri Kisan Yojna (PMKISAN), Annadata Sukhibhava, Vaddileni Runalu, Farm Mechanisation etc system
- e-Panta, d-Krishi data
- Data from InSight, Performance Monitoring application
- State Specific Weather and Flood forecast Warning systems and other forecasting systems

- State specific Crop pest surveillance system if any (System to identify pest and diseases on crops)
- GoI Cultivator Registry, Consent Manager and e-KYC service

The Unified Agriculture Database shall include the following key tentative datasets:

SL. No.	Category	Sub-category	Time Period
1	Administrative boundary	Village, Mandal, Sub-Division, District, State	Static – to be updated whenever changes happens
2	Cadastral boundary	Survey Number / LP number	Static – to be updated based on RoR/RoFR
3	Cultivator database		To be updated in real time
4	Agriculture market Intelligence system		Dynamic
5	Crop data	Crop wise and growth stage wise photos	Multi-time in a season, every season
		Ground truth samples	Every Season
		Crop wise and growth stage wise master data	Every Season
		Crop wise and growth stage wise pest and disease library	Every Season
		Crop wise package of practises data	Every Season
		Crop wise and growth stage wise water requirement data	Every Season
		Historical crop cutting data and yield statistics	Every Season
6	Irrigation data	Command and ayacut boundary	Static/To be updated periodically
7	Satellite data	High resolution satellite data	Multi-time (on Demand) per season
		Medium resolution Optical and microwave satellite data	Time series (Since inception of satellite)
		Coarse resolution satellite data	Time series (Since inception of satellite)
8	Weather data (Historical, real time, forecast)	Rainfall, Temperature, Humidity, Wind speed	Historical - >100 years; real time - daily, sub-daily; forecast - next 7/ 10/ 20/40days
9	Soil data	Soil Texture at multiple depth	Static – to be updated based on soil test data

Key functional requirements of the Unified Agriculture Database are provided below:

- Data Integration: The system should be capable of integrating spatial and non-spatial data from various sources into one unified agriculture database. This includes real-time sensor data, weather stations, drone data, forecast models, satellite data, hydrology models, and crop models, data from government agencies, file uploads, FTP, and web portals, crowdsourced data, and digitized data.



- b) **Data Standardization:** The system should ensure data standardization to maintain consistency across different datasets. It should establish data models and mapping techniques to align data from various sources into a unified format for efficient storage, retrieval, and analysis.
- c) **Data Source Connectivity:** The system should have the ability to connect to different data sources, including state and central government agencies, through APIs, file uploads, FTP, and web portals. It should establish secure connections to retrieve data from each source and ensure data integrity during the integration process.
- d) **Integration with Existing Systems:** The system should integrate with various existing systems developed by both State and Central, such as the Pradhan Mantri Kisan Yojana (PMKISAN), e-Panta, d-Krishi, automation systems for agro services, marketing platforms, weather and flood forecast warning systems, crop pest surveillance systems, and other relevant systems used in the agriculture ecosystem.
- e) **Data Capture from External Systems:** The system should capture relevant financial data from external systems through APIs. It should establish secure connections with these systems to retrieve financial data of users and institutions involved in cultivation.
- f) **Data Processing**

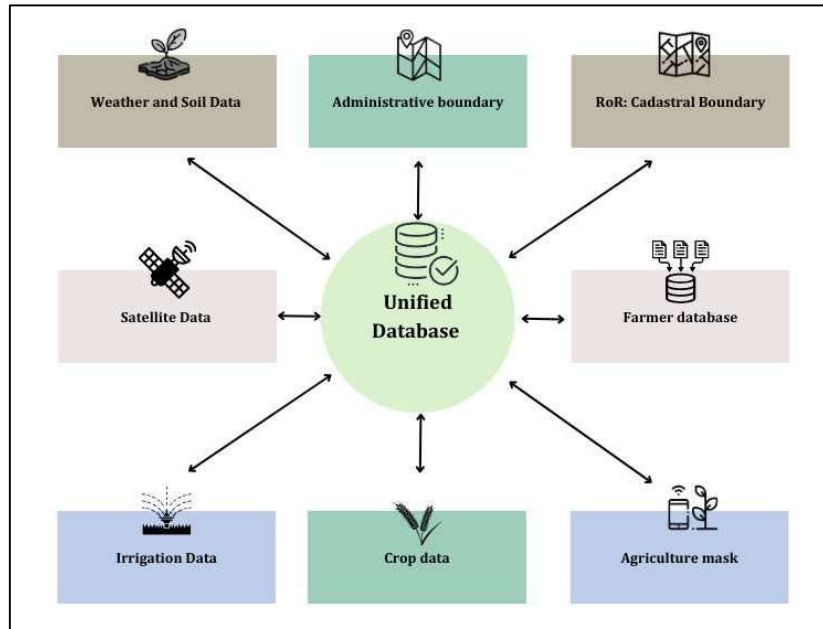
As there shall be different types of data processing based on the source of data and various steps should be taken by the processing unit to generate an output.

The types of Data processing that should be undertaken are as follows:

- Batch Processing
- Real-time Processing
- Multi-processing
- Time-sharing
- Automatic Data Processing

This module is expected to automatically download process and store various pipeline of data such as from satellite, ftp, sensors, data services etc. and its derived results.

- g) **Data Security and Privacy:** The system should prioritize data security and privacy. It should implement appropriate security measures to protect the confidentiality, integrity, and availability of the data as per the guidelines issued by the state
- h) **Scalability and Performance:** The system should be scalable to accommodate the growing volume of data and users. It should be able to handle data processing and retrieval efficiently, ensuring optimal performance even as the database expands.

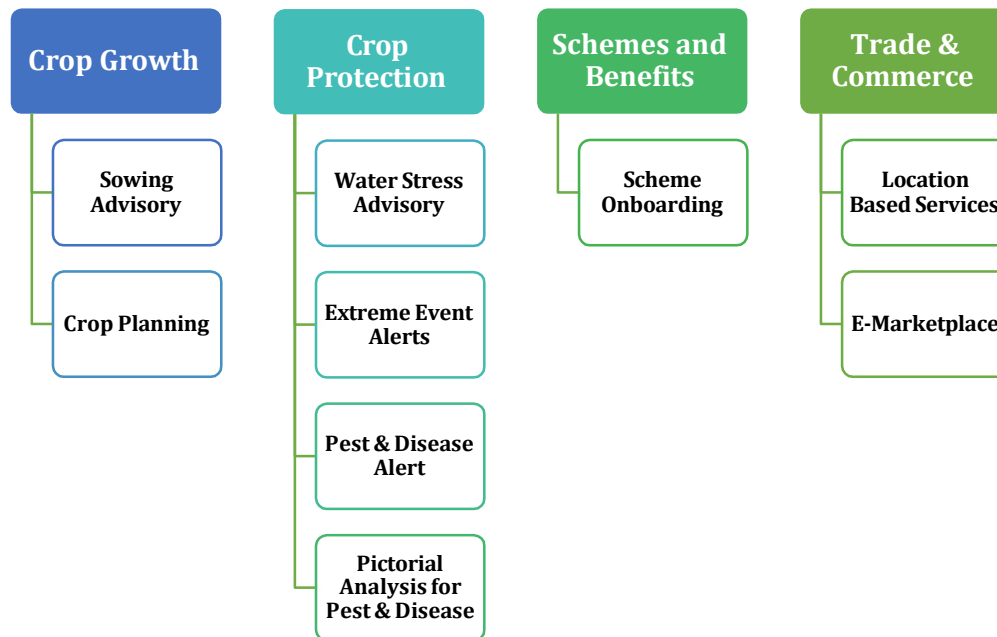


### 3.3 Cultivator (Owner / Tenant) Services:

APAIMS 2.0 should feature a unified database featuring the details of cultivators (owners and tenants). They should be able to access the application through an intuitive mobile application or through the website. Cultivators (owners and tenant cultivators) should be able to access government benefits and DBTs they are eligible for through the app, thus reducing their financial burden.

The platform should help cultivators make informed decisions on crops, sowing, and irrigation with real-time weather updates, while AI-driven pest and disease alerts enable early intervention. Additionally, it should enhance profit maximization by providing market insights and connecting cultivators with agri-traders and streamlining access to inputs and machinery.

Cultivator/ Tenant Cultivator Services



### 3.3.1 One Mobile Application for Cultivator (Owner / Tenant)

The mobile application's objective is to make one unified mobile application for the cultivators (owner/tenant). The app should facilitate the modification of the information recorded in the system and track the benefits/schemes at the field level in addition to the sharing of advisories and cultivator specific information.

They facilitate efficient resource allocation, early warning systems, and dissemination of crucial information, ultimately contributing to improved agricultural productivity, better resource management.

The mobile application should be developed which provides the following functional requirements:

- Availability in Android Play store and Apple iOS App store : The Mobile application should be available for download from Google Android Play store and Apple iOS App store.
- User authentication: The Mobile application should have login page for authentication of the user and support multifactor authentication including OTP, Bio- metric authentication, Facial recognition.

The functional requirements of the one mobile application of the cultivator module are mentioned below:

#### Consent Manager Service Integration

- APAIMS 2.0 mobile app shall integrate/implement Consent Manager system developed by DA&FW, GoI and adopted by the State, which shall allow cultivators (both owners and tenants) to provide digital consent for the usage of their personal and land-related data.

- The system shall ensure compliance with data privacy regulations, allowing users to revoke or modify consent as required.

#### e-KYC Service Integration:

- APAIMS 2.0 should be able to integrate e-KYC (Know Your Customer/Crop) services to verify the identity of cultivators, ensuring the accuracy of ownership/tenancy data and details of crops grown.
- Simplified and automated processes for cultivators shall be ensured to complete identity verification through Aadhaar/ State or Cultivator ID based e-KYC or other recognized verification methods.

#### Farmer ID Service Integration

- GOI is enabling state's cultivator registry database and creating cultivator ID for every cultivator, this Cultivator ID will be used for uniquely for providing services to cultivator and will be a dynamic database, APAIMS 2.0 will need to integrate with Cultivator ID system for validation of ID, Cultivator details and any future update into the cultivator information.

#### Cultivator Workflow in the mobile application

- Cultivators should be able to register and login to the mobile application via OTP / Facial authentication
- Cultivators should be able to obtain a detailed calendar of the package of practices to be followed from date of sowing to harvesting based on the crop/ crops registered.
- App should facilitate the dissemination of information effortlessly and with specific details of the crop the cultivator is growing.
- Cultivators should be able to use their mobile phones to register any incident or any crop health issue as soon as they noticed it in the field.
- Cultivators can take photos and videos of the Pest & Disease, or crop health issue and report crop loss in the mobile application.
- App should facilitate cultivators to check the schemes eligibility and apply for them, track the DBT process.
- App should provide information to the cultivators on current market prices for the selected crops in the nearby markets / mandis published by government agencies/reputed companies. This will help cultivators to make appropriate decisions about when and where to sell their produce.
- App should help cultivators to identify potential buyers of their produce and sell it at the right price to the trader directly.
- The mobile app should also help the cultivators regarding the information on inputs like seeds, fertilizers and pesticides availability near to their locations, by integrating with data from existing systems.

- Any other feature as informed by department.

### 3.3.2 Sowing Advisory

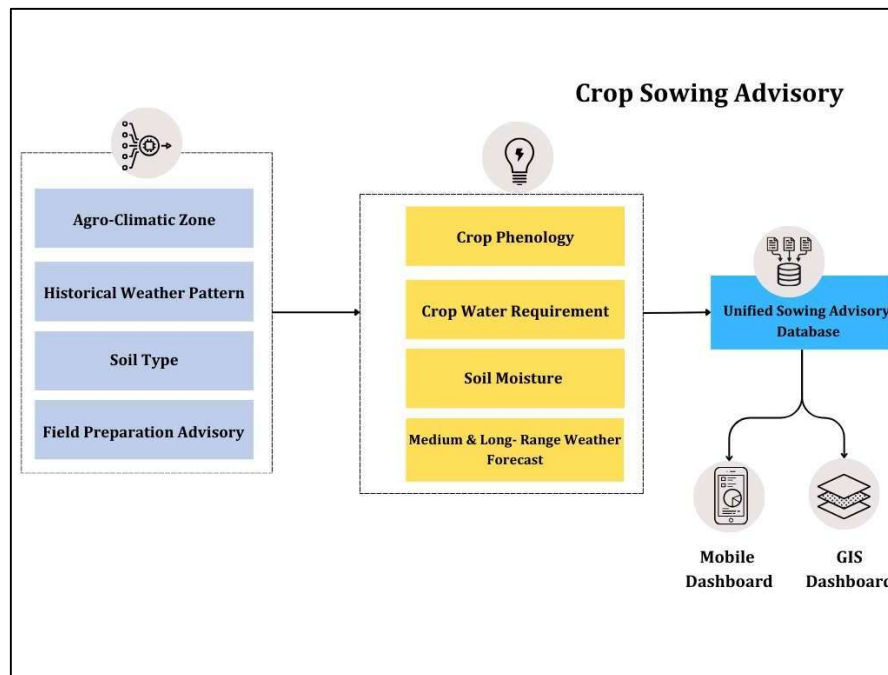
The primary objective of this module is to create a comprehensive and dynamic sowing advisory system that leverages historical weather patterns, recent weather data, long-range forecasts, crop models and real-time data to offer field-level sowing recommendations to cultivators for a selected crop. The advisories should aim to inform cultivators on a weekly / bi-weekly basis on when to sow? How to sow? Field and inputs preparatory work related to sowing? Such that cultivator gets improvement in crop success rates by ensuring that germination is enhanced, critical growth stages are aligned with favourable weather conditions, and overall yield becomes high.

The sowing advisories should be disseminated to cultivators at field level on a weekly/need basis via multi-channel, mobile application, SMS or WhatsApp for answering questions related to sowing like when to sow? How to sow? Preparatory work related to sowing?

#### Methodology of Sowing Advisory:

- The sowing advisory methodology aims to provide accurate and timely recommendations to cultivators regarding optimal sowing periods based on a comprehensive analysis of historical weather patterns, short, medium and long-range forecasts, soil moisture, and crop-specific requirements.
- The system should incorporate tools for monitoring and analyzing soil moisture and temperature data, linking this information to the sowing recommendation process considering their crucial role in the sowing decision-making process.
- System will simulate a given crop for each week in the sowing window for a village location for each season of last 30 years of daily weather data. The system during the simulation should compute:
  - ET using dynamic daily rainfall, temperature, humidity etc.
  - Root zone plant available soil moisture
  - Create water stress index as a measure of crop water requirements vs plant available water and use it to create yield and success factor for the crop.
  - With combination of success factor and yield of each year's simulation, create week wise sowing success factor for each crop at each village.
- The System should generate farm wise soil moisture values for different farms in the village using rainfall data from weather stations, and computed ET data. This soil moisture value will be used to assess germination success of sowing.
- System will make use of mid and long-range weather forecast to compute crop water stress during its critical periods.
- For each major crop in a village, the system will make use of the below to create final sowing advisories which will be relayed to cultivators
  - Week and crop wise sowing success factors

- Present Soil moisture and germination probability.
- Water stress in the critical stages of the crop life cycle.
- By identifying specific Agro-Climatic Zones (ACZ) and integrating real-time data, the system tailors' crop-specific advisories and field preparation and sowing techniques guidance or information, aligning with the most favourable sowing windows.
- Continuous monitoring and evaluation of crop success rates inform ongoing improvements to the advisory process, ultimately contributing to enhanced agricultural productivity and sustainable farming practices.



Following are the functional requirements of sowing advisory module in APAIMS 2.0:

Data sources and Integration:

- The system shall retrieve historical as well as near real-time weather data from reliable sources, such as state weather stations via APIs. There should also be a mechanism to upload data file via FTP.
- The system shall integrate weather data at regular intervals (hourly, daily, weekly, monthly) considering factors like temperature, rainfall, humidity, wind speed, and sunshine hours.

Geolocation services:

- The system shall integrate with geolocation services or databases to determine the specific location of the user or the agricultural field for accurate weather monitoring.
- The system shall also allow users to input or select their location manually.

Crop Specific Sowing Advisory:

- The system should offer crop-specific sowing recommendations based on the historical weather patterns and short, medium & long-range rainfall forecasts, taking into account temperature and other relevant climate variables, and soil moisture conditions
- The system should identify the optimal sowing window based on at least 30 years of historical rainfall and weather pattern, crop phenology data to maximize crop success and also to maximize success of seed germination, survival and crop success for any particular ACZ up to field level.
- Cultivators should receive timely advisories regarding field preparation and optimal sowing windows, considering the current soil moisture and the upcoming 10-day rainfall forecast.

#### Advisory Pattern:

- The system should provide the field preparation advisory along with best method of seed sowing for a particular crop like stripe seeding, point seeding, dibbling, drilling, and broadcast seeding etc as per the agricultural university recommendation.
- To ensure effective communication, the system should be capable of dispatching sowing advisories to cultivators on a weekly basis/ need basis across all cropping seasons (Kharif, Rabi, and Summer) through various communication channels such as mobile applications, SMS, and WhatsApp, in the local language for wider accessibility.

#### Sowing Advisory Dissemination workflow:

- Cultivators shall be able to consume data via a mobile app and a web-based dashboard designed for ease of use.
- Receive Notifications: Push and in-app notifications should inform cultivators about the sowing window of a particular crop in the field, how to sow and sowing recommendation for that crop.
- Access Advisory: Upon clicking the notification, cultivators should be directed to the advisory section within the app or dashboard, where they can view sowing advisory, field preparation advisory, soil moisture and forecast weather data etc.
- Make Decisions: Based on the advisory, cultivators shall take action, such as field preparation, sowing adjustment, or preparing for sowing.

### 3.3.3 Crop Planning

With changing weather and market demand, as well as available options for diversification, it is essential to cultivate the right basket of crops to minimize risk and maximize overall income of the cultivator. This module should consider agriculture, economic, social and climate change data to determine the most suitable crop combination for a specific area.

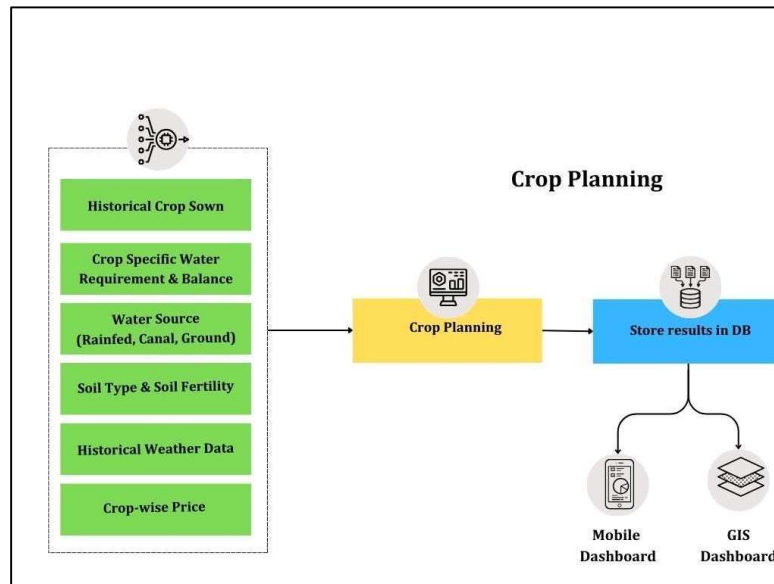
The Cultivator Earning Card which should be generated and designed to help the cultivator to optimize their crop choices based on their specific Agro Climate Zone (ACZ), soil characteristics, water availability, and market conditions. The card should provide insights on potential crops that can increase the overall income of the cultivators thereby increasing the overall Agriculture income at state level.

#### Methodology of Crop Planning:

The crop planning methodology involves a systematic approach to assist cultivators in making informed decisions regarding the selection, rotation, and management of crops to optimize agricultural productivity and sustainability. The methodology typically includes the following key components.

- Conduct thorough assessments of agro-climatic zones to understand local environmental conditions, including temperature, rainfall, humidity, and soil types, which influence crop suitability and performance.
- Conduct analysis of Crop water requirement and available water sources.
- Evaluate soil fertility, texture, pH levels, and nutrient content to ensure that crop selection aligns with soil characteristics and supports healthy plant growth.
- Analyse historical crop performance data to identify successful crops and planting schedules, considering factors such as yield, disease resistance, and market demand. Historical crop success factor in a village should be derived through simulating real weather conditions of last 30 years for every village and crop combination.
- Water availability/allocation to crops through rain, irrigation (major, medium and minor), and ground water should be considered. A wide recommendation of high-water consuming crop will starve to yield loss if aggregate crop water requirement exceeds the water availability.
- Integrate historical market demand and pricing data to align crop planning decisions with market trends and ensure the production of desired crops. Again, a wide recommendation of high earning crop will exceed the market demand and reduce the price.
- The final crop planning and its recommendations to cultivators will need to be a complex large scale multi-tier optimization that will need to consider data, constraints and objectives at multi-scale farm to region to districts.
- Crop suitability will be done at Farm scale with multi-factors of soil, weather, irrigation, market access etc
- Water availability will be required to be assessed for each farm, but its budgeting will need to be done at command area, block, or sub-basin scale.
- Market demand constraints will need to consider connectivity, demand and prices.





The requirements of this crop planning module are:

- To help the cultivators to arrive at the optimum combination of crops suitable for their fields.
- To reduce the overall risk and increase income of the cultivators with the right crop plan.
- To increase the overall agriculture GVA at state level.

The functional requirements for this module are:

- Agro-climatic and Agricultural Data Integration:
  - The system should integrate crucial agro-climatic and agricultural data like weather data, soil health indicators, market demand, and historical crop performance to provide insights into climate conditions and agricultural dynamics.
  - It should include data on temperature, rainfall, humidity, and other relevant weather parameters to support agro-ecological characterization.
- Historical Crop Pattern: It should integrate the historical cropping pattern & crop lifetime at field level, with seasonal yield to calculate the seasonal income of the cultivator.
- Water Source monitoring: The system should be able to identify available irrigation sources like Rainfed, Canal, Ground water etc.
- Crop Water Requirement: The system should be able to calculate the crop water requirement for each crop
- Crop Suitability Analysis: The system should suggest the cultivators the optimum combination of crops suitable for their fields based on parameters such as local climate conditions, soil type, water resources, source of irrigation, crop water requirement during whole season, market demand, and other relevant factors.

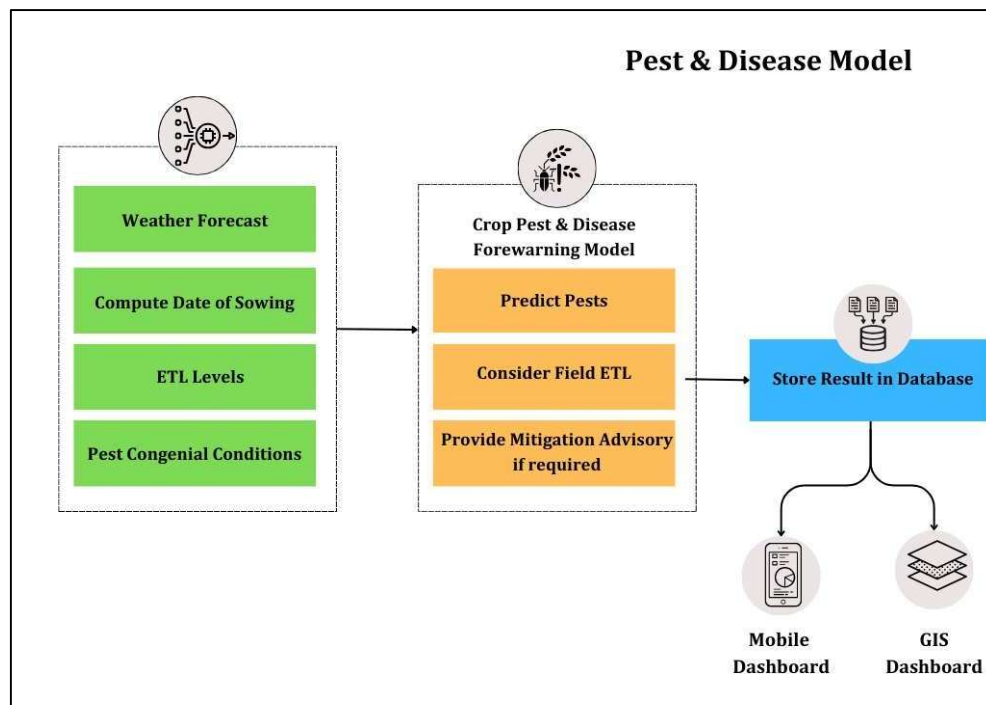
- Income Indicator: The cultivator should be informed about their potential income based on the selected crop(s) by considering factors such as estimated yield, Input costs (seeds, fertilizers, pesticides, water), Market prices (based on historical data and current trends), including seasonal price variations and demand-supply dynamics in income projections.
- The system should provide increase income analytics between normally grown crop and selected crop(s) from the suitability analysis.
- Crop Planning Dissemination workflow:
  - Cultivators shall be able to consume data via a mobile app and a web-based dashboard designed for ease of use.
  - Receive Notifications: Push and in-app notifications should inform cultivators about the crop suitability, crop plan and optimum combination of crop.
  - Access Advisory: Upon clicking the notification, cultivators should be directed to the advisory section within the app or dashboard, where they can view crop plan, recommended crop combinations, in season water availability and trend of market condition.
  - Make Decisions: Based on the advisory, cultivators shall act, such as cropping pattern, crop combination and crop suitability.

### 3.3.4 Pest & Disease Forewarning

Following are the functional requirements of Pest & Disease Forewarning module in APAIMS 2.0:

- Pest alerts module of the system should provide crop-specific advisories to the cultivators about the fields that are likely to be Pest or Disease-infested in advance of 1 to 2 weeks of time.
- The model should run in automation using AI or Rule based engines that will consider current weather patterns (Rainfall, temperature, humidity), weather forecasts, crop stages, epidemiology of pest/disease and various critical stages of the crop to generate probability of occurrence of where a pest or disease could infect the crop depending upon the favourable conditions for pest or disease to thrive.
- There should also be the Economic Threshold Level (ETL) which indicates whether an intervention is required to prevent massive economic loss. In addition to raising advisories, the solution should also specify appropriate remedial action that needs to be done to mitigate pest/disease risk.
- The model should also provide these advisories at the field level to the cultivators on weekly/need basis.
- Configurable no-code Pest & Disease setup module should be available where the Department officials will be able to add new, modify, delete the parameters related to pest or disease prediction rules.
- Cultivator will be given forewarning advisories on their mobile app, with preventive measures to be taken.

- The system shall allow capturing of actual pest & disease occurrence at field level.
- There will be mechanism built to assess the accuracy and error in the reported forewarning in spatio-temporal manners, and this will be utilized for adaptive tuning of the models.



### 3.3.5 Pictorial analysis for Pest and Disease and Remedial Advisory

The APAIMS 2.0 pest and disease detection module should integrate AI-based algorithms to automatically identify various types of pests or diseases affecting crops. This module shall leverage image recognition technology by analysing pictures of infected plants or pests captured through a mobile application. The solution should provide cultivators with real-time identification of pests and diseases based on their growth stage, crop type, and visible symptoms. The module shall be trained on a vast dataset covering multiple crops grown in Andhra Pradesh and their associated pests and diseases at various developmental stages. This AI-powered system allows cultivators to not only detect the type of infestation but also estimate whether the infestation has reached the Economic Threshold Level (ETL), a critical factor for taking pest control measures. By guiding cultivators with accurate pest identification and corresponding remedial actions, the system should minimize losses, optimize pesticide use, and promote sustainable crop management practices.

Key functional requirements of this module are:

- Image Capture and Upload:
  - Cultivators should use the mobile app's image capture feature to take photos of the affected plants or visible pests.

- The system should prompt the cultivator to specify the crop type and growth stage before uploading the image for analysis.
- The cultivator should also be able to run checks on historical inputs with access to images that were uploaded in past, and the system shall learn and provide insights on similar congenital conditions as well as remedies.
- **AI-Based Detection:**
  - The system's AI engine should process the uploaded image, identifying the pest or disease based on its symptomatology.
  - After analysing the image, the system should provide real-time feedback to the cultivator, identifying the pest or disease and its corresponding severity.
- **Advisory for Remedial Actions:**
  - Once the system shall identify the pest or disease, it should deliver detailed remedial measures directly via the mobile app, advising on treatment options including pesticide usage or other methods of control.
  - The app should provide continuous updates and follow-up actions based on the field conditions and pest dynamics.

### 3.3.6 Irrigation & Water Stress Advisory

This module shall provide real-time, crop-specific irrigation advisories that can be easily consumed by cultivators via a user-friendly mobile app and web dashboard. The module should be designed to deliver actionable insights, forecasting crop water demand, identifying critical water stress periods, and offering guidance on irrigation management, all with a clear, intuitive workflow for cultivators.

Below are the Functional Requirements of this module:

- **Seamless Workflow for Cultivators:**

Cultivators shall follow a user-friendly workflow within the app or dashboard:

- Cultivators shall be able to consume data via a mobile app and a web-based dashboard designed for ease of use.
- **Receive Notifications:** Push and in-app notifications should inform cultivators when their crops need irrigation or when crop water stress is imminent.
- **Access Advisory:** Upon clicking the notification, cultivators should be directed to the advisory section within the app or dashboard, where they can view water demand details, recommended irrigation amounts, and forecast data.
- **Make Decisions:** Based on the advisory, cultivators shall take action, such as irrigating fields, adjusting water usage, or planning for future irrigation needs.
- **Track Crop Health:** cultivators should be able to continuously track their crops' water status via visual charts on the app that show water stress levels, soil moisture data, and expected rainfall.

- Weekly and Daily Crop-Specific Advisories:
  - The system shall provide weekly/need forecasts of crop water demand and daily updates on soil moisture levels and irrigation needs.
  - Cultivators will receive actionable irrigation plans for the upcoming week, which will highlight the required amount of water for each crop at different growth stages and suggest appropriate timing for irrigation.
  - The system will recommend the water required during critical crop stress periods and shall alert cultivators to nearby available water sources.
- Historical, Real-Time & Forecast Data Integration:
  - The system shall integrate and update data daily, incorporating historical, real-time and forecasted weather data (e.g., rainfall, temperature, humidity), crop growth stages, soil physical properties (such as texture, depth, bulk density, water holding capacity etc.), soil moisture levels from hydrological models and other relevant parameters required for the soil water balance model.
  - Cultivators shall be able to view real-time changes in these parameters and track how they affect water needs for their crops.
- Evapotranspiration and Soil Water Balance Model Integration:
  - The system shall integrate evapotranspiration data and a soil water balance model to estimate crop water requirements.
  - Cultivators should receive advisories based on daily calculations of soil moisture, rainfall, temperature, and crop-specific data.
- Crop Water Requirement Calculation:
  - The system should calculate crop water requirements using the integrated soil water balance model. It should consider factors such as soil moisture levels, evapotranspiration rates, crop type, growth stage, and other relevant parameters to estimate the amount of water needed by the crop on a daily basis.
  - The system should provide projected whole season water requirement estimation, till date water requirement estimation and next one week water requirement. This advisory should be sent to cultivators on a weekly basis.
- Continuous System Updates:
  - The system shall allow for continuous model updates, incorporating new data to refine irrigation advisories over time.
  - Regular updates shall be provided to cultivators regarding improvements in weather forecasting, water source availability, and irrigation techniques.

### 3.3.7 Extreme Weather Event Alerts

The system should provide advisories to cultivators on Extreme Weather events such as Wind speed, Heavy Rainfall, Cyclone, Flood, Heatwave, Dry Spells, Drought, etc.

The functional requirements of this module are mentioned below

- Wind speed, Heavy Rainfall, Cyclone, Flood: System should integrate Weather forecast data from various sources such as IMD, ECMWF, etc. There should be a threshold value (IMD criteria) for each of the weather parameters, beyond which the alerts or advisories related to crop health, loss should be disseminated to cultivators.
- Heatwave, Dry Spells, Drought: System should integrate observed and forecast temperature, humidity, rainfall and wind speed parameters to assess the occurrence of Heatwave, Dry Spell and Drought. The system should disseminate the relevant alert and advisory to the cultivators related to Crop management.

Following are the extreme weather event and the respective agro-met advisories that the system should provide

### Flood

Flooding in agricultural fields is caused by excessive rainfall, river overflow, or the breaching of dams, which leads to waterlogging and stagnant water in the root zones of crops. This can cause oxygen deprivation to the plant roots, creating anaerobic conditions that promote root rot and other diseases. Flood events can also lead to leaching of soil nutrients, damaging crop yields and significantly reducing harvests. In low-lying agricultural regions, flood warnings are critical as they allow cultivators to take preventive measures, such as installing temporary drainage systems, relocating assets, and harvesting mature crops before floodwaters cause irreversible damage. Effective flood management helps mitigate these risks and ensures that farms can recover quickly post- event.

Workflow for cultivators:

- The system should issue real-time flood alerts using weather data from IMD and satellite imagery.
- Cultivators should receive advisories via SMS or mobile app notifications that specify the severity and location of the potential flood.
- The system should recommend flood prevention measures such as creating drainage channels or trenches to direct excess water away from crops.
- After the flood, the system should guide cultivators through recovery actions, including soil rehabilitation techniques or suggestions for replanting suitable crops.

### Heavy Rainfall

Excessive rainfall during the growing season can lead to waterlogged fields, soil erosion, and nutrient leaching, particularly nitrogen. This negatively impacts crop development, especially during sensitive phases such as flowering and fruiting. Over time, water-logged soils can damage root systems by depriving them of oxygen. In regions with poorly drained soils, this results in increased vulnerability to diseases like fungal infections. Heavy rainfall events also disrupt field operations, including sowing, spraying, and harvesting. Effective advisories allow cultivators to adjust their field management practices, ensuring that preventive measures such as improving drainage or deferring operations are implemented.

#### Workflow for cultivators:

- The system should monitor IMD forecasts and other meteorological models to detect the possibility of heavy rainfall.
- Cultivators should receive warnings with location-specific details about when and where the heavy rainfall is expected.
- The system should provide recommendations on how to protect crops, such as improving soil drainage or applying mulch to prevent erosion.
- After the rainfall, advisories should focus on recovery actions, such as applying fertilizers to replenish nutrients lost due to leaching.

#### Cyclone

Cyclones are accompanied by strong winds, heavy rainfall, and storm surges, all of which pose significant threats to coastal agricultural areas. These intense weather systems can cause widespread destruction of crops, particularly tall crops such as sugarcane, maize, and cotton. Livestock and farming equipment are also at risk during such events. Cyclones often lead to salinization of soil due to seawater intrusion, which further hampers crop growth. Timely cyclone warnings provide crucial lead time for cultivators to protect their assets, secure infrastructure, and harvest crops that are near maturity before the cyclone makes landfall.

#### Workflow for cultivators:

- The system should use real-time data from IMD and ECMWF to track the development of cyclones.
- Cultivators should receive alerts about the cyclone's predicted path, intensity, and estimated time of landfall.
- Advisories should suggest actions like securing loose farm equipment, harvesting mature crops early, and relocating livestock to safer areas.
- After the cyclone, the system should offer recovery strategies such as drainage solutions, soil treatment, and damage assessment for replanting.

#### Wind speed

High wind speeds, particularly during critical stages of crop growth such as flowering and grain filling, can cause physical damage to crops, including lodging (the flattening of crops) and breakage. In regions with dry and exposed soils, strong winds can also erode the topsoil, reducing soil fertility and moisture retention. For crops like maize and sorghum, which are susceptible to wind damage, preventive actions such as staking or creating windbreaks are essential. By providing early windspeed alerts, cultivators can take proactive measures to minimize damage and secure their fields.

#### Workflow for cultivators:

- The system should monitor wind speed forecasts from IMD and other sources, issuing alerts when critical thresholds for wind speed are expected.
- Cultivators should receive advisories specifying wind speed and potential risks to their crops.

- The system should recommend steps like erecting wind barriers, using stakes to support tall crops, or reinforcing plant structures.
- After the wind event, the system should guide cultivators on recovery measures, including how to assess crop damage or reseed if necessary.

### Dry Spells

Dry spells are periods of insufficient rainfall that do not meet the requirements for drought but still cause significant crop stress, particularly in rainfed agricultural systems. Prolonged dry spells reduce soil moisture, leading to water stress in crops during key growth stages like germination and vegetative growth. This affects crop yield and quality, particularly for moisture-sensitive crops like rice and wheat. Irrigation scheduling and the adoption of water conservation techniques become critical during such periods.

#### Workflow for cultivators:

- The system should detect dry spells by monitoring rainfall deficits and soil moisture levels.
- Cultivators should be notified of impending dry spells, receiving advice on optimal irrigation schedules and the use of drought-resistant crops.
- The system should suggest water-saving practices such as applying mulch to conserve soil moisture and minimize water usage.
- If the dry spell continues, the system should recommend alternative cropping patterns or switching to contingency crops better suited to dry conditions.

### Drought

Drought refers to an extended period of abnormally low rainfall, resulting in water shortages that affect crops, livestock, and the agricultural ecosystem as a whole. Drought conditions lead to severe soil moisture deficits, inhibiting germination, growth, and ultimately causing crop failure. Prolonged drought periods can cause irreversible damage to soil structure, making it challenging for cultivators to restore productivity without significant soil management efforts. Advanced drought predictions can allow cultivators to optimize water resources, adopt drought-resistant crop varieties, and implement soil conservation strategies.

#### Workflow for cultivators:

- The system should monitor long-term weather patterns and integrate indicators such as rainfall, soil moisture, and temperature forecasts to identify drought conditions.
- Cultivators should receive timely advisories about upcoming droughts along with recommendations for water-saving techniques like drip irrigation.
- The system should guide cultivators on switching to drought-tolerant crops and adjusting planting schedules to align with reduced water availability.
- Post-drought, the system should offer strategies for soil nutrient restoration and help cultivators with plans for re-sowing drought-resilient crops.

### Heatwaves



Heatwaves are extended periods of abnormally high temperatures, which can cause significant heat stress in crops, particularly during flowering and grain-filling stages. High temperatures accelerate evapotranspiration, depleting soil moisture and increasing water demand. Crops such as wheat, maize, and rice are particularly vulnerable to heat stress, which can lead to lower yields, grain sterility, and poor quality. Implementing heatwave preparedness measures, such as irrigation management and the use of shade structures, is essential to protect crops.

Workflow for cultivators:

- The system should monitor weather forecasts for temperature and humidity levels to predict upcoming heatwave conditions.
- Cultivators should receive alerts when temperatures are expected to rise above critical thresholds, highlighting when crops are most at risk.
- The system should provide advisories on protective measures, such as using shade nets, adjusting irrigation schedules, and applying stress-relief sprays.
- After the heatwave, the system should guide cultivators on crop recovery techniques or suggest heat-resistant crop varieties for future planting cycles.

The advisories shall be delivered through multiple channels to ensure accessibility and immediate response from cultivators:

- Mobile Application and SMS Alerts:

The system shall send notifications through a mobile application designed for cultivators, which shall present data in an easy-to-understand format. Alerts should be accessible in Telugu and English, with options for text and audio formats. In addition, SMS notifications shall be employed to ensure that cultivators in remote areas with limited internet connectivity receive timely updates.

- Dashboard for Cultivator Groups and FPOs:  
For organized cultivator groups and Cultivator Producer Organizations (FPOs), the system shall provide a dashboard that aggregates alerts at a regional level. This dashboard should allow groups to monitor advisories in real time, enabling coordinated responses such as bulk purchasing of protective materials or organizing group irrigation schedules during droughts.

- Voice-Based Interaction:

The system should include a voice-based interface in the mobile app, allowing cultivators to receive advisories by making voice queries or listening to audio alerts. This will accommodate cultivators who prefer voice communication over text, thus expanding the reach and usability of the system.

- Advisory Workflow and Response Strategy:

The workflow for advisory dissemination shall be automated and tiered, based on the severity of the weather event. It should include:

- Early Warning Alerts: When initial indicators of an extreme weather event are detected, the system shall send an early warning advisory, including recommendations for preparatory actions.
- Active Event Alerts: During the occurrence of the event, the system shall provide continuous updates and guidance to manage the situation, such as emergency irrigation for heatwaves or crop cover suggestions during heavy rainfall.
- Post-Event Recovery Advisory: After the event subsides, the system should issue advisories focused on recovery efforts, such as drainage solutions for flooded fields, replanting strategies, or soil health restoration techniques.

### 3.3.8 Gen-AI - Cultivators Helpdesk (Pilot in 2 Districts)

In APAIMS 2.0, a cultivator helpdesk is envisioned where they can raise their issues or support request such as inputs, crop management, schemes, etc., on a pilot basis in two districts selected by the department for two consecutive seasons, for all the crops in that district. Thereafter, full model is to be developed and deployed, if the pilot results are found satisfactory throughout the state.

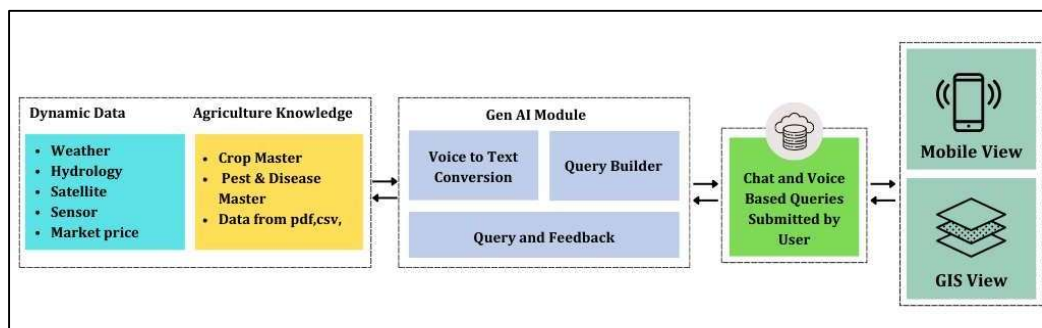
It is envisaged to make available relevant information and services to the cultivators, FPOs/Cultivator groups through the use of emerging technologies such as Gen-AI. This information should be delivered in the form of chat based in Telugu and English languages.

An interactive interface that can assist cultivators, through chat or voice-based queries shall be developed. Cultivators can request assistance through the dashboard or mobile, enabling easy access to help and support.

The response to the cultivator should be in text, voice, images, video and package of practice media, where cultivator can also download and save some of the document contents.

Some of the use cases include querying on Weather Forecast, pest/disease prediction & identification, irrigation management, getting to know market prices and various government schemes.

Initially, this module shall be developed and implemented on a pilot basis for 2 districts, as selected by the department.



The functional requirements for this module are provided below:

- **Centralized Information Access:** The cultivator's helpdesk should provide all relevant information related to crops, best agricultural practices and various agriculture schemes provided by the Central and State Government. The portal should present this information in various formats such as text, audio, image, Package of Practises (POP) videos through chat-based system in mobile application or dashboard ensuring accessibility and comprehension in the preferred language of the cultivators.
- **Interactive Query System:** Cultivators should have the capability to ask specific queries related to agriculture in Telugu and English. The system should provide an interactive query system using Gen-AI where cultivators can submit their questions and receive prompt and accurate responses from Gen-AI.

Some of the use Cases of the Gen-AI based cultivator helpdesk are mentioned below:

#### Information Access on Agricultural Practices:

##### Use Cases:

- The system shall provide cultivators, Cultivator Producer Organizations (FPOs) with comprehensive information on best agricultural practices, including crop selection, soil health management, organic fertilizers, and pesticide use. It should deliver content in text or audio formats, accessible through chat-based systems via mobile applications or web dashboards, ensuring that the information is understandable in the preferred language of the cultivators.
- For example, cultivators can ask about suitable crop varieties for specific soil types or the recommended organic treatments for pests, and the system should promptly respond with reliable and relevant advice.

#### Sample Questions:

- "What are the best practices for paddy cultivation?"
- "Which fertilizers are recommended for paddy cultivation?"

#### Sample Gen-AI Response:

- "For optimal paddy cultivation, start with thorough soil preparation, ploughing, levelling and puddling are essential. Use suitable certified seed suitable for your region. Transplant the seedlings at an appropriate age..."
- Here are Photos and videos on soil preparation and transplanting "
- "In paddy, the fertilizer recommendation will be based on soil nutrient status. In general, paddy requires 80 kg Nitrogen, 60 kg phosphorus, and 40 kg Potassium. The actual dose depends upon the soil test and duration of the crop.

#### Scheme Eligibility and Registration Assistance:

The Scheme Eligibility and Registration Assistance module shall provide comprehensive support to cultivators in discovering and enrolling in Central and State Government agricultural schemes. This module aims to assist cultivators by offering up-

to-date information on various schemes, guiding them through the application process, and ensuring they can easily access government benefits.

Use Cases:

#### Scheme Eligibility Assistance:

- The helpdesk shall provide the latest information on agricultural schemes, including eligibility criteria, application procedures, and benefits.
- Cultivators shall be able to query about specific schemes and receive step-by-step guidance on how to apply or avail of the benefits.
- The system shall assist cultivators in staying informed about newly launched programs (e.g., subsidies for Farm Implements, organic farming incentives) and updates, ensuring they can leverage government support.

#### Scheme Registration Assistance:

- The system shall facilitate the on-boarding process for cultivators seeking to enrol in government schemes, covering subsidies and support programs.
- It shall guide cultivators through each step of the process, including document submission, application tracking, and deadlines.
- The helpdesk shall ensure cultivators are kept informed about scheme deadlines, eligibility changes, and the latest benefits available under different schemes, maximizing their participation in government initiatives.

#### Sample Questions:

- Scheme Eligibility Queries:
  - "What are the eligibility requirements for the Pradhan Mantri Fasal Bima Yojana?"
  - "How can I apply for the drip Farm Implements subsidy?"
- Scheme Registration Queries:
  - "What documents do I need to apply for a farm loan under the Vaddi Leni Runalu scheme?"
  - "How can I track the status of my application for an agricultural machinery subsidy?"

#### Sample GenAI Response:

- Response for Scheme Eligibility:
  - "To apply for the Pradhan Mantri Fasal Bima Yojana, you need to be a registered cultivator with a valid landholding. The scheme provides insurance coverage for crop loss due to natural calamities. You can apply online through the official portal or visit your local agriculture office for assistance."
  - "For the drip irrigation subsidy, please find the guidelines for subsidy. You have to submit the required documents as per the guidelines"
- Response for Scheme Registration:

- "To apply for interest subversion under the Vaddi Leni Runalu scheme, you will need to submit your Aadhar card, proof of land ownership (land records), and the crop and the area sown.
- "To track the status of your application for the agricultural machinery subsidy, you can visit the official government scheme portal or mobile app by entering your credentials. Simply enter your application ID/ Cultivator ID in the 'Track Application' section. This will provide you with real-time updates on your application status, including any pending documentation or approvals."

#### Sowing Advisory Based on Weather Forecasts:

##### Use Cases:

- The system shall leverage weather data to advise cultivators on optimal sowing times for various crops. It should provide timely recommendations considering upcoming weather conditions such as rainfall, temperature, and humidity.
- For example, if a forecast indicates high rainfall, the system should suggest delaying sowing to prevent waterlogging or provide guidance on water-resistant crop varieties.

#### Sample Questions:

- "When should I sow maize for the upcoming season?"
- "Will the expected rainfall next week affect my sowing schedule for ragi?"
- "Is it advisable to start sowing paddy now, given the weather forecast?"

#### Sample GenAI Response:

- "You will get a notification through mobile app once your field is suitable to take up maize sowing. However, you sow maize 2-3 days after the expected rainfall to ensure optimal soil moisture for seed germination. Keep an eye on the weather forecast which can affect germination and establishment of the crop."
- "For Ragi, it is advisable to delay sowing until after the anticipated rainfall next week to prevent waterlogging. Consider sowing a drought-resistant variety if the dry conditions persist."
- "Yes, it is advisable to take up paddy nursery sowing since the required water is available at the time of field preparation and transplantation."

#### Pest and Disease Forewarning:

##### Use Cases:

- The GenAI helpdesk shall provide forewarning alerts for pest and disease outbreaks based on regional data and historical patterns. It should use AI algorithms to analyze climate data, pest movements, and crop conditions to predict the likelihood of infestations.
- The system should notify cultivators about potential threats, such as locust swarms or fungal diseases, enabling them to take preventive measures in advance.

#### Sample Questions:

- "Are there any upcoming alerts for pest infestation in my farm?"
- "How can I protect my crops from a predicted fungal outbreak?"

#### Sample GenAI Response:

- "In the current season you have sown, red gram in one acre. The crop is in early vegetative stage, there is a possibility of stem borer."
- "To protect your crop, Spray Metominostrobin @ 500ml/ha"

#### Visual Analysis for Pest and Disease Detection:

##### Use Cases:

- The helpdesk shall enable cultivators to upload images of affected crops for visual analysis. It should employ AI-based image recognition technology to identify pests or diseases and suggest appropriate remedies.
- For example, if a cultivator uploads an image showing yellowing leaves, the system should analyze the pattern and provide possible causes like nutrient deficiency or pest attack, along with recommended actions.

#### Sample Questions:

- "What disease is affecting my paddy plants based on the attached photo?"
- "Can you identify the pest shown in the image of my cotton crop?"
- "What could be causing the yellowing of the leaves in my groundnut field?"

#### Sample GenAI Response:

- "Based on the uploaded image of your paddy plants, the yellowing leaves could indicate a nutrient deficiency, possibly nitrogen. I suggest you to apply Urea 45 kg (Nitrogen, 20kg) to address this issue."
- "The pest shown in your cotton crop image appears to be the cotton pink bollworm. It is suggested for foliar application of insecticide formulations containing chlorpyrifos or indoxacarb to kill the moths of pink bollworm."

#### Irrigation and Water Stress Advisory:

##### Use Cases:

- The helpdesk shall offer irrigation-related advisories, including water stress alerts, based on soil moisture data and weather forecasts. It should help cultivators optimize water usage by suggesting irrigation schedules and techniques such as drip or sprinkler systems.
- In cases of anticipated water scarcity, the system should recommend drought-resistant crops or alternate watering strategies to mitigate potential losses.

#### Sample Questions:

- "How often should I irrigate my sugarcane crop during this dry spell?"
- "What is the best irrigation method for conserving water in paddy fields?"
- "Is my crop showing signs of water stress based on the current conditions?"

Sample GenAI Response:

- "You have sown sugarcane crop in light soil. Based on the rainfall forecast, you are advised to irrigate in 7-10 days interval."
- "The best irrigation method for conserving water in paddy fields is the alternate wetting and drying technique. This approach can reduce water usage while maintaining healthy crop growth."

Extreme Weather Alerts:

Use Cases:

- The system shall monitor weather conditions and provide real-time alerts to cultivators regarding extreme events like cyclones, heavy rainfall, or heatwaves. It should guide cultivators on protective measures, such as reinforcing field structures or harvesting crops early to minimize damage.

Sample Questions:

- "Is there a cyclone forecasted for my region this month?"
- "What precautions should I take for my crops with heavy rains expected tomorrow?"

Sample GenAI Response:

- "You have sown paddy during this season. Your crop is in grain filling stage. As heavy rains are expected, drain out the water in the field. Provide water outlets in each sub fields."

Agricultural Market Intelligence Assistance:

Use Cases:

- The GenAI helpdesk shall provide market intelligence, including current market prices, demand trends, and optimal selling times for various crops. It should enable cultivators to make informed decisions on crop sales, ensuring better returns.
- The system shall also assist with accessing online marketplaces, helping cultivators list their produce and navigate e-commerce platforms for agricultural goods.

Sample Questions:

- "What is the current market rate for turmeric in Guntur?"
- "When is the best time to sell my harvested groundnuts for a higher price?"
- "How do I list my farm produce on the e-marketplace?"

Sample GenAI Response:

- "The current market rate for turmeric in Guntur is ₹4,500 per quintal. Keep in mind that prices can fluctuate based on the market forecast, the prices may slightly go up in another 2-3 weeks."
- "To list your farm produce on the e-marketplace, you can create an account on the platform, upload product photos and descriptions, and set your prices. I can guide you through the process step-by-step."

### 3.3.9 Scheme and DBT Module

The central and state governments are financing several beneficial schemes for cultivators such as Annadatha Sukhibhava, Vaddi Leni Runalu, IND GAP certification, as well as PMFBY, PM-KISAN, ATMA, RKVY, AIF, and others. Direct Benefit Transfers (DBT) offer a more simplified, efficient, and expeditious flow of information and funds, ensuring precise targeting of beneficiaries while reducing the occurrence of duplication and fraudulent activities in government schemes.

In APAIMS 2.0, schemes and DBTs module, is designed to provide cultivators with access to information about enrolled schemes, their status, and eligibility for both existing and new schemes, thus streamlining the process of availing benefits under various agricultural programs

The functional requirements of this module are mentioned below:

- **System Integration:** The system should support seamless integration with diverse central and state government systems via APIs to provide cultivators with access to scheme details and DBTs information
- **User Registration:** To ensure a user-friendly experience, the system should enable cultivators to undergo a one-time registration process.
- **Enrolled Schemes Status:** The system should allow cultivators to view the status of their enrolled schemes, including whether they are sanctioned, approved, or pending.
- **Category-Wise Application Status:** Cultivators should be able to obtain category-wise scheme application statuses through the system.
- **Scheme Eligibility Check:** A search feature should be incorporated into the system, allowing users to look for schemes based on specific criteria such as name, category, or other relevant parameters and user eligibility for a scheme.
- The system should identify the eligibility of the cultivator for new schemes and send notification through mobile app so that cultivator can apply for the scheme.
- The system should facilitate the cultivators with input requirement of any eligible scheme for registration such as relevant documents, such as land records, identification, and agricultural certificates, to the designated authorities through the system.
- The system should feature a comprehensive provision, enabling cultivators to access user support and contact information on schemes.
- **Notifications and Reminders:** The System should ensure timely submission of all necessary documents and information by providing the notifications alerts to the cultivators.



- The system should provide information to cultivators to comply with the guidelines and requirements specified under each scheme to continue receiving benefits.
- The system should facilitate the cultivators that they may receive scheme-related information, notifications, or reminders via SMS, WhatsApp or in app alerts directly to their mobile phones.

### 3.3.10 Agriculture Market Intelligence and Access System for Cultivators

The Cultivator Market Intelligence module under APAIMS 2.0 shall empower cultivators to optimize their sales strategies by providing real-time market data, price alerts, and predictive insights. Cultivators shall interact with this module via a mobile app that enables them to make informed decisions regarding crop sales based on historical trends, current prices, and market recommendations.

#### Earning Potential:

- The system shall allow cultivators to view the historical average price and the Minimum Support Price (MSP) for all crops suitable for their region.
- The system should display weekly and long-term historical price data for each crop. This includes the highest and lowest recorded prices in the last 5 to 10 years
- The module shall calculate the potential revenue for the cultivator by considering key factors such as:
  - Crop acreage
  - Estimated harvest time
  - Historical price data and MSP
- This revenue estimation shall help cultivators evaluate the earning potential of different crops before making planting decisions.

#### Price Monitoring and Alerts:

- Cultivators shall be able to monitor current market prices for selected crops in real-time via the mobile app.
- The system shall enable cultivators to set price alerts for specific thresholds. Cultivators will receive push or in-app notifications when the selected price thresholds are met.
- The alerts shall be customizable, allowing cultivators to choose the frequency of notifications and the type of crops they want to monitor.

#### Market Selection:

- The system shall display nearest markets (mandis and e-market places) that are actively purchasing the cultivator's crops, along with daily or weekly price updates.
- Cultivators shall have the ability to compare prices across different markets, allowing them to select the most profitable option.
- The platform shall provide recommendations based on market trends and price comparisons, advising the cultivator on the most profitable market to sell their produce.

### Informed Decision-Making:

- The system shall present historical weekly price trends and predictive insights to help cultivators determine the best time to sell their crops.
- Forecasting models from external agencies such as Government institutes or private players shall be integrated into APAIMS 2.0 which should be used to analyze market conditions and recommend optimal selling times, aiming to maximize the cultivator's income by advising on favourable or unfavourable market conditions.
- Cultivators shall have access to graphical representations of price trends, helping them visualize the data and make more informed decisions about when and where to sell their crops.

### Recommendations for Crop Sales:

- The system shall provide real-time recommendations to cultivators on whether to hold off selling or proceed based on price forecasts and market conditions.
- The platform shall advise cultivators to take action, such as:
  - Selling immediately if prices are forecasted to drop
  - Holding onto their produce if prices are expected to rise in the near future
  - These recommendations shall be based on market data, historical trends, and predictive analytics, ensuring cultivators are equipped to make optimal selling decisions.

### Market Linkage and Access Module

As part of Market Linkage and Access, a module should be developed to connect cultivators with trade and commerce businesses. This module will enable seamless integration between APAIMS 2.0 and online trade and commerce platforms like ONDC, e-NAM etc., allowing businesses to link cultivators with wholesalers, retailers, and other relevant enterprises. Cultivators shall gain access to more markets and be able to leverage services such as transportation, price discovery, and more, offered by these platforms.

### Potential Market Linkages:

APAIMS 2.0 should integrate with available services by central govt, state govt, corporations and private enterprises, and act as a conduit for marketplaces and online businesses that offer services such as

- **Quality-Based Pricing:** Integrate applications that enable quality-based grading and pricing. Cultivators can receive higher prices for better-quality produce, creating incentives for maintaining quality standards.
- **Logistics & Transportation Support:** Businesses that provide cultivators access to transportation and logistics services through the platform, facilitating smoother and cost-effective delivery of their produce to markets or buyers.
- **Local Buyer Networks:** Businesses or marketplaces that connect cultivators to local buyers such as restaurants, grocery stores, and food processors, fostering direct relationships and cutting out intermediaries, thereby increasing cultivators' profitability.

- Traceability Solutions: Implement a traceability feature allowing cultivators to tag their produce with digital certificates of origin or quality, adding value to their products, especially for export or premium markets.

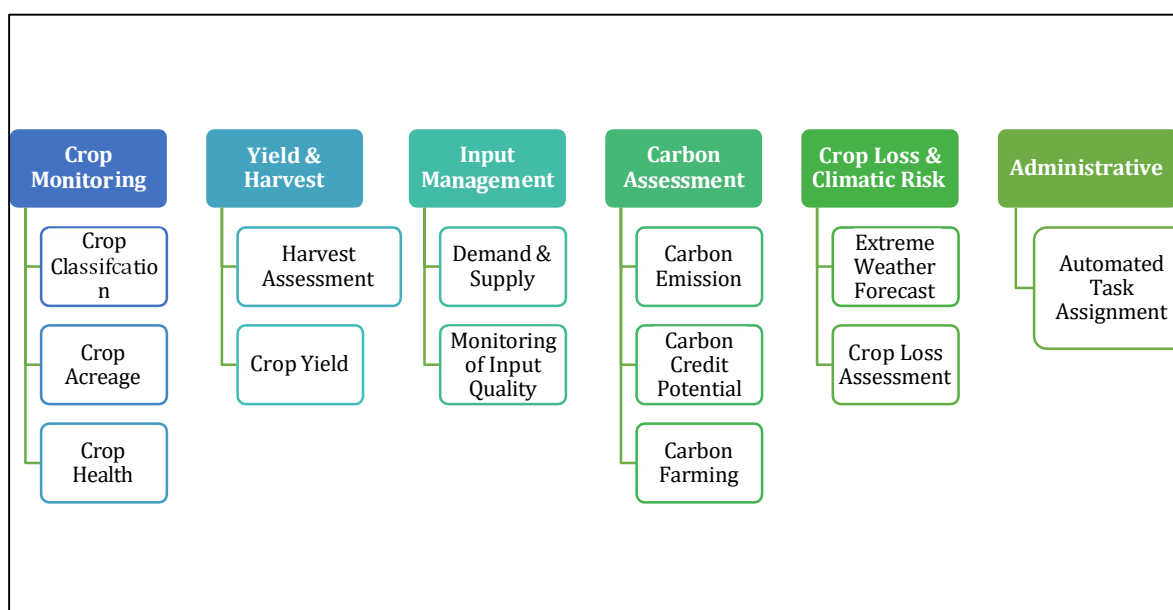
Key Features:

- API Integration: Provide APIs to integrate with trade and commerce platforms.
- Cultivator Access: Cultivators should have the option to access and register with trade and commerce businesses through APAIMS 2.0.
- Business Identification: Trade and commerce platforms should be able to identify cultivators registered via APAIMS who are selling produce required by their registered wholesalers, retailers, and other businesses.
- Enable businesses to carry out cultivator and crop verification through the platform.

### 3.4 Department Officer’s ERP:

APAIMS 2.0, as agriculture ERP, will deliver a comprehensive solution to the agriculture department officials by integrating modules like Crop Classification & Acreage, Crop Health, and Harvesting Assessment etc. Using satellite data, AI/ML algorithms, and real-time monitoring, it will offer precise crop mapping, health assessments, yield predictions, and loss analysis. The platform will support better crop planning based on soil health, resource availability, and historical yield data, empowering informed decisions and streamlined operations. Additionally, it should aid officers in on boarding cultivators into state schemes, monitor their impact, and help achieve strategic goals at both state and district levels. The system should also assess the demand of inputs like seeds, fertilizers, pesticides, bio-agents based on normal areas. It should also track the targeted samples for agriculture officers for collection, analysis and follow-up action on sub-standard samples.

Overview of the Departmental ERP Modules (Not exhaustive)



### 3.4.1 Department Official – One Mobile Application

The mobile app should facilitate the department officials to verify cultivator (tenant and owner) related advisories, their field and crop data, monitor and track the services of cultivator such as scheme applications, field visit requests, crop loss validation, report pest and disease information, etc.

The system should have Mobile applications built on technology which allows for the application to be available in Android Play store or Apple App store. The system should be developed on open-source frameworks which allows for deployment of Android and Apple IOS applications using the same code. The Mobile application should have features like geo-tagging for location identification. The Mobile application should have offline mode of operation to ensure data is saved when there is no connectivity. The data should be synced to servers once connection is available.

Following are the functional requirements of the mobile application for department officials, duly adopting/integrating/improving the existing systems:

- **Pest & Disease Data Collection:** The system should facilitate the officials at village level, mandal level to capture pest & disease related information such as location, pest or disease type, name including geo-tagged photos/videos. This data collection could include ground-truthing of system generated advisory, reported by cultivators or random data collection by the officials.
- **Crop Loss Report Validation:** The system should facilitate the officials to assess and validate crop loss reports submitted by cultivators. This involves inspecting the reported losses, assessing the accuracy of crop loss, and verifying the causes of crop damage (e.g., pests, diseases, natural calamities). The system shall also provide a workflow-based verification at village level and approval process at mandal, district level.
- **Govt. Scheme Registration Validation:** The system should facilitate the officials to verify Govt. scheme applications by cultivators. Based on the cultivator's eligibility of the various schemes, the officer can verify, approve the application of the cultivator. There shall also be a workflow-based verification at village level and approval process at mandal, district level based on the scheme category.
- **Agro Advisories:** Within the Officer Interface, the "Agro Advisory" section includes various features and functionalities related to crop stress, pest stress, date of sowing, field preparation, and extreme weather events. These components are crucial for providing valuable guidance and recommendations to cultivators. All the information shall be disseminated by the department officials at village level.
- **Announcements (Push Notifications):** Announcements or advertisements regarding various programs/ campaigns undertaken by the agriculture department can be added by the Department officials in the mobile app/portal which should be sent as push notifications or alerts to the cultivators.
- Any other, as required by the department

### 3.4.2 Departmental Process Automation and Task Management (No/Low Code)

The "Departmental Process Automation and Task Management" module in APAIMS 2.0 will streamline and automate the workflows of departmental officials across different hierarchies. This module will enable officials to efficiently assign, manage, and monitor tasks at the village, mandal, district, and state levels. It will provide tools for tracking progress, setting deadlines, managing forms, and generating reports, allowing for improved transparency, accountability, and productivity within the department.

Below are the key Functional Requirements of this module:

#### User Mapping and Hierarchical Task Assignment:

- Department officials shall be able to map users across various hierarchical levels (village, mandal, sub-division, district, and state), assigning appropriate roles and permissions based on the official's responsibilities.
- The system shall facilitate task assignment to officials at different levels, ensuring that tasks are properly distributed and tracked across the department.
- Officials shall have the capability to reassign or escalate tasks based on urgency or priority, ensuring timely execution and completion of essential departmental activities.

#### Configurable Form Creation and Template Management:

- The system shall allow department officials to create customizable forms using a no-code/low-code interface, which will be used for a range of departmental needs, such as audits, inspections, and data collection.
- Pre-designed form templates can be saved and reused for recurring processes, ensuring consistency in data collection and reporting across different hierarchies.
- Officials shall be able to modify, duplicate, and manage form templates as required, allowing for flexibility in adapting to changing operational needs.

#### Instance Creation and Task Tracking:

- New task instances can be created from existing templates and assigned to the relevant officials, with deadlines established to ensure timely completion.
- The system shall provide real-time tracking of task instances, enabling officials to monitor task status and progress across different administrative levels.
- Task instances can be duplicated or reopened for ongoing processes or revisions, ensuring flexibility for recurring tasks.

#### Time-Bound Workflow and Notifications:

- Tasks can be set with defined deadlines, ensuring that each stage of the workflow is completed within the required timeframe.
- Automated notifications and reminders shall be sent to officials to ensure deadlines are met, with alerts for approaching deadlines or delays in task completion.
- The system shall enable department officials to take immediate corrective actions if tasks are not progressing as planned, ensuring operational efficiency.

#### Audit Trails and Historical Data Access:

- The system shall maintain detailed audit trails, allowing officials to track who performed specific actions within the system, ensuring transparency and accountability throughout the task lifecycle.
- Historical data from previous tasks and forms shall be stored and made accessible for future reference, enabling officials to review past performance and make informed decisions for ongoing tasks. Data should be exportable in common formats (Excel, CSV) for further analysis or sharing with external stakeholders.

#### Role-Based Access and Permissions:

- Role-based access control shall be implemented, ensuring that officials have appropriate access to view, modify, or approve tasks based on their role and responsibilities within the department.
- The system shall allow delegation of access and permissions to lower-level officials while ensuring that overall supervision and control remains with senior department officials.

#### Real-Time Dashboards for Monitoring and Analytics:

- A real-time dashboard shall be provided to give officials a comprehensive view of all ongoing tasks, categorized by status, priority, and assigned officials.
- The system shall include both MIS and GIS dashboards across the state, district, sub-division, mandal, village level using graphical representations such as bar graphs, pie charts etc. allowing officials to monitor task progress geographically and visually. there should be GIS based heatmaps representing the data from village to mandal to district level for better visualization.
- Officials shall be able to generate detailed reports on task performance, covering metrics such as completion rates, delays, and bottlenecks, enabling data-driven decision-making.

#### 3.4.3 Crop Sowing Advisory Monitoring

The Crop Sowing Advisory monitoring module shall serve as a decision- support tool for department officers, providing actionable insights and guidance to aid in the planning and management of sowing activities at various administrative levels. This module shall enable officers to make informed decisions regarding sowing schedules, validation of suitable conditions, and preparedness for necessary agricultural inputs. It shall be accessible via a department-level dashboard, providing real-time information and resources to facilitate efficient crop management.

#### Department Official Workflow:

Department officers shall play a critical role in facilitating the crop sowing advisory, encompassing tasks such as enablement, preparation, validation, and ensuring optimal sowing conditions. Their responsibilities shall include:

- Enablement and Preparation

- Officers shall ensure that the necessary agricultural inputs (such as seeds, fertilizers, pesticides, and machinery) are made available to cultivators on time.
- They shall coordinate the distribution of inputs under various government schemes, ensuring equitable and efficient allocation based on regional requirements.
- Officers shall validate that the preparations align with government guidelines and ensure that inputs are of high quality and readily accessible to cultivators.
- Information on Sowing
  - The advisory shall provide detailed guidance on the optimal time for sowing different crops based on agro-climatic zones and regional conditions.
  - Officers shall advise cultivators on best practices for sowing, including seed treatment, spacing, and depth of sowing, to improve crop germination and yield.
  - The system shall include updates on expected sowing schedules and any deviations due to unforeseen circumstances, such as delayed rainfall or extreme weather events.
- Validation of Congenial Conditions
  - The system shall assist officers in validating whether the current conditions (weather, soil moisture, temperature) are conducive for sowing.
  - It shall utilize real-time data from weather forecasts, satellite imagery, and ground sensors to assess the suitability of the environment for specific crops.
  - Officers shall provide advisories or warnings to cultivators if conditions are deemed unfavourable, recommending postponement or adjustments in sowing practices.
- Preparedness for Inputs
  - The advisory shall support officers in assessing the readiness of agricultural inputs and ensuring their availability before sowing begins.
  - Officers shall verify that the distribution plans for inputs such as seeds, fertilizers, and irrigation equipment are in place, minimizing delays.
  - The system shall offer predictive insights to identify potential shortages or logistical challenges, allowing officers to take proactive measures.
- Dashboard for Department Level Monitoring

The department-level dashboard shall present a comprehensive view of sowing activities across different regions, offering insights into the status of sowing preparations, current sowing conditions, and input availability at different levels like village/ mandal/ district/ state.

It shall enable department officials at various levels to:

- **Near Real-time Data Visualization:** The dashboard should provide near real-time updates and monitoring on crop sowing activities across different regions village/mandal/district/state, including information on the types of crops being sown, the progress of sowing activities, and any issues encountered.
- **Weather Data:** Access real-time weather forecasts & pattern affecting sowing activities, such as rainfall forecasts, temperature variations, and potential weather-related risks along with soil moisture levels to determine the suitability of sowing conditions.
- **MIS Dashboard:**
  - The dashboard should include interactive MIS view that have the summary representation of the weekly crop sowing progress, historical sowing data, success rates across the different regions (village/mandal/district), visible through graphical representations (bar charts, pie charts, etc).
  - This should highlight the percentage of completion compared to the as on date-normal sowing, allowing officials to quickly assess the overall status of progressive sowing in the season.
- **GIS based Dashboard:**
  - The dashboard should show the GIS view of crop sowing recommendations provided by the system and the areas where crop sowing advisory should be most effectively adopted by the cultivators.
  - GIS Heat maps: Also, it should have GIS view for geographical distribution of progressive sowing in the season and allow users to drill down from state to village level for detailed information.
- **Advisory to cultivator:** The system should have the capability that department official can provide advisories or warnings to cultivators if conditions are deemed unfavourable, recommending postponement or adjustments in sowing practices.
- **Report Generation:** Generate reports and analytics on sowing trends crop wise, location wise from state to village level.

#### 3.4.4 Crop Planning for Department Officials

With changing weather and market demand, as well as available options for diversification, it is essential to cultivate the right basket of crops to minimize risk and maximize overall income. The Crop planning module will consider agriculture, soil, economic, social and climate change data to determine the most suitable crop combination for a specific area.

##### Department Official Workflow:

Department officers shall play a critical role in ensuring that the actual sowing data aligns with the Crop Planning recommendations and provides valuable feedback for analysing and refining the Crop Planning model for crop planning. Integrating this validation process within the Crop planning monitoring system can be highly beneficial. The validation process includes:

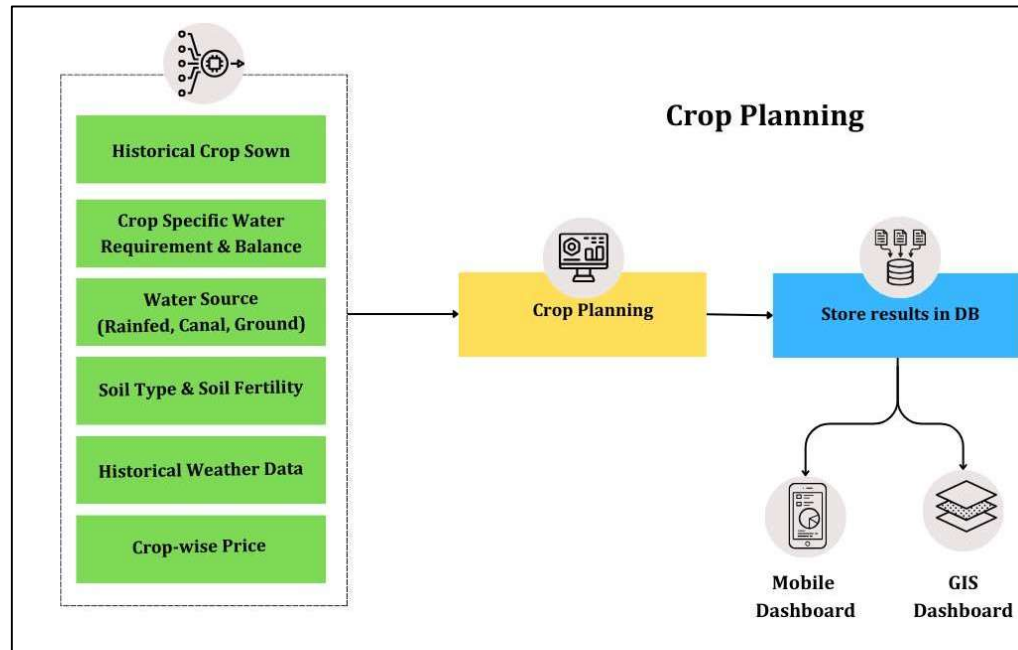


- a) Crop Planning Recommendation Validation Process: Upon accessing the Crop Planning recommendation for a particular crop in a selected village, the department staff is prompted to validate whether the actual cropping pattern aligns with the Crop Planning recommendations. The validation process allows the staff to authenticate if the cropping pattern is in accordance with the recommendations or if there is any deviation.
- b) Crop Planning Deviations: The system shall analyse and provide deviation from the Crop Planning recommendations with the actual crop-wise sown data from e- PANTA, satellite data. The system shall provide the deviations in the area, yield, and Gross Value Added (GVA) of the selected crop to the department official. The deviations from the Crop planning recommendations shall provide valuable feedback for analysing the performance of the Crop Planning model.
- c) Loop for Improvement: The system should provide enhancement on production and value by following Crop Planning recommendation so that the adaptation should be scaled up in other region by department of agriculture.

The functional requirements of this module for the Department officials are as below:

- Agro Climatic and Agricultural Data Integration: The system should integrate agro-climatic and agricultural data to provide insights into climate conditions and agricultural dynamics. It should include data on temperature, rainfall, humidity, sunshine hours and other relevant parameters to support agro-ecological characterization and regional planning.
- Agro-Climatic Zone Mapping: The dashboard should incorporate a detailed GIS map showcasing different agro-climatic zones, enabling officials to visualize and understand the unique characteristics of each zone.
- MIS Dashboard:
  - The dashboard should include interactive MIS view that provide the overview of planned crops in different ACZs, deviation in the Crop Planning recommendation based sown area from the actual area, yield, and Gross Value Added (GVA) of the selected crop, visible through graphical representations (bar charts, pie charts, tables, etc).
  - This should highlight the percentage of deviation in area, yield and GVA to the normal area, allowing officials to quickly assess the overall status of crop planning recommendations.
  - Any other features suggested by the department
- GIS Dashboard:
  - The system should have GIS view for geographical visualization of planned sowing profiles across different ACZs, progress status overlaid on a map and allow users to drill down to specific regions or zones up to village level.
  - GIS Heatmaps: The dashboard should include GIS-based heatmaps showing the geographical spread of crop planning recommendations provided by the system across village, mandal, district and state level.

- Any other feature suggested by the department
- **Crop Planning Deviations:** The dashboard should enable departmental officials to visualize seasonal crop sowing in sync with Crop Planning recommendations for different agro-climatic zones up to village level. Also, this should provide Crop Planning deviation analysis in different village/mandal/district administrative levels.
- **Customizable Reporting:** Enable users to create custom reports tailored to their specific needs, allowing for the seamless communication of key insights and data.



### 3.4.5 Crop Classification & Acreage for major 6 crops:

- The intent of this module is to provide Crop Classification and acreage estimation based on satellite data and a comparison of cropping pattern and crop acreage against the e-PANTA, Digital Crop Survey data from the department and DES (Department of Economics and Statistics) for 6 major crops in the state.
- The module should use remote sensing data to detect Crop type by developing crop signatures for the selected 6 major crops and estimate Crop acreage.
- The system should use both optical and microwave remote sensing data to determine the crop acreage estimation for different crops.
- The module will include:
  - Classify crop types sown at the farm level.
  - This information will also be aggregated to provide visibility for crop acreage at village, mandal, district, and state levels in both interactive GIS and MIS dashboards.

The functional requirements for this module are:

- **Integration of Satellite Data Sources:**

The system should integrate freely available satellite data sources such as LANDSAT, Sentinel-2, Sentinel-1, MODIS etc. It should be capable of processing satellite-specific data and utilizing different satellite image products for crop mapping.

- **Training/Ground Truth Data Collection:**  
System shall have capability to receive various ground-truth data, collected either through field surveys or by using existing high-quality datasets, as input to serve as training data for the classification algorithms. This data is expected to provide accurate locations and labels for paddy, and other crops.
- **AI/ML Algorithm for Crop Mapping:**  
The system should employ AI/ML algorithms to automatically or semi-automatically map dominant crops using satellite remote sensing data. **Classification Algorithms:** The platform shall have capabilities to apply supervised and unsupervised machine learning techniques, such as Random Forest, ANN, Support Vector Machines, kmeans etc. to classify the satellite images at field level based on the various input features and training data.
- **Field-Level Crop Mapping:**  
The system should enable crop mapping at the field-level by utilizing segmented field boundaries. It should utilize satellite data and AI/ML algorithms to accurately differentiate and classify crops within individual fields.
- **Aggregation of Crop Information:** The system should estimate crop information at higher hierarchical levels such as village, mandal, sub-division, district, and state by aggregating the field-level crop data. It should provide summarized crop maps and statistics at these levels to support decision-making and planning at various administrative scales.
- **Accuracy Assessment:** System should have the capability to validate the classification results using an independent set of ground-truth data which was not used during the training process. Capabilities to calculate accuracy metrics, shall be provided to evaluate the performance of the classification algorithm and identify areas for improvement.

Following are the major 6 crops to be tested on a pilot basis in Kharif season

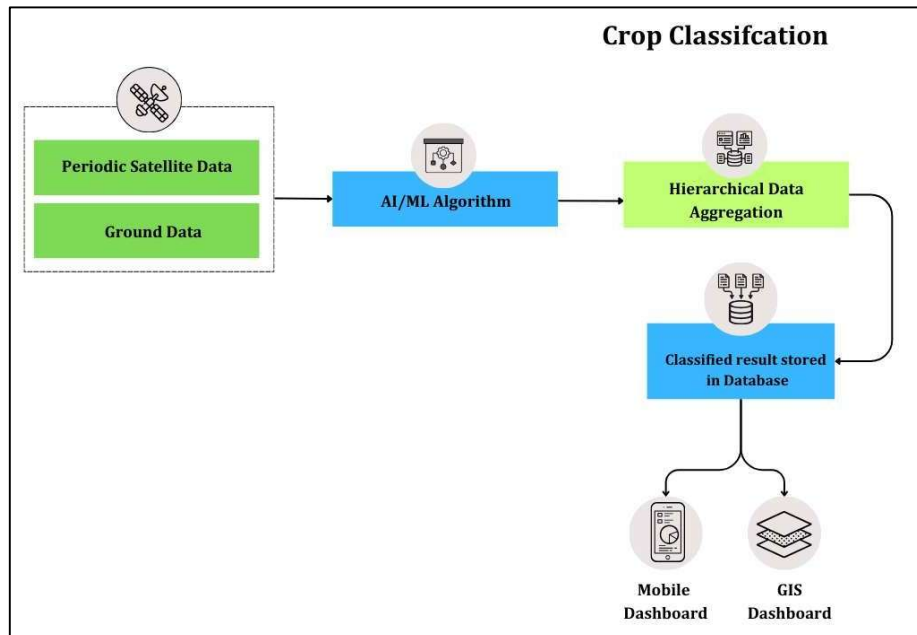
- Paddy, Cotton, Red gram, Maize, Ground nut and Sugarcane (or)
- As suggested by the department

List of 6 crops to be tested in Rabi season

- Paddy, Maize, Jowar, Bengal gram, Turmeric, and Sugarcane (or)
- As suggested by the department
- **Comparison of Satellite vs e-PantaData:** The system should be able to show the comparison of crop statistics assessed using remote sensing data with e-PANTA data that is available with the Agriculture Department.

Period of Pilot:

- The pilot shall be conducted for consecutive seasons (Separately for Kharif and Rabi) for the contract period, starting from T (issue of work order) onwards.
- The system shall develop crop signatures for the selected 6 crops in Kharif and Rabi for all these seasons duly improving accuracy every season.
- The system shall achieve minimum 80% accuracy by end of third season, (Separately for Kharif and Rabi) in respect of each of 6 major crops selected, when compared to ground truth data through Digital Crop Survey done by the department.
- The system shall achieve minimum 95% accuracy by end of last season of the contract, (Separately for Kharif and Rabi), in respect of each of 6 major crops selected, when compared to ground truth data through Digital Crop Survey done by the department.
- MIS/GIS Dashboard:
  - The system should have a user-friendly dashboard interface that allows users to easily access and interpret the crop classification results.
  - It should provide intuitive MIS dashboard showing crop distribution across District, Mandal, village level using tables, bar graphs, pie charts, tables.
  - MIS Dashboard should include various bar graphs comparison as-on date seasonal crop sown to normal areas, crop wise sown area charts, drill down from state to village level crop sown areas and other key statistics.
  - Dashboard shall also show the deviation of Pilot data from DCS data in pictorial form drill down from state to village level crop sown areas
  - GIS heatmaps shall display the dominant crop data distribution at village, mandal, district level across the seasons with the respective GIS map legends, location/season/year filter and also include search functionalities.



### 3.4.6 Pictorial Analysis for Pest & Disease Detection:

6.5.1 The AI-based Crop Photo Analytics Module shall be designed to enhance agricultural monitoring by leveraging artificial intelligence to detect crop growth stages, pest infestations, and diseases through image recognition. The system's key platform features should include building a comprehensive database of crop images, creating annotation classes for labelling crop types and risks, and training models using deep learning techniques to enhance detection accuracy. This shall enable the agriculture department to streamline its pest and disease detection processes, reduce manual intervention, and implement faster, data-driven decision-making. The module should also allow scalable model management, making it easy to update and monitor AI models for continuous improvement. Through this platform, the department shall be able to more efficiently track crop health, predict potential outbreaks, and provide timely advisories.

Below are the functional requirements of the module, duly adopting/integrating/improving the existing systems:

- **Data Upload Interface:** Department users should be able to upload crop photos to the system, tagging them with appropriate location and time-specific details for accurate analysis.
- **Data Query Interface:** Users shall be able to retrieve data using filters like crop type, growth stage, location, and time, helping them analyse crop conditions for specific regions and periods.
- **Annotation Class Creation Interface:** This interface should enable users to create predefined labels for crop types, risks, and growth stages, facilitating consistent data annotation for AI model training.
- **Annotation Generation Interface:** Users should be able to annotate crop images by labelling specific features (such as pest symptoms) using the system's built-in tools for precision and accuracy.

- Model Training Interface: Users should be able to train AI models with annotated data using this interface, adjusting parameters to improve detection accuracy.
- Prediction Interface: This should provide users with the ability to input new crop images and generate predictions on crop growth stages, pest presence, or diseases.
- Model Management Interface: This should allow administrators can upload, delete, or deploy AI models from this interface, helping to maintain model efficiency and relevance over time.

#### Workflow for the Agriculture Department:

- a) Data Collection and Annotation: Agriculture officers and field agents collect crop images and upload them through the Data Upload Interface. Each image is annotated with details about crop type, growth stage, and any visible pests. The Annotation Module ensures consistency in labelling, which feeds into the AI model training pipeline.
- b) Model Training and Deployment: Using the Model Training Interface, the system trains AI models based on annotated crop images, optimizing them for pest detection, crop growth stage recognition, and risk analysis. After validation, the trained models are deployed through the Model Manager for use in real-time prediction.
- c) Crop Monitoring and Risk Prediction: Once models are deployed, agriculture department officials can upload new images from the field. The Prediction Module analyses these images, identifying crop types, growth stages, and pest outbreaks, allowing the department to make data-driven decisions on pest management or issue advisories to cultivators.
- d) Advisory and Pest Management: Based on the AI-generated predictions, the department can provide targeted advisories to cultivators, helping them take preventive or remedial measures for crop health and pest control.

#### 3.4.7 Crop Health Monitoring for major 6 crops in each season for contract period:

Crop health Assessment and early detection of crop infestations are critical in ensuring good agricultural productivity. Stress associated with, for example, moisture deficiencies, insects, fungal infestations and nutrient deficiencies, must be detected early enough to provide an opportunity for the cultivator to mitigate. NDVI based crop health monitoring (or) any other latest data/technology should help in following ways:

- The department will specify the names of the major 6 crops to be taken for each season.
- The model shall verify the crop health across the state using satellite data
- Provide near real time crop health assessment at field and further aggregated to administrative levels.
- Provide near real time understanding of crop risks.
- Allow the officer to report field observation and do validation for reported crop health risks.
- The system shall analyse the deviations and improve the technology to achieve minimum 90% accuracy after two seasons.

The functional requirements for this module are:

- a) **Satellite Image Analysis:** The system should analyse satellite images to detect and track changes in crop growth and development over time. It should process the images to extract relevant information related to crop health, chlorophyll content, water content, and other indicators of growth.
- b) **Crop Growth Indicator Estimation:** The system should estimate crop growth indicators, such as vegetation indices (e.g., NDVI - Normalized Difference Vegetation Index, EVI - Enhanced Vegetation Index, LSWI – Land Surface Water Index), from the satellite images. These indices will provide insights into the health and vigour of the crops, helping monitor changes in growth.
- c) **Specific Crop or All Crops Assessment:** The system should offer an option to assess crop growth indicators for a specific crop or all crops. Users should be able to select the crop of interest and view the corresponding growth indicators, facilitating focused analysis and decision-making.
- d) **Aggregation at Village and Mandal Level:** The system should aggregate all the crop growth indicators at the village and mandal level. It should provide an overview of crop growth patterns and variations within these administrative units, allowing users to assess the overall crop performance in specific areas.
- e) **Visualization of Crop Growth Indicators:** The system should provide visualization of crop growth indicators on a user-friendly interface, such as graphs or maps. It should present the indicators in a clear and easily understandable format, enabling users to track and analyse the growth patterns of specific crops or regions.
- f) **Officer Field Validation Workflow:** The system shall enable designated officers to conduct field visits and report observations regarding crop health risks, such as soil moisture deficiencies, pest infestations, or nutrient deficiencies. These officers should validate the satellite-derived assessments by comparing them with real-time conditions observed in the field. This workflow should include:
  - Submission of geotagged field observations through a mobile or web interface.
  - Validation or correction of satellite-detected crop health risks based on field data.
  - Notification of discrepancies between satellite data and field observations for further investigation.
- g) **Model Correction Using Field-Reported Data:** The system shall support the correction and refinement of crop health models using the data reported by field officers. When validated field observations differ significantly from the satellite-derived crop health assessments, the system should:
  - Automatically update and recalibrate crop health models to reflect the more accurate field-reported data.
  - Ensure that future satellite image analyses incorporate corrected parameters based on field inputs.
  - Track and log all model corrections to provide transparency in the decision-making process.

### 3.4.8 Harvesting Assessment for major 6 crops (Pilot in 2 Districts)

6.7.1 This module should leverage satellite data and provide harvesting assessment periodically to identify the percentage of harvested area vs sown area of 6 major crops in the state. This will help the department to manage resources for uninterrupted harvesting.

- This should help in assessing produce inflows at various key points like purchase centres, warehouses.
- With climate forecast, it should also suggest storage options and readiness for upcoming produce.
- Should help streamline procurement process.

6.7.2 The functional requirements for this module are:

a) Integration of Satellite Data:

- The dashboard should integrate with cloud free satellite data to generate information on crop harvesting progress.
- It should leverage remote sensing technology to capture and analyse relevant data for harvested area assessment.
- The system shall process and analyse the remote sensing data based on the satellite date of pass.

b) Periodic Harvest Assessment: The system shall periodically assess crop harvesting progress, providing updates on the percentage of harvested areas. Time Series vegetation indices and spectral bands shall be utilized to detect crop harvest status. The algorithm should check for each satellite overpass date to detect harvest status in unharvested land parcels.

c) The crop harvest progression mapping methodology should involve the following steps:

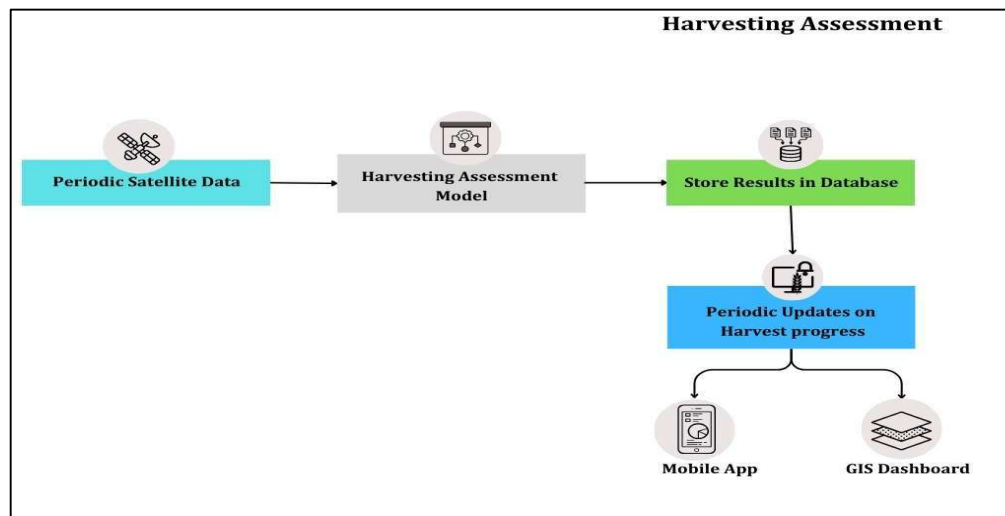
- Image Acquisition: Acquire optical and microwave satellite imagery covering the agricultural regions of interest during the harvesting season.
- Pre-processing: Pre-process the remote sensing data to correct radiometric and geometric distortions, as well as atmospheric effects.
- Image Analysis: System shall analyze the satellite imagery to identify and track changes in crop color, texture, and structure to analyse the crop maturity and readiness for harvest.
- Phenological Models: Develop phenological models based on remote sensing indices, and ground observations to estimate the stage of crop maturity.
- Harvest Progression Mapping: The system shall periodically assess crop harvesting progress, providing updates on the percentage of harvested areas. Progression of harvesting activities should be mapped at various spatial scales, such as field, village, mandal, and district levels. This mapping should provide a spatial representation of harvesting status in the region.

d) Ground Observations: Ground-based information collected through field surveys and cultivator reports should help validate and calibrate assessment remote sensing data. It should provide ground truth data about the actual progress of harvesting activities.



## e) GIS/MIS Dashboard:

- The dashboard should provide and MIS/GIS view of the periodic assessments of crop harvesting progress.
- It should update the percentage of harvested areas vs sown area at regular intervals depending on satellite data availability or overpass frequency, allowing users to track and monitor the pace of harvesting activities from field to state level.
- MIS Dashboard should display data in charts, tables of Harvested area crop wise, week wise in a particular season in a drill down view from state to village and field level.



## Period of Pilot:

- The pilot shall be conducted for consecutive seasons (Separately for Kharif and Rabi) for the contract period, starting from T (issue of work order) onwards.
- The system shall be developed for the selected 6 crops in Kharif and Rabi separately.
- The system shall achieve minimum 80% accuracy by end of third season, (Separately for Kharif and Rabi) in respect of each of 6 major crops selected, when compared to ground truth data through Survey done by the department.
- The system shall achieve minimum 95% accuracy by end of last season of the contract, (Separately for Kharif and Rabi), in respect of each of 6 major crops selected, when compared to ground truth data.

### 3.4.9 Extreme Weather Event (Drought & Flood)

Drought: This module corresponds to the automation of the drought manual that was proposed by the Central Government. This should help in identifying the areas under Early season drought or late-season drought along with either severe or moderate drought.

This DSS should use data from various agencies on weather data, surface water data, and groundwater data to show status of different metrological and Hydrological drought indices, and whether a particular location is under moderate or severe drought.

It should further provide early alerts on -

- Approaching droughts using Rainfall, Hydrological, Remote Sensing, and Crop Situation related indices.
- Drought severe ness
- Zone mapping with drought and its intensity
- Provides estimation of impacted cropped area and relative produce loss due to drought.

The functional requirements for this module are:

- a) Automation, Tracking, and Monitoring: The dashboard should automate, track, and monitor the information and processes related to extreme events such as drought as per Govt. of India Drought Manual. It should provide real-time updates and notifications on the status of drought conditions in different areas, helping stakeholders take timely actions.
- b) Identification of Drought Areas and Severity: The dashboard should use data from various agencies, including weather data, surface water data, and groundwater data, to identify areas experiencing early season drought or late-season drought. It should also determine the severity of the drought, categorizing it as either severe or moderate. This information will assist in making informed decisions and providing appropriate support to cultivators.
- c) MIS/GIS Dashboard: The dashboard should have a user-friendly MIS/GIS interface that is easy to navigate and understand. It should provide clear visualizations, intuitive controls, and personalized settings to enhance user experience and enable efficient decision-making.

MIS Dashboard should display all the Drought Mandatory and Impact parameters and drill down from state to village level. GIS heatmaps should be able to display the Drought indices as separate layers and also be able to display the early season and final drought indicators.

Display of Drought Mandatory/Impact Indices: The dashboard should display various meteorological and hydrological drought indices, showcasing the status of each index for different locations. It should present this information in a visually intuitive manner, enabling users to quickly understand the severity of drought conditions in specific areas.

Floods: The system should provide simulation as well as in-depth understanding of flood impacts on cropped areas. This should enable:

- All Flood simulation and analyze impact area.
- Estimate losses.
- Post event analysis for the field impact.
- Provide early warning advisories to cultivators and administrative staffs.

Integrate Simulated Flood Result and Impact Analysis: The dashboard should integrate flood simulation results and provide capabilities to understand flood prone areas and impacts on cropped areas. It should utilize simulation to visualize the potential effects of floods on agricultural land. This feature will assist in planning and mitigating the impact of floods on crops.

MIS/GIS Dashboard:

- MIS Dashboard should display the information about key locations that will be impacted with flood in the event of heavy rainfall, cyclone, etc
- GIS Dashboard should highlight the key areas in various categories such as red zone, yellow, orange and green zone to display the spatial and temporal representations of the Flood impact in various locations across the specific timeframe and estimate the crop loss for the respective locations.

#### 3.4.10 Crop Yield Assessment Dashboard for Major Crops (Integration)

The Dashboard of Crop Yield Assessment module in APAIMS 2.0 will connect with multiple existing systems to provide comprehensive yield data. By integrating with the Crop Cutting Experiment (CCE), YESTECH data from GoI and other available systems, the system will provide real-time and historical crop yield information to departmental officials. This will enable effective monitoring, reporting, and decision-making related to crop performance, supporting better planning and resource allocation at all levels of the department.

Functional Requirements for Departmental Officials:

##### a) Integration with Crop Cutting Experiments (CCE):

- APAIMS 2.0 shall integrate with the Crop Cutting Experiment (CCE) system and/ or other systems available with the Agriculture Department to collect and utilize data for assessing actual crop yields across different regions.
- CCE data shall be automatically updated and made available within APAIMS 2.0, allowing department officials to analyze yield results across multiple crop types and geographical areas.
- The system shall provide access to detailed reports from CCE, including information about yield variations, harvesting time, and region-specific data.

##### b) Integration with YES-TECH Data from GoI:

- The system shall integrate with YES-TECH data from the Government of India (GoI), which provides additional crop yield metrics using advanced remote sensing technology.

- Yield data from YES-TECH shall be pulled into APAIMS 2.0 in real time, allowing department officials to monitor yields across different regions and generate insights at the state, district, mandal, and village levels.
  - Officials shall have access to satellite-based yield estimates and can compare them with ground-truth data from the CCE, ensuring accuracy in crop yield assessment.
- c) MIS Dashboards for Crop Yield Monitoring:
- The system shall provide MIS dashboards that enable department officials to view real-time crop yield data from both CCE and YESTECH sources.
  - The dashboard shall offer a consolidated view of key metrics, such as:
    - Crop yield trends over time
    - Comparative analysis of normal vs. actual yields
    - Performance of specific crops in different regions across village, mandal, sub-division, district and state level.
  - Officials should be able to filter yield data by crop type, geographical area, and time period to gain deeper insights and support decision-making processes.
- d) GIS Dashboards for Spatial Visualization:
- A GIS dashboard shall allow officials to visualize yield data on a map, showing spatial distributions of crop performance across various regions.
  - The GIS dashboard shall provide heatmaps, allowing department officials to identify high- and low-yield areas based on integrated CCE and YESTECH data.
  - Officials will be able to drill down from state-level views to district, mandal, and village levels, enabling targeted interventions and resource allocation.
- e) Data Export and Sharing:
- Officials shall be able to export data from the MIS/GIS dashboards in multiple formats (e.g., Excel, PDF) for further analysis or sharing with other stakeholders.
  - The system shall support data sharing across various departments, ensuring that yield assessment information can be integrated with other agricultural planning modules within APAIMS 2.0.

F) Any other requirements from department – The system shall meet the further requirements from the department.

General conditions in using GIS software:

- Use of Open Source GIS Software: As much as possible, open-source GIS software should be utilized for this project to minimize the financial burden associated with software procurement.
- The crop classification method for each crop and other related modules should be well-documented with detailed input datasets. The methodology should be approved by the Indian Space Research Organisation (ISRO) or any authorised governmental organisation or published in a reputed research journal.
- Use of Bhoonidhi Platform: The ISRO-developed Bhoonidhi platform, which provides access to Indian satellite data, should be leveraged for downloading satellite imagery under this project. Data that is not available through this platform, shall be obtained by the bidder at their own cost.

- Geo-Spatial Data Policy - 2022: Follow the Geo-Spatial Data Policy, introduced by the Department of Science and Technology (DST), Government of India, governs the use, sharing, and accessibility of geospatial data in India. The APAIM 2.0 should refer the Geo-Spatial Data Policy.
- OGC (Open Geospatial Consortium) Standards: APAIMS 2.0 must adhere to the Open Geospatial Consortium (OGC) standards for geospatial data, services, and technologies. These international standards ensure interoperability and seamless integration across different geospatial systems. By following OGC standards, APAIMS 2.0 can facilitate efficient data exchange and collaboration between diverse platforms.

#### 3.4.11 Gen AI – Agriculture Assistant for Department Officials

The Gen AI – Agriculture Assistant module within APAIMS 2.0 is designed to serve as an advanced, interactive tool that shall assist agricultural officers at the block, district, and state levels.

The system should offer chat- and voice-based interaction, allowing officers to quickly access critical agricultural information such as weather forecasts, pest and disease alerts, seed requirements, crop loss assessments, and details about government schemes. The system should be accessible via both a web dashboard and a mobile application, ensuring seamless access to real-time data and decision support resources.

Below are the Functional Requirements of the module :

- a) Multi-Modal Interaction:
  - The system shall support both chat-based and voice-based interactions, enabling officers to submit queries either via text or voice commands.
  - The system should process these queries and provide relevant information through natural language responses.
  - The system shall support both Telugu and English to cater to all users within the department.
- b) Access to Real-Time Agricultural Data:
  - The system shall provide real-time weather forecasts, with the capability to present 7- to 10-day projections and historical weather data specific to different regions.
  - The system should issue pest and disease alerts based on current data from field sensors and regional monitoring, along with detailed mitigation strategies.
  - The system should calculate crop seed requirements, allowing officers to enter specific parameters such as field size and crop type to generate recommendations.
  - The system should provide officers with access to up-to-date information on government schemes and subsidies, including eligibility criteria and application procedures.
- c) Customizable Dashboards:
  - The system should allow officers to customize their dashboards based on their role and jurisdiction, ensuring that they have quick access to the tools and data most relevant to their responsibilities.

- The system shall generate performance analytics and insights on agricultural interventions, allowing officers to view trends and generate reports for decision-making purposes.
- Training and Knowledge Repository:
  - The system shall offer access to a dynamic knowledge repository, which should provide officers with best practices, guidelines, and training materials related to crop management, pest control, and other agricultural activities.
  - The system should allow officers to escalate queries to human experts when required, recommending relevant experts based on the context of the query.
- AI-Powered Decision Support:
  - The system shall analyze historical data and current trends to offer predictive insights and risk analysis, enabling officers to proactively manage potential risks such as pest outbreaks or adverse weather conditions.
  - The system should support scenario modeling, allowing officers to simulate various conditions (e.g., delayed sowing, drought) and receive predictions on their potential impact on crop yields.
- d) ERP Integration:
  - The system shall be fully integrated with the department's Enterprise Resource Planning (ERP) system to ensure seamless data exchange, synchronization, and reporting.
  - The system should pull relevant data from the ERP for monitoring and evaluating officer performance, tracking scheme implementation, and generating insights on agricultural trends.
- e) User Feedback Mechanism:
  - f) The system shall include a feedback mechanism that allows officers to provide input on the performance of the AI assistant, ensuring continuous improvements to the system's accuracy and usability.

Following are some of the required use cases for GenAI – Agriculture Assistant for Department official :

(i) Weather-Based Advisory and Crop Planning

Use Case:

- The AI assistant shall offer weather-based insights to assist officers in advising cultivators on the best agricultural practices. Officers shall use these insights to optimize sowing, irrigation, and harvesting schedules based on weather forecasts, such as rain, temperature fluctuations, and extreme conditions.
- The AI Assistant should provide officers with real-time forecasts and agricultural advisories, suggesting the best practices based on upcoming weather, such as adjusting sowing dates, scheduling irrigation, and recommending protective measures against extreme weather.

### Sample Questions:

- "What should be the weather conditions expected in the Krishna district for the next 10 days, and shall I recommend delaying sowing activities?"
- "How should cultivators prepare for the predicted cyclone in the coastal regions?"
- "Shall we advise additional irrigation for wheat due to an expected dry spell next week?"

### Sample Gen-AI Responses:

- "In Krishna district, expect intermittent rain and mild temperature changes over the next 10 days."

### (ii) Pest and Disease Monitoring

#### Use Case:

- The system shall monitor pest and disease data collected from field sensors, satellite imagery, and regional reports. It should issue alerts to officers when pest infestations or disease outbreaks are detected, providing details on affected areas, the severity of outbreaks, and recommended control measures.
- The AI assistant should utilize data from various sources to identify early warning signs, offer pest and disease management strategies, and prioritize measures like biological controls or chemical treatments, depending on the severity.

### Sample Questions:

- "Shall we issue a pest alerts based on current conditions?"
- "How should we manage fungal disease risks in this plantation during the monsoon season?"

### (iii) Seed Requirement Estimation

#### Use Case:

- Officers shall use the AI assistant to calculate seed requirements for different crops based on factors such as field size, soil quality, and crop variety. The system should also consider seed availability and recommend alternatives if needed.
- The AI Assistant should provide accurate seed requirement estimations, recommend appropriate seed varieties, and suggest alternative planning in case of shortages or regional preferences.

### Sample Questions:

- "What should be the recommended seed variety for a saline soil region, and how much should be allocated?"
- "Shall we increase the supply of drought-resistant paddy seeds for the upcoming kharif season?"

### (iv) Crop Loss Assessment and Compensation

#### Use Case:

- The system shall assist officers in evaluating crop loss due to natural calamities, pest infestations, or diseases. It should enable accurate loss estimation and facilitate the processing of compensation claims by providing eligibility criteria, required documentation, and suggested compensation amounts.
- The AI Assistant shall help officers streamline the compensation process based on predefined government guidelines.

Sample Questions:

- "What should be the compensation rate for crops damaged by heavy rains?"
- "How shall we assess the crop loss due to a drought that affected multiple villages?"
- "Shall we start the compensation process for cultivators affected by the recent hailstorm?"

#### (v) Accessing Information on Government Schemes

Use Case:

- The AI assistant shall provide detailed information on various government agricultural schemes, including subsidies, grants, insurance programs, and developmental projects. Officers should be able to use this information to guide cultivators on scheme benefits, eligibility, and the application process.
- The AI Assistant should deliver accurate and up-to-date information on schemes, eligibility criteria, benefits, and documentation requirements, helping officers effectively communicate with cultivators.

Sample Questions:

- "What subsidies shall be offered for organic farming practices in this district?"
- "How should cultivators apply for crop insurance under the Pradhan Mantri Fasal Bima Yojana?"

#### (vi) Performance Monitoring and Reporting

Use Case:

- Officers shall use the AI assistant to track the performance of agricultural programs, monitor the adoption of new technologies, and generate reports for higher authorities. The system shall provide real-time data, analytics, and insights to support program evaluation.
- The AI Assistant shall pull data from integrated systems, present analytics, and generate performance reports that facilitate data-driven decision-making.

Sample Questions:

- "How shall we track the progress of soil health card distribution across different districts?"
- "What should be the key findings from the adoption of micro-irrigation techniques over the past year?"
- "Shall we prepare a report on the success rate of pest management initiatives?"



### 3.4.12 Scheme & DBT Monitoring and data collection.

The "Scheme Monitoring" module aims to facilitate the efficient tracking and management of both Central and State schemes at multiple hierarchical levels, from village officials to state administrators. The system shall develop required modules for digitisation of all activities, including digital payments, of the department at present and during the contract period also, as per respective scheme guidelines. The system shall also provide necessary interfaces for collection of data from different field officers, as and when requested by the department. The system shall meet all the digital requirements of the department during the contract period. The data obtained from these modules shall be integrated and maintained in unified data base for future references.

The system will provide real-time insights into scheme performance, beneficiary tracking, and compliance using MIS-GIS dashboards and other analytical tools. This module will enable comprehensive monitoring and management of various Agriculture Schemes including Annadatha Sukhibhava, Vaddi Leni Runalu, PMKISAN, Cultivator Suicide Compensation, Inputs Subsidy, and Farm Mechanization Subsidy etc., Integrated into a Departmental ERP system, it will offer real-time tracking, reporting, and workflow management through both mobile and desktop platforms. The department officials should have a dashboard to monitor the status of schemes implementation.

Some of key features of this module are mentioned below:

- Maintain Scheme Master for State and Central schemes
- Role-based access facility for various department officials
- Manage workflow for department officials to monitor the scheme applications, verifications and approval.
- The system should provide a user-friendly dashboard for officials to monitor scheme accessibility and status of cultivators availing the schemes.
- The system should provide Reports in a MIS/GIS dashboard with scheme-based report in the form of graphical, charts, tables and map representation.
- The system should perform the impact assessment of each scheme in terms of implementation, production and productivity.

Below are the detailed functional requirements of the module:

#### a) Departmental Workflow Management:

##### Scheme Application Verification:

- Officials across various levels (Village, Mandal, District, and State) should access the system via a mobile app/ web application and dashboard allowing them to monitor and manage scheme activities on the go.
- Automated workflows should guide officials through the process of verifying beneficiary details, approving subsidies, and ensuring compliance with scheme guidelines.

- Each scheme (e.g., Annadatha Sukhibhava, PMKISAN) should have predefined workflows for approvals, verification, and disbursement of benefits.
  - Task Assignment & Notifications:
    - Tasks related to scheme monitoring, such as verification of cultivator data, approval of applications, and field inspections, can be assigned to officials at various levels.
    - The mobile app shall send push notifications to users regarding pending tasks, upcoming deadlines, and alerts for issues like delays or non-compliance.
  - Offline Functionality:
    - The mobile app will support offline data entry and sync capabilities, allowing officials to work in areas with limited connectivity. Once reconnected, the data will automatically sync with the central system.
  - Digital payments – The system shall support payments to the department, in implementation of different schemes, through digitally using the UPI platforms, integrated into the system.
  - The system shall also design and develop a comprehensive HRMS module for registration of all the permanent, contract, temporary employees of the department and perform all HR activities viz., leaves, transfers, disciplinary actions etc., digitally. Dashboard and MIS reports are also to be enabled as required by the department.
  - The system shall also design and develop a comprehensive financial module for monitoring the funds receipt, distribution and expenditure etc., under various state and central governmental schemes. Dashboard and MIS reports are also to be enabled as required by the department.
- b) Data Entry and Beneficiary Management:
- Scheme-Specific Data Entry:
- Village and Mandal level, subdivision level and district level officials should able to enter data for each scheme (e.g., farm mechanization- total scheme implementation process workflow, (total solution to the department) subsidy details) via both mobile and desktop interfaces.
  - Beneficiaries can be selected based on pre-set eligibility criteria, and officials can upload supporting documents, such as land records or bank details.
- Village-Level Data Entry:
- Village-level officials should input data for various attributes related to schemes, such as progress status, resource allocation, and usage.
  - Fields official should include details about scheme beneficiaries, such as cultivators, households, or other target groups, and their eligibility for different schemes.
  - Beneficiary data entry should include fields for personal details, scheme enrolment status, benefits received, and other relevant indicators.
  - Ability to select or assign beneficiaries based on predefined criteria (e.g., landholding, income, etc.).

#### Beneficiary Tracking & Verification:

- Real-time tracking of beneficiary approval status, payments disbursed, and pending applications.
- The mobile app should allow officials to verify beneficiary details (e.g., crop details for Inputs Subsidy or machinery purchase for Farm Mechanization Subsidy) in the field.

#### c) Dashboards for Analytics and Reporting:

##### Real-Time Monitoring & Data Visualization:

- An intuitive dashboard should be available on both the mobile app and desktop to visualize scheme progress, disbursement rates, and beneficiary reach across various regions (village, mandal, district, and state).
- Each scheme (e.g., Cultivator Suicide Compensation, Vaddi Leni Runalu, etc) should have its own set of KPIs, visible through graphical representations (bar charts, pie charts, etc.).

##### GIS-Based Heatmaps:

- The dashboard should include GIS-based heatmaps showing the geographical spread of scheme beneficiaries and the areas where schemes like Annadatha Sukhibhava and PMKISAN are most effectively reaching cultivators.
- Heatmaps should visually highlight underperforming regions where scheme coverage is low (marked in red) or on-target areas (marked in green).

##### Scheme Comparison & Drill-Down Analytics:

- Officials can compare the performance of multiple schemes in real-time (e.g., Annadatha Sukhibhava vs. Inputs Subsidy) and drill down from the state level to village-level data to assess regional effectiveness.
- Filters can be applied to view performance based on criteria such as financial disbursement, number of beneficiaries, or scheme-specific milestones.

#### d) Automated Reports & Alerts:

##### Automated Reporting:

- The system should generate periodic reports summarizing scheme performance, financial disbursements, and compliance status.
- Reports can be exported in various formats (Excel, PDF) for further analysis or sharing with other stakeholders.

#### e) Centralized Scheme Data Repository:

##### Unified Database for All Schemes:

- APAIMS 2.0 should act as a central repository for all schemes, integrating data from multiple sources (e.g., Government of India databases, state agriculture departments).

- Historical data, such as past benefits received by cultivators, should be available for each scheme, ensuring that officials have full visibility of a beneficiary's history before approving further disbursements.

#### Continuous Data Synchronization:

- Real-time updates and synchronization across mobile and desktop platforms will ensure that scheme data is always up to date, and any updates made at one level (village or district) are immediately reflected across the system.

### 3.4.13 Crop Loss Reporting & Workflow

The Crop Loss Reporting and Workflow module shall leverage advanced remote sensing technology, AI/ML algorithms, and manual mobile workflows to provide a comprehensive solution for assessing crop loss due to adverse weather conditions. The system shall enable accurate and timely loss estimation, allowing for faster processing of cultivator support, conflict resolution among stakeholders, and resource efficiency in the assessment process. It will integrate both satellite-based and field-level data to deliver detailed insights into the extent of crop damage or loss. The output shall not be academic in nature to department, but should be implementable in field, without manual survey (or) ground truthing.

The system should help in:

- Save time and resources for the extensive task of loss estimation
- Eliminate conflicts between stakeholders
- Faster processing of support to the cultivators
- Image based crop detection and damage assessment: AI-based automatic identification crop types shall be implemented on the platform. This solution shall provide the name and growth stage of crop by analysing the mobile-based captured image of crop leaf and plant structure.
- Further, Abiotic damage assessment such as waterlogged, drought or water stress shall be carried out by pictorial analysis using mobile captured photograph to assess crop loss. AI models shall be trained using a wide range of crops and at multiple growth stages. Image-based crop identification using AI involves leveraging machine learning algorithms and computer vision techniques to accurately detect, identify, and classify crop types in images.

The functional requirements for this module are:

a) Satellite Assessment vs Field Reporting: The system shall utilize a hybrid approach to crop loss estimation, combining satellite-based remote sensing data with ground-level field reporting to ensure accuracy and reliability in assessments.

- Satellite-Based Assessment: The system shall use satellite imagery to monitor large agricultural areas and assess the impact of weather events such as droughts, cyclones, floods, and other extreme conditions. Remote sensing data shall provide insights into affected areas by detecting variations in vegetation health, crop growth stages, and

water stress levels. The system shall automatically analyze this data to identify patterns that indicate crop loss.

- **Field-Level Reporting:** In addition to satellite data, the system shall enable department officials field-level reporting through manual data collection using the APAIMS 2.0 mobile application. Officers and cultivators can capture images of crops directly from the field, which the system shall then process to assess the extent of damage. This method will allow validation and cross-referencing of satellite data, ensuring a more precise loss estimation.
- The integration of both satellite and field-level reporting shall enable the system to reconcile discrepancies and generate a holistic view of the crop loss, thereby enhancing the credibility of the loss assessment process.
- The system shall not remain as only a academic report and should be improved subsequently, thus reducing and then completely eliminate the filed level reporting, by mid of the contract period.

#### AI-Based Crop Detection and Damage Assessment

- The module shall incorporate AI-based automatic detection and damage assessment capabilities, significantly improving the efficiency and accuracy of crop loss estimation.
- **Image-Based Crop Damage Assessment:** The system shall employ AI-powered image recognition techniques to automatically identify crop types and growth stages using images captured via mobile devices. This feature shall help in understanding the impact of weather events on different crop stages, facilitating targeted damage assessment.
- **Damage Assessment for Abiotic Stress:** AI algorithms shall be trained to assess damage caused by abiotic stressors such as waterlogging, drought, or water stress through pictorial analysis. The system shall analyze images captured in the field to detect signs of stress, such as discoloration, wilting, or abnormal growth patterns. This AI-driven approach shall ensure consistent damage assessment across various crop types and conditions, providing an accurate estimation of losses.
- The system shall not remain as only a academic report and should be improved subsequently, thus reducing and then completely eliminate the filed level reporting, by mid of the contract period.

#### Manual Mobile Workflow

The system shall support a manual mobile workflow to complement automated processes, enabling on-ground officers to participate actively in crop loss assessment.

- **Data Collection via Mobile App:** Officers and cultivators shall use a mobile application to capture real-time photographs of the affected crops. These images shall be uploaded to the system, where AI models shall process them to determine crop types and assess the extent of damage. The mobile app shall provide an easy-to-use interface for submitting reports, tracking submission status, and viewing assessment outcomes.

- **Validation of Remote Sensing Data:** The field data collected through manual mobile workflows shall serve as a validation layer for satellite-based assessments. The system shall compare the data from remote sensing with the manually collected field reports to identify any discrepancies and refine the final crop loss estimates. This approach shall enhance the accuracy of the overall assessment.
- **Workflow Management:** The system shall provide a streamlined workflow for officers, enabling them to assign tasks, validate reports, and escalate cases if required. The mobile app shall facilitate communication and coordination among stakeholders, ensuring timely action and efficient management of crop loss reporting.

#### Key Features and Functionalities

- **Remote Sensing Data and AI/ML Integration:** The system shall integrate remote sensing data with AI/ML capabilities to assess crop area and detect damage. This integration will facilitate rapid and accurate estimation of crop loss, minimizing/eliminating the need for extensive manual efforts.
- **Extreme Event Impact Assessment:** The system shall assess the impact of extreme weather events on crops using remote sensing data, providing insights into the extent of crop damage or loss, without field verification, for quicker response measures.
- **Automated Loss Estimation:** By automating the loss estimation process through AI-driven analysis, without field verification, the system shall save time and resources, providing stakeholders with reliable data for decision-making.
- **Event-Specific Analysis:** The dashboard shall offer insights into crop loss associated with specific weather events, enabling users to understand the impact on different crops and regions.
- **User-Friendly MIS/GIS Dashboard:** The dashboard should have an intuitive and user-friendly interface that is easy to navigate and understand. It should provide interactive visualizations, graphs, and maps to present weather conditions and crop loss data in a clear and concise manner.
- The system shall provide real-time monitoring and reporting of crop loss due to weather conditions. Users should be able to access up-to-date information on crop damage, enabling timely decision-making and response.
- The dashboard shall have GIS technology enabled to provide spatial analysis and visualization of crop loss patterns. GIS capabilities should allow users to view and understand the geographic distribution of crop loss, aiding in targeted support and assistance.
- The dashboard should offer role-based access to different agricultural officials or stakeholders. Access permissions shall be customizable to ensure data privacy and security.
- The dashboard shall have data export and generate comprehensive reports for further analysis and documentation purposes.

### 3.4.14 Carbon Assessment (Pilot for 2 Districts)

The objective of farming the carbon module is to:

- increase the economic value of the state's natural assets
- increase the resilience of the agricultural industry with improved soil health
- help economic diversification and additional income to cultivators
- meet greenhouse gas reduction targets

This module shall be done on a pilot basis for all crops in 2 districts as selected by the Agriculture Department.

- **Carbon Emission:** A carbon emission dashboard should be made available that will estimate, identify and display a heat map of agriculture carbon emission in the state. Crop-specific carbon emission potential data, as well as crop type maps should also be used to estimate cropland carbon emission hotspot maps.
- **Carbon Credit Potential:** Each crop in combination with different crop management practices (such as sowing method, choice of fertilizer, amount of fertilizer etc.) has a different potential to sequester atmospheric carbon in soil through plant photosynthesis activity. The dashboard should display the state's cropland carbon credit potential heat map. To estimate the amount of carbon that can be sequestered, crop specific carbon sequestration potential should be used.
- **Carbon Farming Monitoring DSS for Pilot region:** In accordance with the state departments' vision, a pilot study should be conducted in which climate smart and carbon sequestering methodologies and practices should be adopted. This DSS should use Data entry from the field, IoT Sensors, Satellite data and scientific models to validate methods and practices and quantify carbon sequestration.

The functional requirements for this module are:

- a) **Data Integration:** The system should integrate relevant data sources such as field data, and crop-specific carbon sequestration potential data. It should ensure seamless data integration to provide accurate and up-to-date information for carbon farming assessment.
- b) **Carbon Emission Dashboard:** The system should provide a user-friendly carbon emission dashboard that estimates, identifies, and displays a heat map of agriculture carbon emissions by utilizing crop type map of the state. It should utilize crop-specific carbon emission potential data and crop type maps to estimate cropland carbon emission hotspot maps.
- c) **Carbon Sequestration Potential Dashboard:** The dashboard should display the state's cropland carbon sequestration potential heat map. It should consider different crops and crop management practices (e.g., sowing method, choice, and amount of fertilizer) to determine the potential for sequestering atmospheric carbon in the soil through plant photosynthesis activity. It should utilize crop-specific carbon sequestration potential data to estimate the amount of carbon that can be sequestered.

- d) Carbon Farming Monitoring for Pilot Region: The system should design a dashboard to monitor carbon farming studies in pilot region. It should integrate data entry from the field, IoT sensors, satellite data, and scientific models to validate carbon sequestration methods and practices. The dashboard should provide analysis of carbon sequestration data from various adopted methodologies and practices.
- e) User-Friendly Interface and Visualization: The dashboard should provide intuitive visualization tools such as heat maps, graphs, and charts to represent carbon emissions, carbon sequestration potential, and pilot studies data. These tools should help users understand and analyze the information effectively. The system should have a user-friendly interface that is easy to navigate and understand. It should provide clear and concise information, allowing users to access relevant data and insights without requiring extensive technical expertise.
- f) Period of Pilot and deliverables:
  - a. The pilot shall be conducted for four seasons starting from T (issue of work order) onwards.
  - b. The system shall quantify the carbon emission and carbon credit potential for all crops in the selected 2 districts and establish a baseline of current carbon sequestration levels on the farm, village wise, to measure the additional carbon captured through new practices, by end of two seasons
  - c. The system shall specify field crop practices, village wise, eligible for carbon credits, by end of two seasons.
  - d. The system shall monitor carbon sequestration for next two seasons and accurately report carbon credits generated duly following the audit standards of Carbon credits.
  - e. Based on the efficiency of the results, the department may take a decision to continue this module.

#### 3.4.15 Analytics on Inputs Supply Management

The Integration of Inputs Supply Management module in APAIMS 2.0 will seamlessly integrate with the existing D-Krishi, IFMS, IPMS, OLMS etc systems to manage the allocation and distribution of agricultural inputs such as seeds, micro-nutrients, and seed treatment chemicals.

By leveraging the functionalities within the D-Krishi, IFMS, IPMS, OLMS etc systems existing with Department, APAIMS 2.0 shall integrate and provide analytics, dashboards on input distribution through Rythu Seva Kendrams (RSKs). This integration will help streamline input supply optimizing the distribution process across the state.

Functional Requirements of the module are:

- Seamless Data Integration with D-Krishi:



- APAIMS 2.0 shall integrate with the existing D-Krishi, IFMS, IPMS, OLMS etc., system available with the Agriculture Department to access existing cultivator data, input allocations, and distribution data.
- The system shall integrate with D-Krishi, IFMS, IPMS, OLMS etc., system via APIs for capturing cultivator input requirements, entitlement calculations, and tracking input allocations from village to state level.
- Notification on Input Availability:
  - APAIMS 2.0 shall integrate with D-Krishi, IFMS, IPMS notification system to inform cultivators and department officials about the status of their input allocations, and when the inputs are ready for collection or delivery at the RBKs.
  - Cultivators shall interact with the APAIMS 2.0 mobile app or web portal, which shall integrate with D-Krishi, IFMS, IPMS via APIs and display entitlement and allocation progress.
- Analytics & Dashboards:
  - Real-time tracking of input distribution and reporting on stock availability shall be integrated with D-Krishi, OLMS, IFMS, IPMS system, ensuring that officials can monitor and adjust input supply strategies within the APAIMS 2.0 system.
  - System shall provide MIS dashboards to the Department officials containing the Inputs stock availability, seed distribution at various RSK vs the demand across the village, mandal and district level using tables, bar-graphs, pie charts, etc.
  - System shall also provide GIS dashboards containing heatmap of input stocks availability vs the input demand across the village, mandal, district and state level.

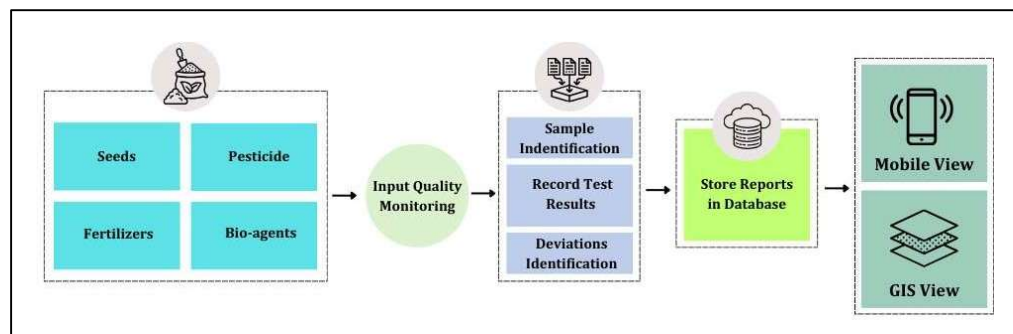
#### 3.4.16 Analytics on Input Quality Monitoring

6.15.1 The Analytics of Input Quality Monitoring module in APAIMS 2.0 should integrate with the existing "InSight" system to provide real-time analytics and monitoring of agricultural input quality through advanced GIS and MIS dashboards. By integrating with InSight, APAIMS 2.0 will enable department officials to efficiently track the quality of agricultural inputs such as seeds, fertilizers, and pesticides, ensuring that only high-quality inputs are available in the market. This integration will automate the sampling and monitoring processes, reducing manual intervention and improving the accuracy and transparency of input quality assessments.

##### 6.15.2 Functional Requirements for Departmental Officials:

- Integration with InSight, OLMS System for Sample Monitoring:
  - APAIMS 2.0 shall integrate with the InSight, OLMS platform to access data from the automated sampling system, which minimizes manual discretion in selecting agricultural input samples.
  - The system shall pull data from InSight related to random sampling of input types (e.g., seeds, fertilizers, pesticides), batches/lots, dealer outlets, and manufacturers, ensuring that all inputs are tested systematically.

- **MIS Dashboards for Input Quality Monitoring:**
  - The module shall provide department officials with MIS dashboards, offering detailed insights into the quality of agricultural inputs available in the market.
  - Officials will be able to track the status of samples collected by Agri Input Inspectors, including details on sampling locations, manufacturers, dealers, and test results from Integrated Agri Labs.
  - The dashboard shall display test outcomes for different input batches, allowing officials to identify poor-quality inputs and take necessary action, such as issuing warnings or penalties to dealers or manufacturers.
- **GIS Dashboards for Spatial Monitoring:**
  - The system shall feature GIS dashboard that visually represent input quality data across various regions such as village, mandal, district, state level showing locations of inspected dealer outlets and laboratories.
  - Officials will be able to view spatial trends in input quality, identifying areas where low-quality inputs are more prevalent, enabling targeted interventions.
  - The GIS dashboard shall also show the distribution of inputs, highlighting areas with the highest concentration of samples drawn and tested, providing a geographical overview of quality control efforts.
- **Analytics on Quality Control:**
  - The module shall provide near real-time analytics on the quality of agricultural inputs, offering a comprehensive view of input quality across the state.
  - Department officials shall have access to key performance indicators (KPIs) such as the percentage of inputs passing quality tests, the number of samples drawn, the number of rejected batches, and trends in input quality over time.
  - The system will support comparative analysis between different manufacturers, dealers, and regions, helping officials ensure that quality standards are met consistently.



### 3.4.17 Analytics on Integrated Call Centre

APAIMS 2.0 should develop a CRP module for effective functioning of Agriculture Department's call centre and integrate the ICC data and systematically identify and highlight abnormal trends in the incoming calls/queries to the department's call centre.

Instances of frequent inquiries from a particular geographical area or concerning a specific crop, pest or disease will be flagged. These anomalies should be presented in a GIS-MIS interface, allowing relevant officials to easily access and analyse the information. This allows the department to proactively address emerging issues and provide targeted support to cultivators.

The functional requirements of the module are provided below:

#### Call Trend Analysis:

- The module should automatically identify and flag abnormal trends in incoming calls/queries, such as frequent inquiries from specific geographical areas or related to particular crops or pest/disease or any specific issue.
- System should implement a pattern recognition system that highlights anomalies, ensuring that emerging issues are quickly brought to the department's attention.

#### GIS-MIS Interface Integration:

- The system should present identified trends and anomalies on an integrated GIS-MIS system.
- System should ensure that the GIS-MIS interface provides an intuitive visualization, allowing department officials to easily analyze and interpret the data.
- System should enable spatial analysis of the data, such as identifying clusters of issues in specific regions or crop zones.
- MIS Dashboard should display the data in form of charts, tables to display the statistics of the abnormal calls coming from specific geographical locations or crops and drill down from state to village and view till the received call details level.

#### Analytics needed for department

- After creation of unified farmer data base by integrating all existing applications of state/ Center and other external agencies, the data need to be analysed for use by the department which will help in better understanding the situation and in efficient planning. Some of the use cases (not exhaustive)
  - Crop wise, variety wise yield analysis
  - Crop wise, area wise, cost of cultivation and benefit analysis
  - Soil type wise, crop wise yield analysis
  - Crop wise market prices analysis
  - Crop planning for various conditions
  - Any other as required by the department, as and when needed.

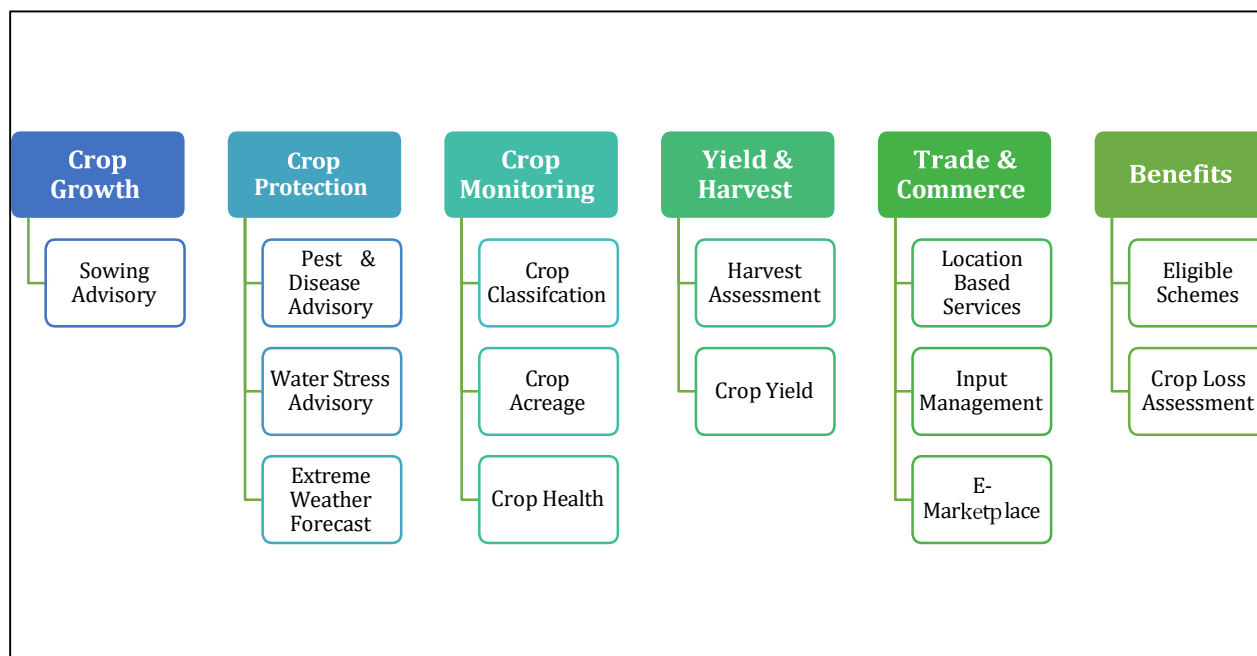
### 3.5 FPOs/ Cultivator Groups:

As of November 30, 2023, under the Central Sector Scheme for "Formation and Promotion of 10,000 Cultivator Producer Organizations (FPOs)", 461 FPOs had been allocated in the State of Andhra Pradesh. These FPOs vary in size, with each typically comprising 300 to 1,000 small and marginal cultivators, though some larger FPOs can have membership exceeding 1,500 cultivators. In Andhra Pradesh, these organizations and groups are instrumental in improving the livelihoods of cultivators by promoting collective bargaining, reducing input costs, and ensuring better prices for their produce. Additionally, FPOs serve as vital links between cultivators and government schemes, ensuring that benefits such as subsidies reach the grassroots level.

FPOs have commenced business transactions, including the following activities:

- Providing high-quality inputs such as seeds, fertilizers, and pesticides to cultivators.
- Collecting and marketing agricultural produce from cultivator-members.
- Offering machinery and equipment for members on a custom-hire basis.
- Enhancing the value of agricultural produce through cleaning, testing, sorting, grading, processing and branding

FPOs and cultivator groups can use APAIMS 2.0 decision support systems to centralize data, improve decision-making, and optimize resources, leading to enhanced productivity and profitability.



Key Modules benefitting FPOs and Farmer Organizations

The functional requirements are provided below:

- a) The APAIMS 2.0 system, shall develop all required modules that require effective functioning of FPOs and Farmer Organisations duly digitising all activities.
- b) System should have the functionality for creation of FPOs and mapping of cultivators and their farm field parcels within the FPO/Cultivator group.
- c) Manage Farmer Groups: System should have a provision for the President/Secretary to manage the members of the FPOs/Groups and raise relevant announcements or advisories, aggregation of demand, aggregation of requirements for agriculture and allied inputs to the members within the FPO/ Farmer group. The members within the FPO/ Farmer group should also be able to communicate among themselves.
- d) All the Crop Production advisories mentioned earlier should be applicable similar to cultivator to each member of FPO or any Farmer groups
  - Sowing Advisory
  - Pest & Disease Alert
  - Irrigation Schedule
  - Extreme Weather Forecast alerts, etc
- e) In addition to the above, crop acreage assessment, crop monitoring, harvest assessment, yield estimation and crop loss reporting services will help the FPOs and cultivator groups to take appropriate steps to safeguard their crops as a unit.
- f) The system should suggest schemes exclusively for FPOs or Farmer groups. The eligibility criteria of the schemes for FPOs and Farmer groups should be captured in the system.
- g) The system should be able to assess the required farm machinery and processing units based on the extent of land being cultivated by the fellow members in the FPO/Farmer groups. The system should also be able to arrive at the additional farm machinery to be purchased on priority basis depending on the financial resources within the FPO/ Farmer groups.
- h) APAIMS 2.0 should estimate the crop-wise, variety wise seed demand and suggest a seed production plan right from foundation seed to certified seeds. The system should assess the extent of area to be sown for foundation and certified seed to get commercial seed for crop production.
- i) Depending upon the extent and nature of the crops sown, the system should estimate the demand of fertilizers and pesticides within the FPO and cultivator groups.
- j) The System shall integrate all the e-Market platforms viz., ONDC, e-NAM, APEDA etc and shall enable the FPOs do the marketing of their produce on their own.
- k) The system should provide market intelligence and services in the areas of insurance (weather insurance, micro insurance, life insurance, health insurance, etc.), organic certification, financial services.
- l) The system should develop linkages for financial services such as loan for working capital, asset building etc.

### 3.6 Increase of Cultivable Land

In view of the increasing trend using land for non-agriculture use by one per cent every year, the uncultivated land has to be brought under cultivation in a phased manner.

The land available under the following three categories of uncultivated land is around 30 lakh ha.

- **Culturable Waste Land:** This includes lands available for cultivation, whether not taken up for cultivation or taken up for cultivation once but not cultivated during the current year and the last five years or more in succession for one reason or other. Such lands may be either fallow or covered with shrubs and jungles, which are not put to any use. They may be assessed or unassessed and may lie in isolated blocks or within cultivated holdings. Land once cultivated but not cultivated for five years in succession should also be included in this category at the end of the five years. The area under cultivable waste land is around four lakh ha.
- **Fallow Lands other than Current Fallows:** This includes all lands, which were taken up for cultivation but are temporarily out of cultivation for a period of not less than one year and not more than five years. The area under this category is around nine lakh ha.
- **Current Fallows:** This represents cropped area, which are kept fallow during the current year. For example, if any seeding area is not cropped against the same year, it may be treated as current fallow. The current fallow land in 2021-22 is 14 lakh ha.

The system should identify the area of crops grown in the preceding five years which should be identified through satellite data and identify the reasons for not cultivated in recent years.

The system should also suggest suitable crops in these areas taking into consideration of the available resources and weather parameters.

The following are the functional requirements of this module :

#### a) Identification of Cultivable Waste Land

- **Using Remote Sensing Data:**
  - **Data Collection:** System should integrate satellite-based remote sensing technologies to identify and map cultivable waste lands, areas where crop was sown 5 years earlier but not cultivated for the last 5 years, areas cultivated 3 years earlier but not cultivated for the last 3 years, not cultivated during the current year across different administrative hierarchies.
  - **Geospatial Analysis:** Use geospatial analysis tools to classify land types, identifying barren, degraded, or underutilized land areas.
  - **Periodic Monitoring:** Implement a system for periodically i.e once in 2 years to monitor land use changes and update the status of waste lands.

- Ground Verification:
  - Field Surveys: Use mobile application to conduct ground truthing through field surveys to verify and validate remote sensing data.
  - Data Synchronization: Synchronize ground verification data with the remote sensing output to ensure accuracy in identification.

#### b) Analysis of Cultivable Waste Land

- Potential Assessment Based on ACZ:
  - ACZ Classification: System should classify the cultivable waste land according to its Agro Climate Zone (ACZ) to determine suitable crops and farming practices.
  - Crop Suitability Analysis: System should perform crop suitability analysis considering ACZ, soil type, water availability, and climate data to identify the most promising agricultural uses.
  - Carbon Emissions Analysis: System should assess the carbon emissions from barren lands, emphasizing the economic and environmental benefits of converting waste land into productive agricultural land.

### 3.7 APAIMS 2.0 Integration with State and Central Systems

#### 3.7.1 Integration with Records of Right (RoR/RoFR) Database

The RoR/ RoFR databases will contain consolidated data of the cultivators of the state. It will include the cultivator's identity, personal information, family information, bank information, land records, season-wise crops sown data, subsidies and benefits eligible for and availed.

##### Data Integration:

- Unified Cultivator Profile: APAIMS 2.0 should integrate The RoR/ RoFR databases data into the unified cultivator database, linking each cultivator's profile with their respective land records.
- Land Details: Similarly, APAIMS 2.0 should capture and integrate details of land subdivisions from the RoR/ RoFR databases, if needed.

##### Seamless Data Exchange:

- APIs for Data Retrieval: The APAIMS 2.0 system should be able to integrate using APIs to retrieve land ownership details, including landowner name, land size, and location from the RoR/ RoFR database.
- Real-time Updates: Ensure that the system can access the latest data from the RoR/ RoFR in near real-time to maintain up-to-date records within APAIMS 2.0.

### 3.7.2 Integration with any other Central and state systems

APAIMS 2.0 should also be able to integrate with existing central and state systems establishing seamless data exchange, interoperability, and coordination across various government systems.

Following are the functional requirements:

#### Integration with Central Systems (Not exhaustive):

- PM-KISAN Integration: APAIMS 2.0 should be able to integrate with PM-KISAN platform via APIs to verify cultivator eligibility, update beneficiary lists, and manage fund disbursements.
- eNAM Integration: Facilitate integration with the National Agriculture Market (eNAM) via APIs for real-time price information, market access, and transaction data.
- Integration with PMFBY: APAIMS 2.0 should integrate with the Pradhan Mantri Fasal Bima Yojana (PMFBY) via APIs for claims, and disbursement tracking.
- APAIMS 2.0 should also be able to integrate with any other relevant central systems which are in use.

#### Integration with State Systems:

- APAIMS 2.0 should be able to integrate with existing systems such as state irrigation management systems for real-time irrigation advisories, water availability updates, and crop water requirement assessments.
- APAIMS 2.0 should also be able to integrate with any other relevant state systems which are in use such as
  - E-Panta
  - D-Krishi
  - Annadatha Sukhibhava
  - Vaddi Leni Runalu
  - Online License Management System (OLMS)
  - InSight, Performance Monitoring application
  - Any other application as per the requirement of the department.



## 3.8 APAIMS 2.0 Platform

### 3.8.1 Unified Agriculture Database

The Unified Database functions as a cutting-edge data lake, designed to store and manage data in various formats, ranging from raw to semi-processed, fully transformed, and catalogued. This advanced repository integrates information seamlessly from diverse sources, including existing systems, gauge sensors, input modules, and standalone systems. It encompasses a wide array of data, such as historical records on demand and supply, efficiently managing vast volumes of information to ensure quick and easy retrieval of diverse datasets.

- **Time-Series Database:** The database should effectively store both time-series and static entity data, ensuring stability, reliability, and ease of maintenance. It must be highly responsive to support Management Information System (MIS) dashboards equipped with Smart Charts and Reports, facilitating real-time decision-making.
- **Geospatial Database:** This component of the database is dedicated to storing geospatial data reliably, enabling real-time analysis without any performance degradation. The geospatial database should allow for the secure storage, maintenance, and sharing of geospatial data, ensuring consistent performance and availability.
- **Advanced Database Properties:** The database architecture incorporates essential properties such as Atomicity, Consistency, Isolation, and Durability (ACID). These properties guarantee that all database transactions are completed successfully, preserving data integrity and reliability, even in the event of system failures.
- **Digital Platform as a Single Window Solution:** The digital platform shall function as a comprehensive 'Single Window' solution, offering a standardized GIS framework for searching, accessing, visualizing, understanding, and analyzing data. Developed with a focus on open-source and open-standards-based systems, it emphasizes standardization, openness, scalability, and security across all hosted applications.
- **Geospatial Data Library:** The envisioned system's Geospatial Data Library shall house an extensive collection of geospatial datasets, including satellite imagery, climate data, terrain information, land use/land cover (LULC), and more. These datasets should be meticulously cataloged, with the database services and platform APIs enabling efficient search, browsing, and retrieval tailored to specific user needs.

#### 3.8.1.1 Satellite Engine

The Satellite Data Processing Engine is to be designed to incorporate a comprehensive range of functionalities and algorithms specifically tailored for processing various types of satellite imagery and data, including optical, radar, and multispectral imagery. Its core purpose is to analyze, interpret, and transform raw satellite data into actionable insights and meaningful information. The engine is optimized to handle large volumes of satellite data, utilizing parallel processing and distributed computing techniques to ensure efficiency and

scalability. Ultimately, this engine empowers users to extract valuable insights from satellite data for a wide array of applications, particularly in agriculture.

- **Automated Satellite Data Downloading:** The engine facilitates automated data downloading by interfacing with a variety of sources, including government agencies, commercial providers, and satellite constellations like Sentinel and Landsat. It supports both periodic data retrieval and on-demand requests, providing a dynamic and responsive data acquisition process.
- **Data Ingestion:** The system leverages cloud storage solutions such as Amazon S3, Azure Blob Storage, or Google Cloud Storage for scalable and durable data ingestion. Each dataset is enriched with metadata, which includes critical information such as image source, resolution, and geospatial coordinates, ensuring the data is ready for analysis.
- **Data Pre-processing:** This stage acts as a crucial intermediary between raw satellite imagery and meaningful analysis. It involves sensor-specific and data-level pre-processing tasks to prepare the data for subsequent analysis, ensuring the quality and relevance of the information derived.
- **Data Cataloguing and Metadata Management:** The platform maintains a comprehensive metadata database, including satellite names, acquisition dates, sensor types, and cloud cover percentages for each dataset. This robust metadata system ensures that datasets are easily searchable and interpretable, facilitating efficient data management.
- **Data Management:** The system employs meticulous data organization, archiving, and storage optimization strategies to manage costs effectively while ensuring data accessibility and reliability.
- **Parallel Processing:** The platform's parallel processing capabilities significantly enhance the efficiency of data analysis by breaking down complex tasks into smaller sub-tasks, allowing for faster and more efficient processing.
- **Visualization:** To help users effectively interpret the results of their analyses, the system provides a suite of advanced visualization tools and interfaces. These tools enable users to view and understand the data in a clear and insightful manner.

### 3.8.1.2 GIS Engine

The platform should have dedicated technical stack for processing Geospatial data. The Platform interpolation services, aggregation services and scientific estimation/distribution services shall use mathematical modelling and spatial association for all the geographical attributes such that the results allow for detection of patterns which are not easy to comprehend in the traditional chart and table views.

- **GIS Operations:** The platform offers a comprehensive set of multi-layer GIS operations, including intersection, union, clip, merge/dissolve, and more. These operations can be performed on various data types, such as points, lines, and polygons for intersection. The intersection tool should extract location information from spatial data (Grid) by calculating the overlap of different grids at a specific geographic point. The union analytical process should be employed to consolidate features from two or more map layers into a unified composite layer. This process combines data from all the included layers, incorporating both overlapping and non-overlapping areas into a new polygon.

- **Heat Maps / Choropleths:** The platform supports the visualization of data using choropleth maps and heat maps. Choropleth maps display variations across a geographic area based on administrative boundaries or enumeration units. Heat maps are usually generated from point data that represents some form of density. However, it's worth noting that choropleths can also be created from point data. The key distinction lies in the fact that choropleth maps are generated based on non-regular enumeration units, while heat maps are depicted on a regular grid of cells. The size of these grid cells can be specified by the cartographer but is consistently calculated.
- **Interpolations:** Spatial interpolation technique available in the platform estimates values at locations where no recorded data is available by leveraging known readings from nearby sources. In the context of GIS, spatial interpolation will be applied to data points, resulting in the creation of a raster surface.
- **Zonal Statistics, Associations, and Aggregations:** Spatial zonal statistics, associations, and aggregations services available in the platform applies to identify the patterns of data or information in the geographical space. This analysis aims to understand the distribution patterns, uncover similarities in distribution, and perform spatial associations and aggregations of data points. These actions provide a statistical perspective on the collected and aggregated data points using relevant statistical methods.
- **Web-Based GIS Editing Tool:** Platform allows users to interact with GIS layer online. This tool provides a user-friendly interface for adding, modifying, and updating GIS shapefiles with ease. Moreover, it incorporates role-based access, ensuring that each user has the appropriate level of control and responsibility. When operating in View mode, users can access various GIS datasets and view them without making any alterations. In Edit mode, users gain the capability to make edits to GIS maps, send their modifications for approval, and ultimately publish the updated maps. The Redlining mode enables users to identify errors and request corrections to GIS maps. In the Publish mode, users can review, correct, and modify changes in GIS shapefiles, and subsequently, they have the capability to publish these updated shapefiles directly into the database and GIS systems, ensuring seamless integration of modifications and data updates.

### 3.8.1.3 AI/ML Engine

Machine Learning (ML) and Artificial Intelligence (AI) should be the fundamental components of the platform, designed to parse, interpret, and understand the data it generates. The system should be equipped with cutting-edge ML and deep learning models integrated within the engine, offering several key advantages:

- **Advanced Algorithm Hosting:** The platform is designed to host and run a variety of machine learning algorithms, including sophisticated deep learning neural networks, ensuring comprehensive data analysis capabilities.
- **Seamless Front-End Deployment:** The deployment of models, explainers, and canary releases on the front end streamlines the development process, saving time and enhancing collaboration across teams.

- **Control and Flexibility:** Teams are provided with full control over model deployment and management workflows, effectively eliminating bottlenecks and accelerating the development cycle.
- **Automation and Optimization:** By implementing ML algorithms, the platform automates and optimizes business processes, driving efficiency and reducing manual effort.
- **Real-Time Data Processing:** Robust AI/ML methodologies support real-time data processing and decision-making, enabling swift responses to emerging trends and insights.
- **Operational Efficiency:** The platform improves operational efficiency by identifying patterns, anomalies, and opportunities within large datasets, providing actionable insights.
- **Platform and Language Agnosticism:** The platform's flexibility allows for the building and deployment of ML models in a manner that suits the user's needs, independent of the underlying platform or programming language.

#### 3.8.1.4 Map Data Service Engine

A Map Data Service Engine is an advanced, web-based platform that offers seamless access to maps, geospatial data, and associated functionalities over the internet. This service empowers users to view, query, analyze, and interact with geographic information through a variety of applications, websites, and client software.

- **Extensive Geospatial Data:** The service hosts or connects to a wide array of spatial data sources, including basemaps, aerial imagery, satellite imagery, and thematic layers such as roads, rivers, administrative boundaries, and land cover. This comprehensive data collection ensures that users can access a diverse range of geospatial information for multiple applications.
- **Dynamic Map Rendering:** The platform dynamically generates map images or tiles based on user-specific requests and parameters, such as zoom level, geographic extent, and selected layers. Map rendering can be executed using raster tiles, vector tiles, or dynamic map images, providing flexible options for map display.
- **Sophisticated Spatial Analysis:** The service is equipped with powerful spatial analysis tools that allow users to perform complex geographic operations. These include functionalities such as buffering, overlay analysis, proximity analysis, and spatial joins, which are critical for detailed geographic analysis.
- **Advanced Data Visualization:** Integrated tools for data visualization on maps support thematic mapping, heatmaps, clustering, and symbolization, enabling users to interpret and present data in a visually intuitive manner.
- **Interactive User Experience:** The service supports a high level of user interaction, including features like panning, zooming, and clicking on map elements for more

information. Additionally, it allows users to draw or edit spatial data directly on the map, enhancing engagement and customization.

- **APIs and Integration:** The service provides robust APIs (Application Programming Interfaces) and integration interfaces, facilitating the access and use of map data and functionalities from various client applications, websites, and development environments. These APIs typically adhere to industry standards such as REST (Representational State Transfer) or SOAP (Simple Object Access Protocol), ensuring wide compatibility.
- **Security and Access Control:** To protect sensitive geospatial data, the service includes comprehensive security features, including authentication, authorization, encryption, and role-based access control. These measures ensure that data is secure, and that access is managed according to specific user roles and permissions.

#### 3.8.1.5 Weather Data Engine

The Weather Data Engine is to be a comprehensive system designed to collect, process, analyze, and disseminate weather-related data and information. Serving as the core infrastructure for delivering weather services across various applications, industries, and users, it comprises several key components:

- **Data Integration:** This engine aggregates data from multiple sources and formats into a unified data model or database. This integration enables users to access and analyze comprehensive weather datasets from diverse origins, encompassing variables such as temperature, precipitation, wind speed, humidity, atmospheric pressure, and other meteorological factors.
- **Data Processing:** The engine processes weather data to clean, normalize, and standardize it for further analysis and visualization. This process may involve quality control measures, data interpolation, and data fusion techniques, ensuring that the information is both accurate and reliable.
- **Numerical Weather Prediction (NWP):** The engine incorporates NWP models, which use current observations and physical equations to forecast future weather conditions. These models generate short-term and long-term weather forecasts for specific locations, providing critical insights for decision-making.
- **Weather APIs and Interfaces:** The engine offers robust APIs and interfaces for accessing weather data and services from various client applications, websites, and software development environments. These APIs typically utilize standard protocols such as RESTful or SOAP APIs, ensuring broad compatibility and ease of integration.
- **Visualization Tools:** To enhance user understanding, the engine includes advanced tools for visualizing weather data and forecasts. These tools present information in graphical formats such as maps, charts, graphs, and animations, allowing users to effectively interpret weather patterns and trends.

### 3.8.1.6 Machine Learning Model Engine and Manager:

The platform must be equipped with the capability to store and manage trained Machine Learning (ML) models effectively. It should include a comprehensive inventory system that catalogs models developed across various modules. Trained models should be securely stored to facilitate retraining and further refinement as needed.

The Model Inventory Management system should feature robust model versioning and a centralized repository, ensuring efficient management of models created by different administrative users for diverse modules. Additionally, this system should incorporate access controls, allowing designated users to perform training, retraining, or prediction tasks via processing jobs, while maintaining strict oversight on model accessibility and usage.

### 3.8.1.7 Pictorial Analysis Engine:

Pictorial analysis using deep learning has significant potential in agriculture, particularly in crop detection. By analyzing images captured by drones or other devices, deep learning algorithms can identify and classify crops with high accuracy.

- **Data Collection:** The system shall integrate a comprehensive dataset of annotated images that includes various pests, their life stages, and relevant environmental backgrounds. These images shall be collected through multiple sources such as field surveys, cameras, drones, or publicly available image repositories. The required datasets shall be made available to the bidder.
- **Data Pre-processing:** The system shall clean, pre-process, and augment the collected image dataset to ensure diversity and minimize potential biases. Pre-processing tasks shall include resizing images, adjusting brightness and contrast, and applying data augmentation techniques such as rotation, flipping, and cropping to enhance the dataset.
- **Object Detection:** The system shall implement computer vision techniques or utilize pre-trained deep learning models (such as VGG, ResNet, or Inception) to extract relevant features from the images. These extracted features shall serve as inputs to machine learning models for detecting leaf patterns of different crops at various growth stages.
- **Model Training:** The system shall train a deep learning model, preferably a Convolutional Neural Network (CNN), to identify crops based on the extracted features. CNNs are particularly well-suited for image recognition tasks and shall be used to learn complex patterns and hierarchies in the provided images.
- **Model Validation:** The system shall validate the trained model using a separate subset of annotated images that were not used during training. Key performance metrics, including accuracy, precision, recall, and F1 score, shall be calculated to evaluate the model's effectiveness in identifying pests and crops in images.
- **Model Optimization:** Based on the validation results, the system shall fine-tune the model parameters or architecture to enhance its performance. This may

involve adjusting the learning rate, optimizing the model architecture, or applying transfer learning techniques to leverage pre-trained models for better results.

- **Deployment:** The system shall deploy the trained and optimized model into the APAIMS 2.0 platform, making it accessible via both mobile app and web-based platforms. The system shall allow users to upload images and receive real-time identification of crop types and related data.
- **Training Module:** The system's AI models should be trained on large datasets using cutting-edge algorithms like CNN, YOLO, and VGG. This deep learning approach shall enhance model performance in recognizing crop types, growth stages, and pests. It also allows customization of training parameters and supports future expansion.
- **Prediction Module:** After training, the system should use advanced AI models to make predictions on new or unseen crop images. It should detect the crop type, assess its growth stage, and identify pest or disease outbreaks based on visual cues, supporting proactive pest management.
- **Plug and Play Model:** The platform should be integrated with various databases, ensuring data from different portals or schemes can be utilized without friction. This modularity shall enhance the system's adaptability across agricultural programs.
- **Model Manager:** The Model Manager interface shall be a centralized tool that helps users monitor, version, and organize AI models. Administrators shall be able to deploy or retire models based on their performance metrics.
- **Scheduler Manager:** This interface should allow users to schedule training iterations, predictions, and other tasks. It ensures that models are retrained periodically, maintaining their relevance.
- **Load Balance:** The platform should optimize computational load distribution to maximize performance. It should dynamically allocate processing tasks like data queries, model training, and inference to available servers based on capacity and resource needs.
- **Task Manager:** Should provide an interface to monitor model training, prediction tasks, and queues. Users should be able to check on the progress of tasks, restart, or cancel any that fail to complete.
- **Interfaces and Workflows:** This shall have various interfaces are provided to simplify tasks such as uploading data, creating annotations, querying the database, and managing models, ensuring smooth user experiences and system interoperability.

### 3.8.1.8 IoT Engine

The digital platform should leverage IoT devices to collect comprehensive data across various domains. These IoT devices must be configurable to adapt to different implementations. The system should provide sensor integration capabilities, allowing users to input necessary details for newly installed sensors at various locations and configure the required communication protocols. This ensures that the system can fetch and receive data at the desired frequency, process it, and store it in the state data center database for publication in the platform.

The IoT devices should be compatible with both intermediary devices and network devices within the data center. Data transmission from these IoT devices to the application network should utilize protocols such as MQTT or HTTPS, with sufficient encryption options like AES to ensure secure data transfer.

The system must be designed to seamlessly integrate all IoT sensors deployed for monitoring various applications, including soil moisture, weather parameters like temperature, wind speed, humidity, and rainfall. The collected data will be used for various analytics and models. Additionally, the system should be designed to either directly integrate data from various sensors or fetch it from a common data repository through APIs, triggered based on the required data frequency.

### 3.8.1.9 GEN-AI Engine

The Gen-AI engine, short for General Artificial Intelligence engine, shall represent a cutting-edge AI system designed to perform a diverse range of tasks with human-like cognitive abilities across various fields. A Gen-AI-powered cultivator service leverages advanced AI technologies, including machine learning, natural language processing, computer vision, and predictive analytics, to deliver personalized and intelligent support to cultivators in managing and making decisions about agriculture.

- **Rules Engine:** The Rules Engine provides a dynamic interface for selecting the appropriate AI or Gen-AI model based on request intent, sentiment, origin, and user type. Configurations can be adjusted during deployment to ensure flexibility and responsiveness to varying conditions.
- **Prompt Chain:** The Prompt Chain outlines the Gen-AI workflow by integrating prompts and agents to determine intent, sentiment, and other request details. Subsequent prompts or agents are activated according to these values and the Rules Engine.
  - **Agents:** These components interact with external systems to gather relevant data, which is then incorporated into prompts for processing by large language models (LLMs) or to initiate workflows with necessary information.
  - **Prompt Chain Components:** Comprising classification nodes and action flows, the Prompt Chain identifies values from emails and enterprise content, triggering the appropriate actions based on Rules Engine configurations.



- Prompts: These capture contextual information from emails and enterprise data, guiding the LLM in processing and summarizing the data. For instance, a prompt might generate a response to an email query.
- Chain of Thought Implementation: Chain of Thought is a prompting technique that enables Large Language Models (LLMs) to break down complex problems into intermediate reasoning steps. Instead of jumping directly to answers, the model explicitly shows its reasoning process, similar to human problem-solving. Key Components are below:
  - Prompt Engineering Layer
    - Structures input prompts to encourage step-by-step reasoning
    - Includes explicit instructions for breaking down problems
    - Incorporates demonstration examples when needed
    - Maintains consistency in prompt formatting
  - Reasoning Framework
    - Captures intermediate thought steps
    - Validates logical connections between steps
    - Ensures coherent progression of reasoning
    - Handles different types of problems (mathematical, logical, analytical)
  - Response Processing
    - Extracts and organizes reasoning steps
    - Identifies key conclusions
    - Formats output for clarity
    - Maintains traceability of logic
- Agent Framework: The Agent Framework facilitates interaction with enterprise and third-party systems to retrieve necessary data. It supports API integration with core applications, allowing the system to access and utilize contextual information from various sources.
- Knowledge Base Creation: Agricultural knowledge is collected in multiple formats and stored in a vector database using vector embeddings. This knowledge base supports Gen-AI's knowledge graphs and retrieval-augmented generation (RAG) processes.
- Answering User Questions via RAG: RAG utilizes domain-specific knowledge to guide LLMs in providing accurate answers. The RAG process includes similarity search, prompt augmentation, and answer generation based on the provided prompts.

- LLM Agnostic: The system shall be adaptable to various commercial LLMs such as ChatGPT 4.0, ChatGPT 3.5 Turbo, Gemini, and open-source models like Llama 2, Mistral, and Falcon.
- LLM Model Inventory:
  - Open Source LLMs: Shall utilize a selection of open-source Large Language Models (LLMs) such as Meta Llama, Google Gemma, Microsoft Phi, Mistral Nemo, etc.
  - Commercial LLMs: Shall integrate with commercial LLMs including Google's PaLM, OpenAI's GPT-4, Mistral, Anthropic Claude Sonnet, etc.
- User Authentication & Authorization: The solution offers flexible user authentication options, integrating with existing identity management systems or using the built-in authentication system. For authorization, the system enforces granular access control through attribute-based policies, ensuring users have permissions tailored to their roles, whether for reading, writing, or deleting resources, thereby maintaining secure and customized access.

#### 3.8.1.10 Voice and Translation Engine

The Voice and Translation Engine is to be designed to process spoken language input, convert it to text, and translate it into another language. By integrating advanced technologies—such as automatic speech recognition (ASR), natural language processing (NLP), machine translation (MT), and text-to-speech (TTS)—the engine facilitates seamless multilingual communication. The key components of the Voice and Translation Engine include:

- Speech Recognition: Utilizing ASR algorithms, the engine transcribes spoken language into text by analyzing audio signals and identifying words and phrases.
- Language Identification: The engine detects the language of the spoken input to ensure accurate translation into the desired target language.
- Machine Translation: After transcription, the engine translates the text into the target language using MT algorithms. These algorithms interpret the source text and generate a corresponding translation.
- Natural Language Processing: To enhance translation accuracy and fluency, the engine employs NLP techniques, including syntactic analysis, semantic understanding, and context modeling, ensuring translations are contextually relevant.
- Text-to-Speech: Following translation, the engine converts the translated text into spoken output using TTS synthesis. This involves generating audio signals that replicate human speech based on the translated text.

- **Language Models:** The engine may leverage language models to refine translation quality by predicting the most appropriate words and phrases in the target language based on the input context.
- **Integration with Voice Assistants:** The Voice and Translation Engine can be integrated with voice assistant platforms, allowing users to interact using voice commands and receive real-time translated responses.
- **Customization and Adaptation:** Advanced engines offer customization options to adapt to specific domains, accents, or dialects, improving the accuracy and relevance of translations for various user groups and contexts.

### 3.8.1.11 Mobile Engine

The system shall feature mobile applications developed using open-source frameworks like Flutter, enabling deployment on both Android and iOS platforms with a single codebase. The applications should be available for download from the Google Play Store and the Apple App Store. Key features and functionalities of the mobile application include:

- **Platform Availability:** The mobile application must be accessible via the Google Play Store for Android devices and the Apple App Store for iOS devices.
- **User Authentication and Role-Based Content:** The application should include a login page with support for multifactor authentication, such as OTP. User access and available functions should be tailored to their role. For example, department personnel should have access to mobile-friendly dashboards and task statuses relevant to their department workflows.
- **Mobile Data Entry and Multimedia Uploads:** The application should offer user-friendly forms for data entry and support the upload of various types of documents and media, including:
  - Geo-spatial metadata for geographic entities.
  - Spatial and non-spatial data.
  - Field or survey data, restricted to the user's jurisdiction.
  - Pictures, forms, video clips, and documents as supporting artifacts.
  - Offline data entry capabilities to ensure data is captured even when connectivity is unavailable, with seamless synchronization to the data server to prevent duplication and ensure data integrity.

### 3.8.1.12 Web Dashboard and Interfaces

The Web GIS Dashboard and Interfaces should provide users with a comprehensive platform to access and interact with MIS and GIS data through an intuitive web-based interface. Leveraging modern web technologies, these interfaces enable users to visualize, analyze, and engage with spatial data seamlessly within a web browser. Key components and features of the Web GIS Dashboard and Interfaces include:

- The presentation layer should be implemented using light weight technologies to provide user friendly dashboards and decision support systems. The system should use the latest technologies like JavaScript, Leaflet JS, HTML 5, CSS on Angular, Node frameworks etc., for displaying information on the UI on mobiles, desktops running on multiple operating systems and browsers. The system should support multiple language literals to be displayed on the user interface.
- **Map Viewer:** The Map Viewer allows users to explore spatial data layers, including maps, satellite imagery, and aerial photographs, overlaid on a base map. Users can navigate, pan, and zoom to examine different geographic areas with ease.
- **Data Layers:** The platform supports the integration of various data layers, such as vector layers (points, lines, polygons), raster layers (imagery, elevation models), and thematic layers (land use, demographics). Users can manage these layers by toggling their visibility, adjusting transparency, and customizing symbology to suit their needs.
- **Data Visualization:** The platform offers robust tools for visualizing spatial data through various charts, graphs, and diagrams. Users can create thematic maps, pie charts, bar graphs, and scatterplots to uncover patterns and trends within the data.
- **Spatial Analysis Tools:** Users can perform spatial analysis tasks directly within the web interface. Available tools include buffering, overlay analysis, proximity analysis, and spatial querying, enabling users to analyze spatial relationships, detect hotspots, and extract valuable insights from the data.
- **Query and Search Functionality:** The platform enables users to query spatial data layers based on attributes or spatial relationships. Users can conduct attribute queries, spatial queries (e.g., point-in-polygon), and keyword searches to retrieve targeted information from the data.
- **Responsive Design:** The interface is designed to be responsive, ensuring accessibility and optimal performance across a range of devices and screen sizes, including desktops, laptops, tablets, and smartphones.

### 3.8.1.13 API Gateway Compatible

- The system shall leverage industry-standard API gateways, such as Load Balancers and NGINX, to ensure reliable and efficient connectivity between client systems and backend servers. The application gateway must support secure access via SSL or equivalent encryption protocols, ensuring high-speed access and appropriate routing of requests to the designated servers for optimal performance.
- The platform architecture must prioritize standardization, scalability, and security, providing a robust hosting environment for applications. It should deliver essential services through standardized Application Programming Interfaces (APIs), promoting efficient and flexible development practices.
- To ensure seamless integration with third-party services, the platform architecture shall be API-driven and based on open standards, supporting modularity in development. This approach will encourage collaboration among development teams while maintaining consistency across the platform.
- Furthermore, the platform must be designed to scale efficiently, handling increased traffic and data loads without degrading performance. It should support multi-user access, enabling concurrent interactions from numerous users. Compatibility across various devices, including desktops, laptops, tablets, and smartphones, shall be a key feature, ensuring accessibility for all users.

### 3.8.1.14 Event Management

The system shall support the ingestion and processing of high-speed, time-series data in various formats, including data from IoT devices, sensors, web forms, Excel files, file uploads, and web services. To ensure efficient handling of incoming raw data, the platform must utilize technologies such as queues, schedulers, and trigger management solutions, including but not limited to Kafka, Quartz, Apache Storm, Python, and TensorFlow.

The event management system should enable parallel processing of data streams, ensuring no data is lost in transit before being processed and securely stored in the database. A robust queuing system should be implemented to buffer incoming messages until the processing services are ready to retrieve and process them. The system must be capable of processing multiple messages simultaneously, ensuring high availability and scalability to handle large volumes of data efficiently.

### 3.8.1.15 Search Feature

The platform should include an Elastic search feature, which acts as a distributed search and analytics engine capable of handling various data types, including textual, numerical, geospatial, structured, and unstructured data. The platform should function as a near real-time search solution, ensuring that documents become searchable within approximately one second of indexing.

The platform should employ a distributed architecture, storing documents across different containers known as shards. These shards should be replicated to ensure redundancy in case of hardware failures. This design should enable the platform to scale

horizontally, accommodating hundreds or even thousands of servers while effectively managing petabytes of data.

In addition to its speed, scalability, and resilience, the platform should offer a comprehensive set of built-in features. These should include data rollups and index lifecycle management, optimizing data storage and retrieval processes.

#### 3.8.1.16 User Access & Data Security

The platform must include robust user management features to ensure secure access and data visibility based on user roles. User rights and responsibilities should be configurable, with access control defined and enforced according to guidelines set by authorities. Key aspects of user management and security include:

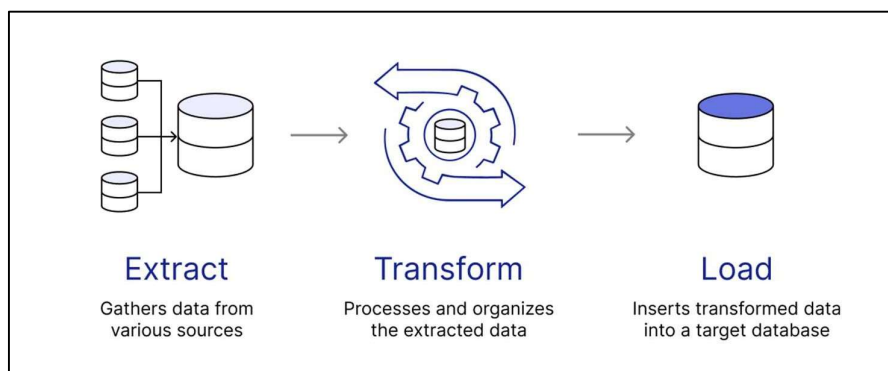
- **Multifactor Authentication:** Access to any function or module within the application should require authentication via user ID and password. The login process must also support multifactor authentication, including CAPTCHA and One-Time Password (OTP) for added security.
- **Role-Based Authorization:** The user management system should allow administrators to manage access through role-based authorization. Roles should be configurable, with access rights assigned at the component or function level. This ensures that users can only access features relevant to their specific role.
- **API-Level Resource Access Management:** Administrators should be able to configure access controls at the API level, ensuring that only authorized users can access critical resources within the system. This also allows for controlled third-party integrations, restricting access to the specific features being integrated.
- **Session-Based Security:** The platform must ensure secure connections from both web and mobile clients using industry-standard secure token management. The system should prevent concurrent sessions to maintain data integrity and facilitate smooth user transitions between assigned functions. Integrated session management is essential for managing user access and transitions effectively.
- **The system should have all processing and microservices to be performed securely and allow for single sign-on integration with other identity servers.** The Client session level and API level security should be handled by using high security token management servers like Keycloak which is an open-source software product to allow single sign-on with identity and access management aimed at modern applications and /services. The user authentication and authorization should be integrated with all services within the system using a dedicated User Management server.
- **Comprehensive Data Security:** Organizations must safeguard their critical business assets and data against unauthorized access and misuse. A unified security platform should be employed to integrate data security information across the enterprise, ensuring scalability across public cloud, on-premises, and hybrid cloud

environments. This platform should combine people, processes, and technology to protect data throughout its lifecycle.

The platform should incorporate necessary security measures to eliminate any potential loopholes that could be exploited.

- The platform should support the latest encryption methodologies, such as SSL 3.0. If necessary, it should provide the capability for integration with any active directory server.
- The platform should include built-in security for all applications and databases hosted within it. Security should be enhanced through data centralization, server security applications, network firewalls, and whitelisting IPs of only essential service endpoints.
- Data encryption should be implemented for both data at rest and in transit, with mechanisms in place to anonymize summarized data upon retrieval. The platform should also provide fine-grained control over the geographic locations of servers involved in application interactions.
- The platform should have adequate protections against cross-site scripting and Cross-Site Request Forgery (CSRF).
- The platform should ensure that the application source code is not exposed on the web console or through any server-side scripts, safeguarding critical logic and sensitive information.
- The platform should facilitate streamlined network event monitoring and error transaction logging for traceability and control.
- The platform should implement identity and access management systems to allow only authorized users limited access to core datasets and retrieval functions.
- The platform should control services for the deployment of builds to respective environments, including development, testing, staging, production, and disaster recovery, using industry-standard Continuous Integration/Continuous Delivery (CI/CD) pipelines.

### 3.8.1.17 ETL Engine



The system should have ETL Engine, which is a crucial component for managing data workflows, encompassing the processes of extracting, transforming, and loading data from various sources into a centralized data repository. This engine facilitates the integration of disparate data sources, ensuring that data is accurately and efficiently processed for analysis and reporting. Key features and components of the ETL Engine include:

- **Data Extraction:** The engine extracts data from a variety of sources, including databases, flat files, APIs, and other data repositories. It supports various extraction methods to handle structured and unstructured data efficiently.
- **Data Transformation:** After extraction, the engine transforms the data to meet specific business needs. This includes data cleaning, normalization, aggregation, and enrichment. Transformation processes ensure that data is accurate, consistent, and formatted correctly for analysis.
- **Data Loading:** The engine loads the transformed data into a target data repository, such as a data warehouse, data lake, or analytical database. It supports various loading techniques to accommodate different data structures and volumes.
- **Data Integration:** The ETL Engine integrates data from multiple sources, creating a unified view of information. It handles schema mapping, data merging, and alignment to ensure seamless integration across systems.
- **Error Handling and Logging:** The engine includes mechanisms for error detection and logging, ensuring that any issues during the ETL process are identified and addressed. It provides detailed logs and alerts for troubleshooting and monitoring.
- **Scheduling and Automation:** The engine supports scheduling and automation of ETL tasks, allowing for regular and timely data processing. Users can define schedules for extraction, transformation, and loading operations, optimizing data workflows and reducing manual intervention.
- **Scalability and Performance:** The ETL Engine is designed to handle large volumes of data and high-performance requirements. It scales horizontally or



vertically to accommodate growing data needs and ensure efficient processing.

- **Data Quality and Governance:** The engine incorporates data quality and governance features to maintain data integrity and compliance. It ensures that data adheres to defined standards and regulations throughout the ETL process.

#### 3.8.1.18 Sandbox environment

A sandbox is a purpose-built working environment that is intended to support self-service analytics and data science development teams. A sandbox can be temporal in nature: existing only for a short time in support of specific data, analytics, or data science development needs. Sandboxes enable data discovery, hypothesis-driven analysis, data science model development, and other self-service tasks. Sandboxes can span data in many forms: structured, semi-structured, and unstructured content.

### 3.9 Training & Capacity Building

Training and capacity-building initiatives are crucial for successful implementation of the APAIMS 2.0 platform. Training ensures users and trainers have the necessary skills and knowledge to utilize the system effectively and efficiently.

- **User Trainings:** Providing comprehensive training sessions for users of APAIMS 2.0, covering various aspects such as system overview, changes in work procedures, benefits of the system, and hands-on training on software functionalities.
- **Training Content:** Training should cover menu navigation, user interface forms, functionalities, features, processes, generated reports, content management system (CMS) functions, and distribution of training manuals.
- **Training of Trainers (TOT):** After the platform is handed over (Go-Live), a train-the-trainers approach is adopted to efficiently deploy training efforts. This ensures that trainers are equipped to train others effectively, optimizing resources and time.
- **Capacity Building:** Capacity building involves imparting necessary knowledge, experience, and technology to selected officials or teams, periodically. The goal is to make them self-sufficient in managing project enhancements and maintenance once the platform is handed over and the initial maintenance period is completed.
- Latest training material, in Telugu & English, soft and hard, suitable to each level of training shall be prepared by the successful bidder and given to department
- Sufficient staff, having good training skills shall be deployed for trainings, as and when requested by the department during the contract period.
- Training shall be in Telugu for all farmers, Farmer groups, FPOs and for departmental officials, it can be both Telugu & English
- If needed, physical trainings will also be organised by the department and the successful bidder shall send sufficient trainers to conduct these trainings, as per the schedule given by the department, during contract period.

- Department will only organise trainings and the cost of training material, cost of trainers, their travel etc., shall be borne by the successful bidder.

### 3.10 Hosting & Security Requirements

- **Cloud Agnostic:** The platform architecture should be cloud agnostic and not dependent on any PaaS, SaaS and cloud native service components. Its deployment shall be done in state data centre as provided by the Agriculture Department.
- **Deployment in State Data Centres:** All the production Databases and Application servers should be deployed in the state data center as Virtual Machines (VMs) which shall be provided by the Agriculture Department. The Databases should be installed in separate servers to ensure isolation and additional security. The production servers should be accessible only to the administration personnel.
- **APAIMS 2.0 - platform architecture** should be able to be deployed in hybrid mode so that some of its architectural components such that Storage, ML computation, Satellite data processing etc. can be deployed in physical infrastructures/servers.
- **Development Environment:** A dedicated development environment shall be established to facilitate the continuous development and customization of the APAIMS 2.0 platform. This environment will provide the necessary infrastructure to develop, modify, and test new features before they are moved to testing and staging environments. The development environment must ensure seamless integration of all platform components, supporting code development, debugging, and early-stage testing. It will allow developers to collaborate effectively while ensuring that all functionalities align with the system's overall architecture and objectives.
- **Testing Environment Setup:** A dedicated testing environment shall be established, replicating the complete APAIMS 2.0 platform with all applications interconnected. This environment must support the full range of functional testing, allowing for the validation and verification of the system's features, dashboard functionalities, and report generation capabilities.
- **Sandbox Environment Setup:** A sandbox/staging environment, identical to the production system in terms of functionality and sample data, shall be set up for user acceptance testing (UAT) and simulation testing. This environment shall serve as a sandbox for validating changes before deployment. Once all testing is completed and validated in the sandbox/staging environment, the settings and configurations shall be enabled in the production environment.
- **Cost of Hosting and Security Audit:** The cost of hosting the APAIMS 2.0 platform and conducting security audits with certified CERT-IN empanelled agencies shall be fully borne by the Department of Agriculture. The application should only be hosted on the production system after successfully obtaining a "safe to host" certificate from a CERT-IN authorized Vulnerability and Security Assessment (VAPT) testing agency, The Agriculture Department will ensure that the necessary resources for hosting, security assessments, and compliance audits are provisioned as part of the project.
- **Bidder Responsibilities for Hosting and Maintenance:** The bidder shall be responsible to provide dedicated IT manpower to manage and maintain the hosting infrastructure, ensuring optimal performance, security, and uptime of the platform. The bidder shall be

responsible for hosting and maintaining all environments required for APAIMS 2.0, including development, testing, staging, and production environments.

### 3.11 Operations and Maintenance

- **Maintenance:** Following the system's Go-Live, comprehensive maintenance services will be provided for an extended period of five (5) years. This includes proactive system upkeep, timely application of bug patches, and implementation of any necessary updates pertaining to data formats or reports within the modules developed as part of this project. The technical support will be promptly addressed and resolve any user-reported issues, within 24 hours, ensuring the smooth functioning and optimal performance of the APAIMS 2.0 platform.
- **Operation Support:** To ensure seamless operation and user satisfaction by providing the frontline support, actively engaging with users to address queries, provide guidance, and help in maximizing the utility of the system. Their continuous presence and proactive approach will foster a collaborative environment, empowering users to leverage the full potential of the APAIMS 2.0 platform in their day-to-day operations.

### 3.12 Project Tasks (Not exhaustive)

The engagement with the on-boarded service provider will be milestone and deliverable-based, with a defined scope of work in a projectized mode.

S No.	Task	Description
1	Requirements Gathering	Conduct meetings with relevant stakeholders to gather requirements.
		Review existing systems and documentations
		Prioritization and approval of requirements list.
2	APAIMS 2.0 Solution Design	Creation of initial design drafts and prototypes.
		Review sessions with stakeholders for feedback.
		Finalization of design documents.
		Approval of the final design by the department.
3	Operationalization of APAIMS 1.0	Bug Fixes & Issue Resolution of APAIMS 1.0
		Updates and Upgrades of existing APAIMS 1.0

S No.	Task	Description
		Migration of APAIMS 1.0 components to APAIMS 2.0
4	Development and Deployment of APAIMS 2.0 Platform on staging	Development and launching of APAIMS 2.0 platform with platform features such as Unified Database, Satellite Engine, GIS Engine, AI/ML Engine, Map Data Server Engine, Weather Data Engine, Model Engine and Manager, IoT Engine, Gen AI Engine, Voice and Translation Engine, Mobile Engine, Web Dashboard and Interfaces, User Access & Data Security
5	Development and Deployment of APAIMS 2.0 Modules on staging	Development of modules with required features and specifications envisaged in the scope., as per the guidelines of the scheme, DBT application as per GOI guidelines for Farm mechanisation Scheme.
6	Testing and UAT	Development of comprehensive test plans.
		Execution of tests and documentation of results.
		Iterative bug fixing and retesting cycles.
		Final validation and sign-off from QA team.
7	Development and Deployment of APAIMS 2.0 on Production	Detailed deployment plan creation.
		Execution of data migration and system configuration.
		User training sessions and materials distribution.
		Post-deployment monitoring and support setup
8	Providing Maintenance & Support activity	Operation Support and maintenance activity for a period of 5 years (T2)

## 3.13 Timeline for Tasks (Tentative)

S No.	Task	Time line proposed (T= Work order date)
1	Requirements Gathering	T+ 1 Month
1.1	Conduct meetings with relevant stakeholders to gather requirements.	
1.2	Review existing systems and documentations	
1.3	Prioritization and approval of requirements list.	
2	APAIMS 2.0 Solution Design	T+ 2 Months
2.1	Creation of initial design drafts and prototypes.	
2.2	Review sessions with stakeholders for feedback.	
2.3	Finalization of design documents.	
2.4	Approval of the final design by all stakeholders.	
3	Development and Deployment of APAIMS 2.0 Platform on staging	T+ 3 Months
4	Operationalization of APAIMS 1.0	T+ 3 Months
4.1	Updates and Upgrades of existing APAIMS 1.0 modules	
4.2	Leveraging APAIMS 1.0 components in APAIMS 2.0	
4.3	Migration of APAIMS 1.0 to APAIMS 2.0	
5	Development and Deployment of APAIMS 2.0 Modules on staging	T+ 4 Months to T+15 Months
6	Testing, UAT and Go Live of each Module	T+ 4 Months to T+15 Months
6.1	Development of comprehensive test plans.	
6.2	Execution of tests and documentation of results.	
6.3	Iterative bug fixing and retesting cycles.	
6.4	Final validation and sign-off from QA team.	
7	Development and Deployment of APAIMS 2.0 on Production	T+15 Months = T1
7.1	Detailed deployment plan creation.	
7.2	Execution of data migration and system configuration.	
7.3	User training sessions and materials distribution.	
7.4	Post-deployment monitoring and support setup	
8	Providing Maintenance & Support activity	T1 + 60 months

## 3.14 Module wise details with comprehensive MIS and GIS reports and Dashboards

Milestone Number	Name of the Milestone	Task/Module to be completed during the Milestone
1	Initialisation and infrastructure Requirement	Operationalization of APAIMS 1.0
		All APAIMS 2.0 Platform Features
		One Unified Cultivator & Agriculture Database
		One Mobile Application for Cultivators
		Department Official One Mobile Application
2	Farmer oriented Services & Advisories	Sowing Advisory
		Crop Planning
		Pest & Disease Forewarning
		Pictorial Analysis for Pest and Disease and Remedial Advisory
		Irrigation & Water Stress Advisory
		Departmental Process Automation & Task Management
3	Weather event alerts and Inputs	Crop Sowing Advisory Monitoring
		Extreme Weather Event Alerts
		Gen-AI Cultivator Helpdesk (Pilot in 2 districts)
		Analytics on Inputs Supply Management
		Analytics on Input Quality Monitoring
		Integration with Department's Integrated Call Centre
4	Deep tech analysis	Agro-Climatic Crop Zone based Crop Planning
		Crop Classification & Acreage for major 6 crops
		Pictorial Analysis for Pest & Disease Detection for Department
		Crop Health Monitoring for major 6 crops of the state
		Harvesting Assessment for major 6 crops of the state
		Extreme Weather Event (Drought & Flood)
		GenAI – Agriculture Assistant for Department Officials
Integration of Crop Yield Assessment (Major Crops)		
5	Departmental workflow and integration	Scheme & DBT Module
		Agriculture Market Intelligence System for Cultivators
		Scheme Monitoring
		Crop Loss Reporting & Workflow
		Carbon Assessment (Pilot for 2 Districts)
		Agriculture Market Intelligence System for Department
		FPOs/Farmer Groups
		Increase of Cultivable Land in the state
		Integration with RoR database, State & Central Systems

## 3.15 Ownership of the Software:

The ownership of the software developed by the successful bidder will reside with the Department of Agriculture. The bidder must maintain the source code in a version control system and provide administrative privileges to the department from the outset of the project. The developer shall provide the Source Code to the department once in six months invariably or whenever requested by the department as per requirement.

In the event of contract termination by either party or upon completion of the contract period, the following conditions apply:

- The bidder shall facilitate a comprehensive knowledge transfer to the agency identified by the department, at no additional cost. This includes returning all technical documentation, operational manuals, source code with version control logs, and all project-related reports/credentials to the department, ensuring a smooth transition.
- Provide complete Knowledge Transfer to the agency identified by the department at no additional cost. Assist the department-designated agency with fulfilling all software requirements to ensure seamless operation of the application at no additional cost.
- The final payment to the service provider will be made only upon submission and acceptance of all required deliverables during the exit management process, including all documentation, source code, and any additional assets as outlined above.

### 3.16 Department Officials:

1. HOD – Director of Agriculture
2. Sections – All sections of Commissionerate of Agriculture
3. DAOs – DAOs of all the 26 districts
4. ADAs – 155 ADAs in the state
5. MAOs – 670 MAOs in the state
6. RSK – 10778 RSK level staff
7. Line departmental officers – as per need

### 3.17 Help Desk

- The successful bidder shall position 5-6 persons in the O/o Commissioner and Director of Agriculture, AP in assisting the user viz., departmental officers, farmers etc.
- Ticketing system shall be developed for receiving issues and to resolve them in time.
- Setting up of help desk and developing required software throughout the contract period, this shall be borne by the successful bidder.
- Key functions of help desk are

### 3.18 Development of website for Agriculture Department:

- A comprehensive, interactive, informative website to be designed and developed for the Agriculture department integrating all the Applications of departmental, allied and other departments of state and central with reports/dashboards that can be accessed by the farmers, department officials at various levels in their respective logins (HOD, Sections of Commissionerate, DAOs, ADAs, MAOs, RSK staff).

## 1. User Support and Issue Resolution

- Respond promptly to user queries via phone, email, chat, or ticketing systems.
- Diagnose and resolve technical hardware and software issues.
- Guide users through troubleshooting steps or escalate issues when necessary.
- Document issues and resolutions for future reference.

## 2. Incident Management

- Log, track, and manage all incidents and requests in the IT ticketing system.
- Prioritize and categorize tickets based on severity and impact.
- Ensure timely resolution of incidents in accordance with Service Level Agreements (SLAs).
- Coordinate with other IT teams or third-party vendors for resolution.

### 3. System Monitoring and Maintenance



- Monitor IT systems and infrastructure for performance and potential issues.
- Perform routine system checks and maintenance tasks, such as updates or backups.
- Report any irregularities or outages to appropriate teams.

#### 4. Knowledge Management

- Create and maintain a knowledge base of common issues and solutions.
- Update documentation related to system processes, user guides, and FAQs.
- Provide training or resources to users for self-help on recurring issues.

#### 5. Communication and Reporting

- Provide regular updates to users on the status of their issues.
- Escalate unresolved issues to higher-level technical support or management.
- Generate and analyze help desk performance reports (e.g., ticket resolution time, user satisfaction).

#### 6. Hardware and Software Support

- Provide support for standard and proprietary software used within the organization.
- Manage user access and permissions for systems and applications.

#### 7. Security and Compliance

- Enforce security protocols, including password policies and access controls.
- Respond to and escalate cybersecurity incidents, such as phishing attempts or malware infections.
- Educate users on best practices for IT security.

#### 8. Continuous Improvement

- Identify trends in user issues and recommend solutions to prevent recurring problems.
- Proactively suggest upgrades or changes to improve system reliability and efficiency.
- Participate in projects for system upgrades, migrations, or new implementations.

#### 9. Customer Service

- Maintain a professional, patient, and customer-oriented approach in all interactions.
- Strive to achieve high user satisfaction through effective communication and resolution of issues.

#### 10. Other Responsibilities

- Stay updated on new technologies and tools relevant to the organization's IT environment.
- Support other IT functions, such as network or server administration, when required.

## 4.0 Pre-qualification Criteria

S. N o	Particulars/ parameters	Documents to be submitted
<b>Legal Entity</b>		
1	<p>a. The Bidder should be a Company registered under the Indian Companies Act and shall be primarily in the business of providing Information Technology Software Development or System Integration or IT Solution Implementation services. The Company should have been in business for at least 5 (Five) financial years as on 31st March 2024.</p> <p>b. Joint Ventures or Consortiums are not allowed.</p> <p>c. GST Registration certificate.</p> <p>d. The Bidder should have at least one office in any of the 26 districts of AP. Billing/Invoice should be done from offices located in AP only. In case, Bidder does not have office in AP as on bid submission date, should submit an undertaking in Pre-qualification bid, to open the office in AP and register for AP GST. All Invoices should be raised with APGST Number only.</p>	<p>1. Certificate of Incorporation of the Bidder to be enclosed.</p> <p>2. Certificate of GST</p> <p>3. Office Address in AP</p>
<b>Blacklisting</b>		
2	<p>The bidder declared blacklisted/ ineligible/ debarred by any State / Central Government or PSU or has been found to have been engaged in activities or practices which are corrupt, fraudulent, Non-Satisfactory work performed or any other unethical business practices, as on date of bid submission, shall not be eligible.</p>	<p>3. Self-Declaration from the Bidder as per from authorized signatory of the firm</p>
<b>Financial Criterion</b>		
3	<p>The Minimum annual turnover per year should be INR 30 Cr at least for 3 years in the past 5 (Five) years and profit making for each of the last 3 (Three) years. The revenues should have accrued from software development in Agriculture and dependent sectors viz., Horticulture, Sericulture, Animal Husbandry, Agriculture Marketing, Weather, Climate, Irrigation, Water resources, Fisheries, Forestry. (Hardware, Drone Surveys, field surveys, Satellite data supply, and Proprietary software supply will not be considered).</p>	<p>4. The bidder should submit audited financial statements and a certificate of revenue composition by the Auditor for FY 19-20, 20-21, 21-22, FY 22-23 and FY 23-24 and all the related documents</p>

4	The bidder shall have minimum positive net worth during last 5 (Five) years.	The bidder should submit audited financial statements and a certificate of revenue composition for each of the 3 years by the Auditor for FY 21- 22, FY 22-23 and FY 23-24.
<b>Prior Experience</b>		
5	<p>The bidder must have successfully executed/completed Services in the last five years for any state/Central or organizations in India or abroad.</p> <ol style="list-style-type: none"> <li>1. Similar Projects: Satellite based IT Monitoring and Management systems in Agriculture or related fields</li> <li>2. Satellite Data Processing: Employ machine learning or scientific algorithms to analyze satellite data for insights into crop health/crop acreage, and other related metrics.</li> <li>3. Geospatial Processing and Analytical Capabilities: Provide tools for processing and analyzing geospatial data.</li> <li>4. AI &amp; Cloud-Based System: Develop AI based applications and manage cloud-based solutions.</li> <li>5. Integration with Third-Party Data Sources: Integration of data from external sources, such as weather services etc.</li> </ol>	<p>5. Provide references along with the necessary contract, purchase order (PO), or work order (WO) or Letter from the client or experience certificate</p> <p>Each reference should include the client's name, the scope of work, the project start date, and the completion date of the installation.</p> <p>Include a certificate from the client confirming the successful implementation and operation of the project.</p>
<b>EMD</b>		
6	Submission of EMD for an amount of Rs.25.00 Lakhs	6. Details of DD/Bank Guarantee. For EMD payment – To be followed as per the AP e-Procurement portal norms.
<b>Certifications</b>		
7	CMMI Level 5 Certificate or above in in Software Application Development	7. Copy of the Certificate
8	ISO 9001:2015 for Quality Management System in in IT/ ICT/Software Development / GIS related activities /Cloud hosting and Spatial Decision Support System	8. Copy of the Certificate
9	Valid ISO 27001:2013 for Information Security Management, Open-Source Technologies, Remote Sensing, AI&ML	9. Copy of the Certificate

## Instructions to Bidders

### 4.1 Completeness of Response

Bidders are advised to study all instructions, forms, requirements and other information in the RFP documents carefully. Submission of the bid shall be deemed to have been done after careful study and examination of the RFP document with full understanding of its implications. The response to this RFP should be full and complete in all respects. Failure to furnish all information required by the RFP documents or submission of a proposal not substantially responsive to this document will be at the Bidder's risk and may result in rejection of their proposal.

### 4.2 Proposal preparation costs & related issues

The bidder is solely responsible for all costs incurred in connection with participation in this process, including, but not limited to, costs incurred in conduction of informative and other diligence activities, participation in meetings/ discussions/ presentations, preparation of proposal in providing any additional information required for facilitating the evaluation process and any other related expenses.

Department, will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

This RFP does not commit to award a contract or to engage in negotiations. Further, no reimbursable cost may be incurred in anticipation of award or for preparing this RFP.

### 4.3 Pre-bid Meeting

Department of Agriculture shall hold a pre-bid meeting (Either virtually or physically – Interested bidders may obtain the Webex link of Pre-bid meeting by sending a mail to [digicellap@gmail.com](mailto:digicellap@gmail.com) under copy to [comagr.ap@gmail.com](mailto:comagr.ap@gmail.com) ) with the prospective bidders for clarifying on the bid conditions and other related aspects. All and any other queries related to scope of work, payment terms and mode of selection will be entertained during Pre-bid clarifications meeting.

Max. Two (2) authorized representatives of the company will be permitted to attend pre-bid meeting.

### 4.4 Responses to Pre-bid Queries and Issue of Corrigendum

Department of Agriculture will try to provide timely response to all queries. However, Department of Agriculture makes no representation or warranty as to the completeness or accuracy of any response made in good faith, nor does Department of Agriculture undertake to answer all the queries that have been posed by the bidders.

At any time prior to the last date for receipt of bids, Department of Agriculture may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder, modify the RFP Document through a corrigendum.

The Corrigendum (if any) & clarifications to the queries from all bidders will be posted in the portal in <http://www.apecurement.gov.in> . Any such corrigendum shall be deemed to be incorporated into this RFP.

To provide prospective bidders reasonable time for taking the corrigendum into account, Department of Agriculture may, at its discretion, extend the last date for the receipt of RFP Proposals.

#### 4.5 Right to terminate the process

Department of Agriculture may terminate the RFP process at any time and without assigning any reason. Department of Agriculture makes no commitments, express or implied, that this process will result in a business transaction with anyone. This RFP does not constitute an offer by Department of Agriculture. The bidder's participation in this process may result in short listing of the bidder.

#### 4.6 Preparation of Proposals

The Proposal as well as all related correspondence exchanged by the bidders and Department of Agriculture shall be written in English language, unless specified otherwise. In preparing their Proposal, Bidders are expected to examine in detail the documents comprising the RFP. Material deficiencies in providing the information requested may result in rejection of a Proposal.

The Technical Proposals shall contain an Executive summary giving a brief overview of the way the bidder proposes to achieve the outcomes and the assessment of resources required.

The bidder is expected to submit the Technical Proposal as per the format given in Appendix II. Submission of wrong type of Technical Proposal will result in the proposal being deemed non-responsive. The Technical Proposal shall not include any financial information.

The Financial Proposal shall be submitted through e-Procurement portal only.

#### 4.7 Submission of Responses

The bidder shall submit (2) proposals – Technical Proposal (Offline – to be handed over to the department at IHC Corporate, Mangalagiri, Guntur Dist on the specified date & time) and Financial Proposal (online in an e-procurement portal only) on or before specified time/date at Department of Agriculture,

The bidder shall scan all the Technical documents that are going to be submitted and keep with them in order to upload them in the e-Procurement portal also.

The original proposal of both Technical and Financial shall contain no interlineations or overwriting, except as necessary to correct the errors made by the bidders themselves. The same authorized representative who has signed the proposal shall initial the corrections.

An authorized representative of the bidders shall sign in all the pages of the original Technical and Financial Proposals. The authorization shall be in the form of written power of attorney accompanying the proposal and supported by any evidence that the representative has been duly authorized to sign.

One set of the documents necessary for Qualification as per the format given in Appendix-I, shall be submitted. An authorized representative of the bidders shall initial all pages of Qualification documents submitted.

#### 4.8 Bid Submission Formats

- a. The entire proposal shall be strictly as per the format specified in this Invitation for Request for Proposal and any deviation may result in the rejection of the RFP
- b. The documents to be submitted for Qualification are:
  - i. General Information of the Bidder – Form PQ#1
  - ii. Financial Turnover – Form PQ#2
  - iii. Past experience details – Form PQ#3
  - iv. Declaration regarding Clean track record – Form PQ#4
  - v. Acceptance of the terms & conditions of the Tender – Form PQ#5
  - vi. Undertaking on Litigations – Form PQ#6
- c. The documents to be submitted for Technical Proposal are:
  - i. Executive Summary
  - ii. Description of approach, methodology. T#1
- d. Commercial quote to be submitted on <http://www.apecurement.gov.in> portal only

#### 4.9 Venue and deadline for submission

- a) Technical Proposals must be submitted at Agriculture Commissionerate, IHC Corporate, Bus Depot Road, Mangalagiri, Guntur Dist, Andhra Pradesh PIN:522503 on or before the last date & time given. Presentations are also to be done in the same venue.
- b) The bidders should take care in submitting their bids & supporting documents well in advance so as to avoid last minute rush & failures. Department of Agriculture will not entertain any such complaints.
- c) The bids submitted by telex/telegram/fax/e-mail, etc., shall not be considered. No correspondence will be entertained on this matter.
- d) Department of Agriculture reserves the right to modify and amend any of the above-stipulated condition /criterion depending upon assignment/project priorities vis-à-vis urgent commitments.

#### 4.10 Short listing Criteria

- a) Department of Agriculture will shortlist bidders who meet the Qualification criteria mentioned in this Invitation to RFP.
- b) Interested bidders shall pay EMD in the form of Bank guarantee or Demand Draft for Rs 25 Lakh (Rupees Twenty Five Lakhs only – Payable in the name of Director of Agriculture, Andhra Pradesh) along with the technical bid enclosures. EMD shall be valid till 120 days of the date of bid.

- c) Any attempt by a Bidder to influence the bid evaluation Process may result in the rejection of their bid Proposal.

#### 4.11 Evaluation Process

- a) The evaluation will be i.e., PQ, TQ (offline) & Commercial (Online Only) on the proposal submitted by the bidders.
- b) The bidders will be shortlisted based on the Qualification criteria as given in this RFP document.
- c) The bidders who qualify in PQ evaluation will be eligible for opening of Technical Evaluation & also bidder should arrange for technical presentation on the understanding of the scope of work, approach and methodology if required as well as demo of the AIMS (Agriculture Information Management System) already developed in any of the other states.
- d) The bidders have to score a minimum of 75 marks in technical evaluation to be considered eligible for Financial Evaluation.
- e) The Financial Proposal of those bidders who get more than 75% marks, in the Technical Evaluation shall be considered for commercial bid evaluation.
- f) Financial proposals of the technically qualified bidders will only be opened.
- g) The overall evaluation criteria – Quality and Cost based Selection (QCBS) shall be 80:20 i.e. 80% weightage to the technical evaluation (technical evaluation criteria as per section 5 of this EOI) and 20% weightage to financial evaluation.
- h) In financial evaluation L1 bidder will be given 100 %Marks i.e 20 marks. Marks for other bidders will be given using the formula (L1 Price/Bidder Price)\*20
- i) The proposals will be ranked in terms of the overall scores obtained from Highest to Lowest. The bidder with the highest overall score will be considered for award of contract & will be issued L1 after commercial negotiations with the Department of Agriculture, AP, Guntur.

#### 4.12 The Technical Proposal shall cover the following:

- a) Core business areas of operation, number of years in the business, ownership and organizational structure of firm.
- b) Client and Project brief details of similar projects.
- c) Audited financial statement for the last three (3) years showing financial capability as specified.
- d) Project Plan for the technical partnership covering scope of work.
- e) Any other relevant information.

#### 6.0 Technical Evaluation Criteria

The bidder should attain a qualifying score of 75 marks for qualifying in technical evaluation and to be further considered for Commercial evaluation. The committee constituted will evaluate each criterion against set parameters given by the department.

S No	Evaluation Criteria	Max Score
I	Past Experiences and Technical Expertise	25
a	<p>Implementation of AIMS or Similar kind of applications in any State/Central governments or organizations in India or abroad, with minimum project value of Rs. 8.0 Cr. The following is the Criteria:</p> <p>a. Value of all the projects – Maximum 20 Marks</p> <p>i) Project/ Projects worth 24 Cr and above – 20 marks</p> <p>ii) Project/ Projects worth 16- 24 Cr – 15 marks</p> <p>iii) Project/ Projects worth 8 -16 Cr – 10 marks</p> <p>b. Experience in Software Development of Open source based GIS Projects – The bidder should have experience in executing large integrated cloud based Geo-spatial Software – Maximum 5 marks</p>	
II	Demonstration of the Application/s	25
a	<p>Based on the above Scenarios 1 or 2 or 3</p> <p>Demonstration of technologies relevant to the modules of the RFP : 25 Marks</p> <p>No Demonstration : Zero Marks</p>	
III	Project Management and Work Plan	30
a	<p>Project Management Framework</p> <p>The proposal should clearly and concisely define the project management framework that shall be followed by the bidder. The framework should contain at least but not limited to the following:</p> <p>a. The Project Organization &amp; Quality Management Strategy – 5 Marks</p> <p>b. Communication Management Strategy – 5 Marks</p> <p>c. Configuration Management Strategy – 3 Marks</p> <p>d. Risk Management Strategy - Highlight the associated risks/problems and plans for mitigation and explain the technical approach it would adopt to address them – 2 Marks</p>	15
b	<p>Work Plan:</p> <p>Apart from the detailed Project Plan proposed by the Bidder, the following has to be provided which would be evaluated in the following parameters: -</p> <p>a. Go- Live and Operational Plan – 7 Marks</p> <p>b. O &amp; M Plan – 5 Marks</p> <p>c. Integration Plan – 3 Marks</p>	15
IV. Technologies to be demonstrated: (as developed in their similar application) 20		
	<ul style="list-style-type: none"> <li>• Satellite Engine : 2 Marks</li> <li>• GIS Engine : 2 Marks</li> <li>• AI &amp; ML Engine : 2 Marks</li> <li>• Map Data Engine : 2 Marks</li> <li>• Weather Data Engine : 2 Marks</li> </ul>	



• Pictorial Analysis Engine	: 2 Marks	
• IoT Engine	: 2 Marks	
• Gen AI Engine	: 2 Marks	
• Voice & Translation Engine	:2 Marks	
• Mobile Engine	: 2 Marks	
<b>Total</b>	<b>I + II + III + IV</b>	<b>100</b>

A detailed live demonstration, on the similar kind of work done, demonstrating use of each technology developed in their application that is mentioned in this RFP, shall be made by the bidder on all the above.

#### 7.0 Statement of important limits/values related to bid

S No	Item	Description
1	Bid Validity Period	30 days from the date of opening of bids.
2	Period for signing contract	Within 10 days from date of receipt of Notification of Award
3	Payment Terms	As per RFP
4	Conditional bids	Not acceptable and liable for rejection
5	Eligibility Criteria	As per RFP
6	Bid Submission	Bidders are requested to submit the bids after issue of minutes of the pre bid meeting duly considering the changes made if any, during the pre bid meeting. Bidders are totally responsible for incorporating /complying the changes /amendments issued if any during pre bid meeting in their bid.
7	Procedure for Bid Submission	Bids shall be submitted at Commissionerate office, Mangalagiri.

#### 8.0 General Instructions to bidders

##### 8.1 Definitions:

- (a) Tender call or invitation for bids means the detailed notification seeking a set of solution(s), service(s), materials or any combination of them.
- (b) Specification means the functional and technical specifications or statement of work, as the case may be.
- (c) Firm means a Company, Authority, Society, Trust, Co-operative or any other Organization incorporated under appropriate statute as is applicable in the country of incorporation.
- (d) Bidder means any firm offering the solution(s), service(s) and/or materials required in the tender call. The word Firms/bidder when used in the pre award period shall be synonymous with bidder and when used after award of the contract shall mean the successful bidder with whom Department of Agriculture signs the contract for rendering of goods and services.

- (e) Qualification and Technical bid means that part of the offer that provides information to facilitate assessment by Department, professional, technical and financial standing of the bidder, conformity to specifications etc.
- (f) Financial Bid means that part of the offer, that provides price schedule, total project costs etc.
- (g) Bid means the qualification bid, Technical submitted at Commissionerate and financial bid on <http://www.apecurement.gov.in/> portal only.
- (h) Goods and services mean the solution(s), service(s), materials or a combination of them in the context of the tender call and specifications.
- (i) The word goods when used singly shall mean the hardware, firmware component of the goods and services.
- (j) Maintenance period means period mentioned in bid document for maintaining the systems as scope of work.
- (k) EMD of Rs.25.00 Lakhs will be kept with the Department till the completion of the process of the RFP. The EMD will be returned to the L1 Bidder up on submission of Performance Bank Guarantee.
- (l) The EMD for rest of the bidders will be returned after awarding the contract to the successful L1 bidder. No interest will be paid for the period till return of the EMD BGs.

## 8.2 General Eligibility

- a. This invitation for bids is open to all firms both from within and outside India, who are eligible to do business in India under relevant Indian laws as is in force at the time of bidding subject to meeting the pre-qualification criterion.
- b. Bidders marked/considered by Department of Agriculture to be ineligible to participate for non-satisfactory past performance, corrupt, fraudulent or any other unethical business practices shall not be eligible.
- c. Bidder/ blacklisted by any Central or State Govt. / Quasi –Govt. Departments or organizations as on bid calling date for non-satisfactory past performance, corrupt, fraudulent or any other unethical business practices shall not be eligible.
- d. Breach of general or specific instructions for bidding, general and special conditions of contract with Department of Agriculture or any of its user organizations may make a firm ineligible to participate in bidding process.

## 8.3 Bid forms

- a. Wherever a specific form is prescribed in the bid document, the bidder shall use the form to provide relevant information. If the form does not provide space for any required information, space at the end of the form or additional sheets shall be used to convey the said information.

- b. For all other cases the bidder shall design a form to submit the required information.

#### 8.4 Cost of bidding

- a. The bidder shall bear all costs associated with the preparation and submission of its bid, and Department of Agriculture will in no case be responsible for those costs, regardless of the conduct or outcome of the bidding process.
- b. Bidder is expected to examine all instructions, forms, terms, and specifications in the bidding documents. Failure to furnish all information required by the bidding documents or to submit a bid not substantially responsive to the bidding documents in every respect will be at the bidder's risk and may result in the rejection of its bid.

#### 8.5 Clarification of bidding documents

- a. A prospective Firm / bidder requiring any clarification of the bidding documents may notify Department of Agriculture contact person either through phone or in person during office hours.
- b. The firms interested in bidding may inform through mail to [digicellap@gmail.com](mailto:digicellap@gmail.com) and link will be sent to them to participate in pre-bid meeting. Clarifications may be obtained in pre-bid meeting

#### 8.6 Amendment of bidding documents

- a) At any time prior to the deadline for submission of bids, Department of Agriculture, for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder, may modify the bidding documents by amendment.
- b) All prospective bidders are requested to see the ap e-procurement portal for any amendment which, will be binding on all bidders. No individual correspondence will be made from the department.
- c) In order to allow prospective bidders reasonable time to take the amendment into account in preparing their bids, the Department of Agriculture, at its discretion, may extend the deadline for the submission of bids.

#### 8.7 Period of validity of bids

- a. Bids shall remain valid for 90 days or duration specified in this document. A bid valid for a shorter period shall be rejected as non-responsive.
- b. In exceptional circumstances, the Department of Agriculture may solicit the bidders' consent to an extension of the period of bid & EMD validity. The request and the responses thereto shall be made in writing. The bid security shall also be suitably extended. A bidder granting the request will not be permitted to modify its bid.

#### 8.8 Submission of bids

- a. The bidders shall submit all the bids i.e., Qualification, Technical cover at O/o Commissioner & Director of Agriculture Guntur.

#### Deadline for submission of bids

- a. Technical Bids must be submitted not later than the bid submission date and time specified in the tender call notice.
- b. The Department of Agriculture may, at its discretion, extend this deadline for the submission of bids by amending the tender call, in which case all rights and obligations of the Department of Agriculture and bidders previously subject to the deadline will thereafter be subject to the deadline as extended.

#### 8.9 Late bids

Any bid not received by the Department of Agriculture contact person by the deadline for submission of bids will be rejected and returned unopened to the bidder, if approached.

#### 8.10 Modification and withdrawal of bids

- a. No bid can be modified subsequent to the deadline for submission of bids.
- b. No bid can be withdrawn in the interval between the deadline for submission of bids and the expiration of the period of bid validity.

#### 8.11 General Business information:

The bidder shall furnish general business information to facilitate assessment of its professional, technical and commercial capacity and reputation.

#### 8.12 Overview of financial bid

The financial bid should be quoted on [www.apecurement.gov.in](http://www.apecurement.gov.in) portal only. Any other form of financial quote will be rejected.

- i. Bid prices
  - a. Prices quoted by the bidder shall be fixed during the bidder's performance of the contract and not subject to variation on any account unless otherwise specified in this Tender document. A bid submitted with an adjustable price quotation will be treated as non-responsive and will be rejected.
- ii. Bid currency: Prices shall be quoted in Indian Rupees and inclusive of all applicable taxes.

#### 8.13 Performance Bank Guarantee

1. The successful bidder is required to furnish an unconditional and irrevocable Bank Guarantee for an amount equivalent to 10% of Contract / Purchase Order Value as quoted in the commercial bid in Favor of Director of Agriculture, Andhra Pradesh from any Nationalized / Scheduled Bank before signing of the contract. Performance security validity 60 days beyond Warranty period (T2). Failure of the successful bidder to comply

with the requirement of submitting the Performance Bank Guarantee shall constitute sufficient grounds for the annulment of the award and forfeiture of the EMD.

#### 8.14 Force majeure

- a. The Firms/bidder shall not be liable for forfeiture of its EMD, liquidated damages, or termination for default if and to the extent that their delay in performance or other failure to perform their obligations under the Contract is the result of an event of Force Majeure.
- b. For purposes of this clause, "Force Majeure" means an event beyond the control of the Firms/bidder and not involving the Supplier's fault or negligence and not foreseeable.  
Such events may include, but are not restricted to, acts of the Department of Agriculture in its sovereign capacity, wars or revolutions, fires, floods, epidemics, quarantine restrictions and freight embargoes.
- c. If a Force Majeure situation arises, the Firms/bidder shall promptly notify the Department of Agriculture in writing of such condition and the cause thereof. Unless otherwise directed by the Department of Agriculture in writing, the Firms/bidder shall continue to perform its obligations under the Contract as far as is reasonably practical and shall seek all reasonable alternative means for performance not prevented by the Force Majeure event.
- d. The decision of the Director of Agriculture, Andhra Pradesh is final

#### 8.15 Confidentiality and Intellectual Property Rights (IPR)

- a. Confidentiality:
  - The selected Bidder shall maintain complete confidentiality regarding all documents, maps, tools, and other data/information received in any form, including electronic media, for the execution of the project.
  - The selected Bidder shall use the Project data exclusively for the purpose defined in the scope of work outlined in the document, including any additions or amendments made prior to the signing of the contract.
  - Upon completion of the contract period, the selected Bidder must ensure the removal and destruction of all data in their possession. If it is discovered at any point that the Service Provider is using data provided by the Department of Agriculture, GoAP, during or after the contract period for any purpose other than what is specified, stringent legal actions will be taken in accordance with applicable laws, and the contract will be terminated without notice or justification.
  - The selected Bidder shall not disclose to any third party any information marked as confidential that has been communicated, made available, or accessible during the execution of the project.
- b. Intellectual Property Rights:  
The parties agree that the final output, whether referred to as a dashboard, visualization, or by any other name, generated during the service delivery will be the

exclusive property of GoAP. Both parties acknowledge and agree that all work products and Intellectual Property Rights related to the software platform, including but not limited to reports, curricula, specifications, outlines, drafts, software, map-based infrastructure, shapefiles, source code, and any other materials in any medium, which are prepared and/or developed by the Service Provider, shall remain the sole and exclusive property of the Service Provider, with a license granted to GoAP for its use.

c. Use of documents and Information:

- The bidder/selected bidder shall not, without the prior written consent of Department of Agriculture, GoAP, disclose, share, or use the bid document, contract, or any provision thereof, nor any specification, plan, drawing, pattern, sample, or information provided by or on behalf of Department of Agriculture, GoAP in connection with the contract, to any person other than those employed by the bidder for the performance of the contract. Any disclosure to such employed individuals must be made in confidence and be limited to what is necessary for the performance of the contract.
- The bidder/selected bidder shall not, without the prior written consent of Department of Agriculture, GoAP, use any document or information made available for the project, except for the purpose of fulfilling the terms of the contract.
- The Service Provider shall submit the necessary source code and documentation to Department of Agriculture, GoAP, which shall have full rights over the source code. The Intellectual Property Rights (IPR) for the source code and related materials shall belong exclusively to Department of Agriculture, GoAP, and the Service Provider will not hold any rights to it. If changes are made to the source code or documentation, the Service Provider shall provide the updated source code and documentation to Department of Agriculture, GoAP, as required.

d. Indemnification:

- The Service Provider shall, at its own expense, defend and indemnify Department of Agriculture, GoAP against all third-party claims of intellectual property rights infringement, including but not limited to patent, trademark, copyright, trade secret, or industrial design rights, arising from the use of the products or any part thereof in the Client's country.
- The Service Provider shall expeditiously address and resolve any such claims, with full rights to defend itself. If Department of Agriculture, GoAP is required to pay compensation to a third party because of such infringement, the Service Provider shall bear full responsibility, including covering all expenses, court costs, and legal fees.
- Department of Agriculture, GoAP shall promptly notify the Service Provider of any such claim and shall provide reasonable assistance in handling the claim.
- Department of Agriculture, GoAP shall indemnify and defend the Service Provider against all third-party claims of intellectual property rights infringement, including

patent, trademark, copyright, trade secret, or industrial design rights, arising from the use of any information or software provided to the Service Provider by the Client under the contract.

#### 8.16 Risk Management

The Service Provider shall, at its own expense, implement an appropriate Risk Management strategy to address and mitigate all risks associated with this contract. The Service Provider is responsible for covering all risks related to its personnel assigned under this contract, as well as the equipment, components, and any other property belonging to its personnel during the entire duration of their involvement with this contract. The Service Provider shall take all necessary actions to minimize and manage these risks. Department of Agriculture, GoAP will not be held liable for any such risks.

#### 8.17 Termination for insolvency

Department of Agriculture may at any time terminate the contract by giving 30 days written notice to the Firms/bidder if the Firms/bidder becomes bankrupt or otherwise insolvent. In this event, termination will be without compensation to the Firms/bidder, provided that such termination will not prejudice or affect any right of action or remedy which has accrued or will accrue thereafter to the Department of Agriculture

#### 8.18 Termination for convenience

a. Department of Agriculture / Service Provider may at any time by giving 30 days written notice terminate the Contract, in whole or in part, for its convenience. The notice of termination shall specify that termination is for either of the parties' convenience, the extent to which performance under the Contract is terminated, and the date upon which such termination becomes effective. In case the Service provider issue notice for termination,

- i. The service provider shall continue the services, till an effective alternative is found by the Department of Agriculture, even beyond 30 days of notice period, without any disruption of services.
- ii. The Service Provide shall provide the KT and all other related/ required information to the agency identified by the Department till the agency gets well acquainted and familiar with the software, database, servers etc.
- iii. Payment pending to the service provider till the service period, will be paid, only after smooth transfer of KT and others as mentioned in point (ii).

b. In case of any deviations of the above, the PBG given by the service provider will be forfeited, the firm will be blacklisted and/or penalty will be levied as decided by the Department of Agriculture.

c. Department of Agriculture may in the following events after giving a prior notice and conducting investigations if required, terminate: -

- i. If the Bidder becomes Bankrupt or financially insolvent during the period of contract.
- ii. If it is found that the bidder has been convicted for any unlawful activities.

- iii. If it is found that bidder has made gross misconduct or involved in practices injurious to the image and interest of the Department or has failed in performing his duties as per contract.

#### 8.19 Resolution of disputes

- a. Department of Agriculture and the Firms/bidder shall make every effort to resolve amicably by direct informal negotiation any disagreement or dispute arising between them under or in connection with the contract.
- b. If, after thirty (30) days from the commencement of such informal negotiations, Department of Agriculture and the Firms/bidder have been unable to resolve amicably a contract dispute, either party may require that the dispute be referred for resolution to the formal mechanisms specified here in. These mechanisms may include, but are not restricted to, conciliation mediated by a third party.
- c. The dispute resolution mechanism shall be as follows:
  - o In case of a dispute or difference arising between Department of Agriculture and the Firm /bidder relating to any matter arising out of or connected with this agreement, such disputes or difference shall be settled at the Director of Agriculture and the decision of the Director of Agriculture will be the final.

#### 8.20 Governing language

The contract shall be written in English. All correspondence and other documents pertaining to the contract which are exchanged by the parties shall be written in same languages.

#### 8.21 Applicable law

The contract shall be interpreted in accordance with appropriate Indian Laws.

#### 8.22 Notices

- a. Any notice given by one party to the other pursuant to this contract shall be sent to the other party in writing or by e-mail and confirmed in writing to the other party's address.
- b. Notice shall be effective when delivered or tendered to other party whichever is earlier.

#### 8.23 Taxes and duties

The Firms/bidder shall be entirely responsible for all taxes, duties, license fee etc. incurred until delivery of the contracted services to Department of Agriculture or as per the terms of tender document if specifically mentioned.

#### 8.24 Standards

- The technology and quality of the service should be of the highest standards available in the present market.



- Before shipping, the identified Firm will inform Department of Agriculture giving full details about these standards and take approval.
- Adopt Local Government Directory (LGD) Codes as Location Masters to ensure uniformity and interoperability across systems.
- Implement Single Sign-On (SSO) functionality to provide seamless access for employees across multiple applications.
- Integration with GSWS Household Data for integrating Household/Resident IDs with the farmers' database to streamline data management.
- Adoption of Open-Source Software (OSS) over Closed Source Software (CSS) to ensure cost efficiency, flexibility, and ease of customization.

#### 8.25 Rejection of Bids

Besides other conditions and terms highlighted in the tender document, bids maybe rejected under following circumstances:

#### 8.26 Technical Rejection Criteria

- Bids submitted without EMD or with improper EMD
- Bids which do not conform to required validity period of the bid as prescribed in the Tender.
- Failure to conform to Technical eligibility & evaluation criteria as per this tender.
- If the information provided by the Bidder is found to be incorrect/ misleading at any stage/time during the Tendering Process.
- Any effort on the part of a Bidder to influence the bid evaluation, bid comparison or contract award decisions.
- Bids without signature of person (s) duly authorized on required pages of the bid.
- Bids without power of authorization and any other document consisting of adequate proof of the ability of the signatory to bind the Bidder.
- Technical Bid containing commercial details.
- Revelation of Prices in any form or by any reason before opening the Commercial Bid.
- Failure to furnish all information required by the tender Document or submission of a bid not substantially responsive to the Tender Document in every aspect.
- Failure to furnish proofs for information provided.
- Bidders not quoting for the complete Scope of Work as indicated in the Tender documents, corrigendum / addendum (if any) and any subsequent information given to the Bidder.
- Bidders not complying with the Technical and General Terms and conditions as stated in the tender Document.
- The Bidder not conforming to unconditional acceptance of full responsibility of providing services in accordance with the Scope of work and Service Levels defined in this tender.
- If the bid does not conform to the timelines indicated in the bid.

Any false declaration by the bidder during the bidding process, following action may be taken:

- Liable for Legal Action
- Forfeiture of entire PBG
- Forfeiture of any Released payments
- Blacklisting of the Vendor

#### 8.27 Commercial Rejection Criteria

- Incomplete Price Bid
- Price Bids in which prices are not quoted or zero price quoted
- Total price quoted by the Bidder does not include all statutory taxes and levies applicable.
- Conditional price bid.

#### 8.28 Right to terminate the process:

The Director of Agriculture has right to terminate the RFP process at any point of time without assigning any reason. Department of Agriculture makes no commitments, express or implied, that this process will result in a business transaction with anyone.

This RFP does not constitute an offer by Department of Agriculture. The bidder's participation in this process may result in short listing of the bidder.

#### 8.29 Negotiations

The Department reserves the right to negotiate with the successful bidder on the Prices quoted. The Department of Agriculture, Andhra Pradesh reserves the right to negotiate, if needed, with the L1 bidder to reach agreement on all points including the quoted price and signing of contract.

#### 8.30 Subcontracts

The Successful bidder shall NOT subcontract this contract in whole or in part.

#### 8.31 Liquidated Damages::

If, at any time during performance of the Contract, the bidder encounter conditions impeding timely delivery of Services, the Supplier shall promptly notify the Director in writing of the fact of the delay, it's likely duration and its cause(s).

As soon as practicable, after receipt of the Bidder's notice, the Director shall evaluate the situation and may, at his discretion, extend the Bidder's time for performance with or without liquidated damages.

a. For Delayed Delivery/Completion: If the successful bidder fails to deliver the products/services or complete the project within the stipulated time specified in the contract, the Department of Agriculture, AP reserves the right to impose Liquidated Damages.

b. For Non-Compliance with Service Level Agreements (SLAs): If the successful bidder fails to meet the agreed performance metrics or SLA requirements, Liquidated Damages will be applicable as specified.

### c. Rate of Liquidated Damages

- Delay in Delivery/Completion: Liquidated Damages shall be imposed at the rate of 0.5% of the total contract value per week of delay, subject to a maximum of 5.0% of the total contract value.
- Non-Compliance with SLAs: For each instance of non-compliance with SLAs, a penalty of Rs. 10,000 per day will be deducted from the payment due to the Contractor/Supplier.

### d. Conditions for Waiver

The Department of Agriculture, AP may waive the imposition of Liquidated Damages if the delay or non-compliance is caused due to:

- Force Majeure conditions as defined under the contract.
- Written approval of extension granted by the Director of Agriculture, AP.

### e. Maximum Cap on Liquidated Damages

The total Liquidated Damages imposed under this Agreement shall not exceed 10% of the total contract value. Once this limit is reached, the Purchaser reserves the right to terminate the contract.

### f. Payment of Liquidated Damages

The Liquidated Damages amount shall be deducted from the Contractor's/Supplier's invoice or recovered from the Performance Bank Guarantee (PBG) as decided by the Director of Agriculture, AP

### g. No Limitation on Other Remedies

The imposition of Liquidated Damages shall not preclude the Department of Agriculture from pursuing other remedies available under the law or the terms of the Agreement, including termination for default.

### 8.32 Bidders on failing to complete the Application:

If the successful bidder fails/unable to deliver the APAIMS 2.0 application and requests to terminate his order if any, then the successful bidder has to pay the department the finalized cost (T1) and also to forego the PBG.

## Check List of Documents

### Compliance/ Agreed/ Enclosed/ Deviation Statement

The following are the particulars of compliance/deviations from the requirements of the tender specifications.

Sl.No	Bid document reference	Remarks
1	Bid Letter form	
2	Certificate of Incorporation	
3	Certificate of GST	
4	Office Address in Andhra Pradesh	
5	Form PQ#1 – Bidder General Information	
6	Form PQ#2 – Bidder Turn over Details & positive Networth details	
7	EMD Details	
8	CMM – Level 5 Certification	
9	ISO 9001:2015 Certificate	
10	ISO 27001:2013 Certificate	
11	Form PQ#3 – Project Experience details	
12	Form PQ#4 – Declaration regarding clean track record	
13	Form PQ#5 – Acceptance of Terms & Conditions	
14	Form PQ#6 – Undertaking on Litigations	
15	Form T#1 – Understanding of the project. (Copy of the Presentation to be enclosed)	
16	Delivery period (No of Days for Go-Live)	

The specifications and conditions furnished in the bidding document shall prevail over those of any other document forming a part of our bid, except only to the extent of deviations furnished in this statement.

Place:

Bidder's Signature and Seal

Date:

NOTE: For every item appropriate remark should be indicated like, "no deviation", "agreed", "enclosed" etc. as the case may be.

## 9.1 Bid Letter Form

From:

(Registered name and address of the bidder.)

To:

The Director of Agriculture  
IHC Corporate, Bus Depot Road  
Mangalagiri - 522503  
Guntur Dist, Andhra Pradesh

Sir,

Having examined the bidding documents and amendments there on, we the undersigned, offer to provide services in conformity with the terms and conditions of the bidding document and amendments there on, for the following project in response to your tender call dated.....

Project title:

If our bid is accepted, we undertake to;

Provide services/ execute the work according to the time schedule specified in the bid document,

Agree to abide by the bid conditions, including pre-bid meeting minutes if any, which remain binding upon us during the entire bid validity period and bid may be accepted any time before the expiration of that period.

We understand that you are not bound to accept the lowest or any bid you may receive, nor to give any reason for the rejection of any bid and that you will not defray any expenses incurred by us in bidding.

Place: Bidder's signature and seal.

Date:

## 9.2 APPENDIX I

## Pre Qualification (PQ) Proposal submission forms

## Form – PQ#1: Bidder's General Information

1	Name of the Company/ Firm	:	
2	Date of Incorporation (Number & Registering Authority) GST No., PAN No.	:	
3	Legal Status of the Company in India And nature of Business in India	:	
4	Address of the Registered Office in India	:	
5	Date of Commencement of Business	:	
6	Name & e-mail id, phone number, fax of the Contact person	:	
7	Web-Site URL	:	
8	Quality Certifications attained by the firm – ISO 9000 certification or any other Internal Quality System with defined quality policy and standard quality procedure.	:	
	Issue Date	:	
	Expiry Date	:	

Place:

Bidder's Signature and Seal

Date:

## 9.3 Form - PQ#2: Bidder's Turnover Details

(All values in Rs. Lakhs)

Financial Information of Bidder				
S No	Financial Year	Turnover of the firm in	Total Profit after Tax	Net Worth of Company
	(1)	(2)	(3)	(4)
1	FY.2019-20			
2	FY.2020-21			
3	FY.2021-22			
4	FY.2022-23			
5	FY.2023-24			

## Note:

1. Turnover in areas other than mentioned above shall not be considered for evaluation.
2. Please attach audited Balance Sheets and IT return statements to confirming the figures mentioned in columns (2).
3. Bidder should submit any of the Audited balance sheet / Profit & Loss statement / certificates from CFO of the Company duly audited by the Chartered Accountant and certified by the Company Secretary for all the above stated three financial years.

Auditor (Signature &amp; Seal)

Place:

Bidder's Signature and Seal

Date:

9.4 Form – PQ#3: Bidder’s Project Experience Details

Bidder should provide the details of projects executed meeting the pre-qualification criteria:

Description of Item	Supporting Document with Page Number
Project Description	
Name of the Client / Department	
Contact address & details of the department	
Value of the Project	
Date of Start of Work	
Date of Completion of Work	
Description of Work	
Bidder should submit any of the following: i. Work orders from client dept.  ii. Work satisfactory certificate from the client dept.	

Note:

6. Please submit supporting documents to support the claim and the certificates must be signed by Senior Executive/ Deputy GM of the organization clearly indicating his/her name, designation and contact details such as Telephone Number, Fax number, email-id etc.

Place:  
Date:

Bidder’s Signature and Seal



## 9.5 Form – PQ#4: Declaration Regarding Clean Track Record

To:

The Director of Agriculture  
IHC Corporate, Bus Depot Road  
Mangalagiri - 522503  
Guntur Dist, Andhra Pradesh

Sir,

I have carefully gone through the Terms & Conditions contained in the RFP Document [No.\_\_\_\_\_]. I hereby declare that my company/ Consortium Partners has not been Debarred/ blacklisted as on Bid calling date by any Central or State Government/ Quasi Government Departments or Organizations in India for non-satisfactory past performance, corrupt, fraudulent or any other unethical business practices. I further certify that I am competent officer in my company to make this declaration.

Yours faithfully,

(Signature of the Bidder)

Printed Name

Designation

Seal

Date:

Business Address:

Undertaking on Acceptance of Terms and Conditions in Tender  
(On company letter head)

9.6 PQ#5 :Undertaking on Acceptance of Terms and Conditions of Tender

Date: dd/mm/yyyy

To,  
The Director of Agriculture,  
Department of Agriculture,  
Chuttugunta, Guntur - 522004  
Andhra Pradesh.

Sir / Madam,

Sub.: Undertaking on acceptance of terms and conditions of this Tender.

Ref.: Tender No: <TENDER REFERENCE NUMBER> Dated <DD/MM/YYYY>

I have carefully gone through the Terms & Conditions contained in thistender document.

I hereby confirm that all the provisions of this tender Document & Corrigendum / Addendum issued are acceptable to my company. I further certify that I am an authorized signatory of my company and am, therefore, competent to make this declaration.

Yours faithfully,

Authorized Signatory

Name of Signatory:

Date:

Place:

Note: This undertaking should be on the letter head of the bidder and should be duly signed and sealed by the authorized signatory of the bidder.

## 9.7 PQ#6 : Undertaking on litigation(s)

(On company letter head)

To,

The Director of Agriculture,  
Department of Agriculture,  
ChuttuguntaCenter, Guntur - 522004  
Andhra Pradesh.

Undertaking on litigation(s)

This is to certify that << COMPANY NAME >> is not involved in any major litigation that may have an impact of affecting or compromising the delivery of services as required under this Tender.

Yours faithfully,

Authorized Signatory

Name of Signatory:

Date:

Place:

Note: This undertaking should be on the letter head of the bidder and should be duly signed and sealed by the authorized signatory of the bidder.

9.8 APPENDIX II

Form – T1: Understanding of the project

Presentation to be given by the bidder as per the Technical evaluation parameters

Place:  
Date:

Bidder's Signature and Seal

### 9.9 APPENDIX III

#### Form C#1: Commercial Proposal

*To be submitted in the e-Procurement portal only*

The quoted price shall be for T2 (Five years) as mentioned in the Tender document which includes design, development and maintenance of website, dashboard, reports etc inclusive of all the GST, any other costs, logistics, fees that were incurred, to be incurred for the coming 5 years. The department hold no responsibility other than the quoted price.

9.10 Performance Bank Guarantee (PBG)

Performance Bank Guarantee (PBG)

To,  
The Director of Agriculture,  
Department of Agriculture,  
Chuttugunta Center, Guntur - 522004  
Andhra Pradesh.

WHEREAS ..... (Name of Bidder)hereinafter called "the Bidder" has undertaken , in pursuance of Tender ID..... dated,..... 20\_ to provide Software services pertaining to the Design, Development and Maintenance of APAIMS for 5 years herein after called "the Contract".

AND WHEREAS it has been stipulated by you in the said Contract that the Supplier shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with the Bidder's performance obligations in accordance with the Contract.

AND WHEREAS we have agreed to give the Bidder a Guarantee:

THEREFORE WE hereby affirm that we are Guarantors and responsible to you, on behalf of the Bidder, up to a total of ..... (Amount of the Guarantee in Words and Figures) and we undertake to pay you, upon your first written demand declaring the Bidder to be in default under the Contract and without cavil or argument, any sum or sums within the limit of ..... (Amount of Guarantee) as aforesaid, without your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

This guarantee is valid until the .....day of.....20\_\_.

Signature and Seal of Guarantors

.....  
.....  
.....

Date ..... 20\_\_

Address:.....

.....  
.....