8-Water Security For Bundelkhand

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ABSTRACT

The Bundelkhand region which span across thirteen districts in two states, MP and UP has a long standing history of droughts and famines. The impact is worst on not only humans but on the entire biodiversity of the region. Hundreds of cattle, birds, monkeys, and dogs have died in Bundelkhand during this summer due to scarcity of water in soaring heat. This all happens even though the Bundelkhand has five rivers - Betwa, Yamuna, Kunwari, Satlej and Pahuj - but most of them have seen a depletion in water over the years. Its time to revive the rivers and watershed structures in the region with the help of technology to enable sustainable growth for Bundelkhand. Improvement in water management has a multiplicative effect on these livelihoods: starting from the primary impact on water availability for agriculture, to the downstream impacts on increased crop yields and rural incomes which lead to better health and education outcomes for small landholding farmer families. The singular objective is to achieve "Sustainable Bundelkhand".

About Vassar Labs

Vassar Labs has a span history of growth and success, founded in 2014. Vassar Labs provides solutions to bring last-mile Visibility and Decision Support to empower authorities and communities to take appropriate actions for Sustainability. Vassar Labs brings together data from Sensors, Satellite Data, Drone, Mobile Applications, SCADA, Web Scraped Data and Mathematical & Hydrological Models to enable decision making in scientific way.

World over, Water is becoming more and more a scarce and valuable resource and needs to be managed better. Vassar solutions in "Water Resource Information & Management" provide visibility to various Water Assets and Environmental factors integrated with forecast to predict what's about to come. The key question we strive to answer via our solutions are:-

- How much Water do we have now?
- How it is spread across reservoirs, ground water, soil moisture, MI Tanks etc?
- How much and where is water is used across the year?
- Where is Groundwater and Freshwater depleting?
- Which villages are running under water deficit?
- How to optimize water use for agriculture?
- Which locations are affected by drought?
- What can be done to conserve water?
- What are the right locations to put conservation structures?

To ensure the excellence of our solution, we deploy best of minds from IIT, NIT, IIIT and MIT. Vassar Labs currently has a team of 170+ people to leverage Machine Learning, Artificial Intelligence, IoT, Big Data and Remote Sensing Technologies. Our employees are the key to the company's exceptional client service and industry-leading growth. We have been appraised as SEI CMMI (Level 5) and have ISO 9001:2015 certification for Quality Management System. Data security is one of biggest concern of todays time, and we ensure the same by having ISO 27001:2013 for Information Security Management System.

Our work for Water Resources Information Management system for Andhra Pradesh, also known as APWRIMS, has won many accolades. Recently It won 3 prizes in National Water Mission Awards 2019 and been appreciated by Niti Ayog and the Ministry of Water Resources of Govt. of India. The implementation could be viewed at http://www.apwrims.ap.gov.in.

Our Solution Case Study

Andhra Pradesh Water Resources Information and Management System (APWRIMS) is an implementation of our solution, a single window access point for all water resources related information of Andhra Pradesh state, assisting all stakeholders (policymakers, managers, water-users) to visualize real-time information on supply and demand of water and to take water management decisions. There are user-specific dashboards, advisories and information available. The User Interface is done in GIS & easy MIS formats for the user to comprehend.

Andhra Pradesh is one of the 29 states of India. Situated in the south-east of the country, it is the seventh-largest state in India, covering an area of 160,205 km 2. As per the 2011 census, it is the tenth-most populous state, with 49,386,799 inhabitants.

APWRIMS is benefiting more than 60% population in the State, dependent on agriculture. The Crop Planning activity recommended shifting from the water-thirsty Agriculture crops to suitable Horticulture crops. This resulted in an increase of about 1.85 L ha of Horticulture crops. Groundwater levels improved by 2 Meter across the State, despite receiving 14% deficit Rainfall and it helped to optimize the inter-basin transfer of water that provided critical and necessary water to entire Krishna Delta region impacting 1.1 million acres. The web-based tool has reported 100k+ hectare for critical soil moisture stress and Due to interventions, there were about 4,540 farmers benefitted and this initiative has helped the Groundnut farmers to increase their yield by 23%. We've helped to stabilize an ayacut of 7.11 Lakh acres. Based on the decision support system we raised Advisories it would lead the total water saving potential of 54.3 T.M.C. at a 40% reliability of excess runoff.

The key components which we developed in APWRIMS are:-

- Water Balance and Water Audit

  Water Audit provides a data-driven hydrological framework that facilitates traceability and accounting of the water resources across the state. It is a realistic assessment of supply, storage, usages, losses and outflows in the present or an earlier "water year". This module results in holistic water auditing and accounting that can help authorities for better management of water resources and planning long-term projects-based intervention.

- Drinking Water Stress

  Predict onset of Drinking Water Stress at Habitation in Advance of 1 week by using ground water level tracking combined with use of historical ground water and start drinking water tank supply data to determine minimum draw level.

- Village Water Budget

  An interactive Decision Support system at a village level, that is based on current Supply and Demand is required for the village. This module results in giving visibility over surplus and deficit areas at a village level.

- Ground Water Resource Estimation

  Estimating Ground Water Resources is done manually at present and there is a need to automate Ground Water Assessment, Categorization, and Evaluation. This helps in understanding and visualizing the areas that are at various stages of exploitation of groundwater. This module results in identifying the villages and areas where Dynamic GW is Over Exploited, Under Exploited and Safe. Also, better Water Conservation Management based on GW Recharge, draft, and potential.

- Minor Irrigation Tanks Vegetation Estimation

  There is a need to find the infiltration and the extent of infiltration in & around Minor Irrigation Tanks. Key stakeholders get information regarding the extent of vegetation in a Minor Irrigation Tank thus impacting the water storage capacity. This module results in decision support for corrective actions to be planned and taken to ensure that the Minor Irrigation Tanks are used to their maximum potential.

- Reservoir Management

  To have all the reservoir related information such as estimation of inflows and outflows based on Rainfall-Runoff, Demand, Gross Capacity, Current Storage and

Flood Cushion, etc. at a Reservoir type and River Basin view in a predictive Decision Support System. Based on predicted and current inflows, demand, flood cushion and other parameters, optimized reservoir releases. This module results in a Unified dashboard that gives a holistic view of the reservoir enabling optimized management of Reservoirs.

- Soil Moisture based Irrigation and Canal Management

  At present, there is no visibility of Water Flow at important points in the irrigation canal network and there is a need for decision support to advise releases based on Soil Moisture and Crop Water requirement. This module results in transparency in water flow at different critical points in the canal network and advisories based on Soil Moisture and required water.

- Watershed Management

  There is a need for better management of watersheds where there is a decision support system that looks at Rainfall-runoff, slope, LULC, and other parameters and provides decision support on best possible sites for a Water Conservation structure and effectiveness of existing structures. This module results in the identification of new water conservation structures, a system to evaluate the effectiveness of existing water conservation structures.

- Agro-Eco Crop Planning

  There is a need to optimize the Cropping pattern to maximize Economic Yields by maintaining water balance, Soil, and other scarce resources. The recommendations of the cropping patterns would be given after considering the Soil Type, Rainfall, Sources of Water & other external factors such as markets access, market linkage, after farm value chain, access to seeds, access to finance, access to fieldworkers, etc. This module results in Cropping pattern advisories based on various constraints like water, soil, etc. to optimize the economic yield.

- Crop Date of Sowing Advisory

  The date of sowing is an important aspect of crop yields as the crop water requirement at the critical stages determines the crop success or failure. The farmers have limited visibility over the weather conditions in the future. The Date of Sowing advisories module ensures that the crops are sown with congenial weather and water conditions, along with historical probabilities of success thereby increasing the chance of crop success.

- Crop Soil Moisture Stress Advisories

  The soil moisture stress affects Crop yields to a large extent. The timely

interventions to mitigate Soil moisture stress provide both Protective and Productive irrigation. This module results in timely advisories for mitigating crop stress & advisories to intervene the same.

Impacts

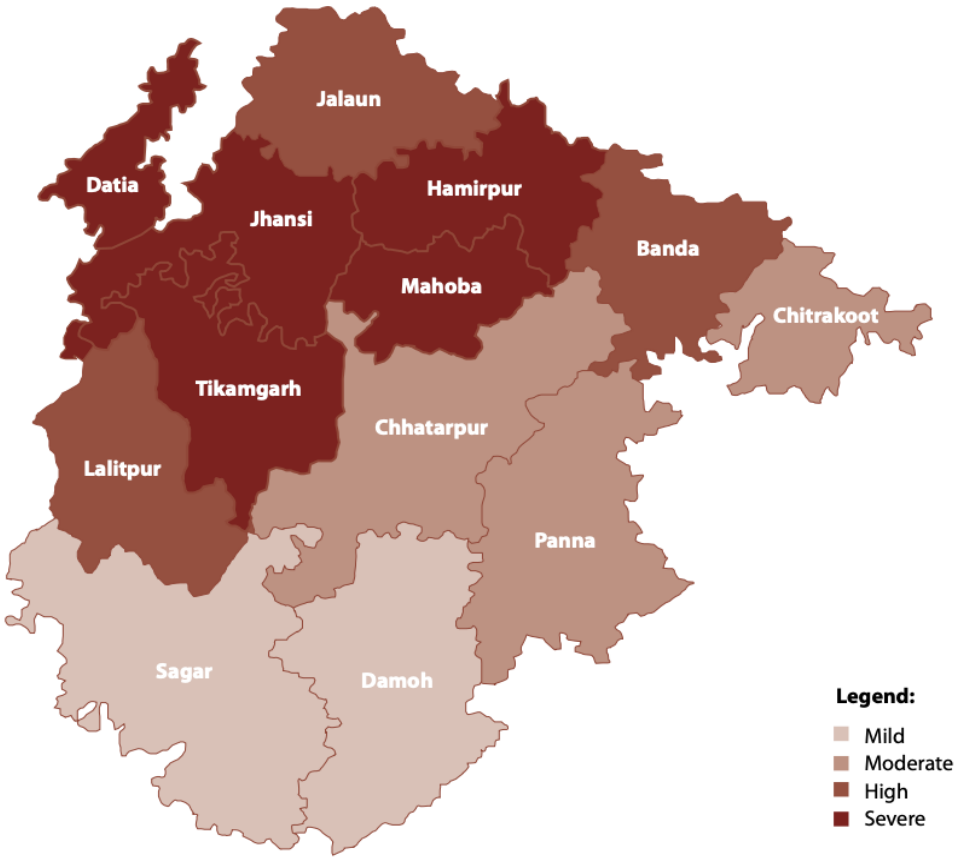
- APWRIMS is benefiting more than 60% population in the State, who are agricultural dependent.
- The Crop Planning activity recommended to shift from the water-thirsty Agriculture crops to suitable Horticulture crops. This resulted in increase of about 1.85 L ha of Horticulture crops.
- Groundwater levels improved by 2 Meter across the State, despite receiving 14% deficit Rainfall.
- Helped to optimize inter-basin transfer of water that provided critical and necessary water to entire Krishna Delta region impacting 1.1 million acres.
- 100k+ hectare reported for critical soil moisture stress and Due to interventions, there were about 4,540 farmers benefitted and groundnut farmers increased their yield by 23%.
- Saved 970 MW hour of energy for pumping the groundwater for irrigation purpose which costs about INR 4,850 million.
- Stabilizing an ayacut of 7.11 Lakh acres
- Lift scheme management: After the revival of the LI Schemes, the ayacut irrigated is increased substantially from 3.81 Lakh acres to 6.15 lakh acres
- Based on the decision support system we raised Advisories it would lead the total water saving potential of 54.3 T.M.C. at a 40% reliability of excess runoff.

Water Problem Of Bundelkhand

The region span across thirteen districts: seven in Uttar Pradesh - Jhansi, Jalaun, Lalitpur, Hamirpur, Mahoba, Banda and Chitrakut, and six in Madhya Pradesh - Datia, Tikamgarh, Chattarpur, Damoh, Sagar and Panna. It covers an area of 7.08 million hectares (mha) and is located between 23020′ and 26020′ N latitude and 78020′ and 81040′E longitude (NGSI, 1989).

Bundelkhand region has a long standing history of droughts and famines. Bundelkhand region is drained by a number of rivers of the Yamuna river system. The main rivers are the Yamuna in north, Ken in east and Betwa and Pahuj in the west. The river Yamuna flows from west to east and its first order tributaries – the Betwa, Ken, Pahuj, Baghain, and Paisuni flow from south to north. Numerous second order tributaries of the Yamuna such as the Dhasan, Jamni, Birma, Sonar, Katne, Bewas, and Kopra drain the area. Also flowing along the west is the Sindh and Chambal rivers, with the Narmada flowing in the south. The region of Malwa and Udaipur- Gwalior forms the southern section of Bundelkhand.

Composite drought hazard map of Bundelkhand



Agriculture in Bundelkhand is rainfed, diverse, complex, under-invested, risky and vulnerable. In addition, extreme weather conditions, like droughts, short-term rain and flooding in fields add to the uncertainties and seasonal migrations. The scarcity of water in the semi-arid region, with poor soil and low productivity further aggravates the problem of food security. Total population of Bundelkhand is 18.3 million, and 79.1% of population lives in rural areas (Census 2011) and more than one third of the households in these areas are considered to be Below the Poverty Line (BPL). The poverty situation in the region has also become extremely critical in the recent years. This is because of lack of employment and lack of opportunities. The insecurity of livelihoods and lack of supportive governance have led to forced large-scale migration of the local population.

Access to Safe Drinking Water, 2011

	Within the premises	Near the premises	Away from premises
MP	24%	45.6%	30.5%
MP-Bundelkhand	15%	48.1%	37.1%
UP	52%	36.0%	12.1%
UP-Bundelkhand	26%	52.6%	21.9%
Bundelkhand	20%	50.2%	29.8%

Source: Census 2011

Summarizing the issues related to water in Bundelkhand region:-

1. **Visibility:** This is the primary issue as there is no singular source of information to understand the crisis in its absolute form.
2. **Water supply & Sanitation:** Getting water is first thing in every bundeli mind, when they end their day or start. Water supply is important for both drinking and agriculture. However at both the front its important to have understanding demand and supply equation in a holistic view.
3. Conservation measures and rain harvesting in the region are inadequate which translate that disaster in Bundelkhand is man made. According to UP's groundwater department officials, 20 blocks in the region were in the 'critical' category in the year 2000, in terms of water scarcity, primarily due to overexploitation of groundwater and lack of rainwater harvesting. The number went up to 173 in 2013, when the last assessment was made.
4. Drought management has to be done and for that impact must be assessed.
5. Flood management have been an issue even though its a dry land. During this monsoon most reservoirs and dams were overflowing. The situation in some areas even demanded helicopters rescue operations.
6. The crop needs to be planned with the understanding of Climatic, hydrology and economy.
7. Challenge of getting water for irrigation during stress.
8. Watersheds have been compromised and most of the conservation structures have been dried over the time. In Conclusion Though the rainfall in Bundelkahnd in 2018 monsoon season was better than previous years, it has not helped farmers in the region as much as it could. It also seems the rainfall distribution and pattern is changing significantly.
9. The river shores have been mutilated and illegal mining have caused a toll on river flow.
10. Diversified execution of plans yield negligible results and tracking project execution and performance is challenge.
11. The situation is worse for cattle.
12. Water security for all must be envisioned.

Net irrigated area as percentage of net sown area in Bundelkhand (Uttar Pradesh)

Districts	Major/ Medium Schemes	Ground Water (Wells)	Minor Surface Water	% of net irrigated area to net sown area
Jalaun	13	27	2	42
Jhansi	7	14	4	25
Lalitpur	9	39	1	49
Hamirpur	35	28	1	64
Chitrakoot	5	18	6	29
Banda	22	27	1	50
Mahoba	19	26	2	47
Region Total	16	26	2	44

Net irrigated area as percentage of net sown area in Bundelkhand (Madhya Pradesh)

Districts	Major/ Medium Schemes	Ground Water (Wells)	Minor Surface Water	% of net irrigated area to net sown area
Chattarpur	6	47	12	65
Tikamgarh	7	64	7	78
Damoh	1	28	11	40
Sagar	2	18	8	28
Datia	10	29	1	40
Panna	1	10	13	24
Region Total	4	33	9	46

Source: Minor Irrigation Census (2001)

Solution For Bundelkhand

Decades of land and water mismanagement made worse by anaemic showers and changing rainfall patterns triggered by climate change have led to untold misery for its largely agrarian population. It is not as if it is not raining at all in Bundelkhand. The problem is that the little water that falls on the ground runs off. The river flows are disrupted and conservation measures are not unto the mark. To solve this issue we must follow step by step approach for series of actions. We as an IT enablers, look it from the perspective of data and science of water. With latest satellites, IoT, Big data and compute technologies we have better tools to understand the region which further empowers to take right decision on time. We have illustrated the problem before, let's take a glance at solution which has potential to change the dynamics of Bundelkhand.

To achieve Sustainability, it requires major work towards getting, understanding the data and applying Artificial intelligence and Machine Learning algorithms to automate the process and eliminate constant human interventions. Effective WRIMS for Bundelkhand needs to be developed with an objective for planning where Stakeholders

& the public have to be informed to gain political support and commitments for WRIMS, then appropriate information has to be organized, retrieved, acquired and maintained or updated.

While developing WRIMS, during data capture process we need to collect information's from, geo-tagged Water bodies and bore wells, along with various layers like administrative, hydrological, soil, agriculture, satellite, aquifer, LULC, Rivers & Canal, Drainage network, DEM, Command Areas, etc. (are included). Data points needs to be created from different sources like Automatic Weather Stations, Reservoir Level sensors, Ground Water Level sensors, River and Canal level sensors, etc. Information for different data points come from Satellites/ models/ IMD/ ISRO/ WRD, among other sources.

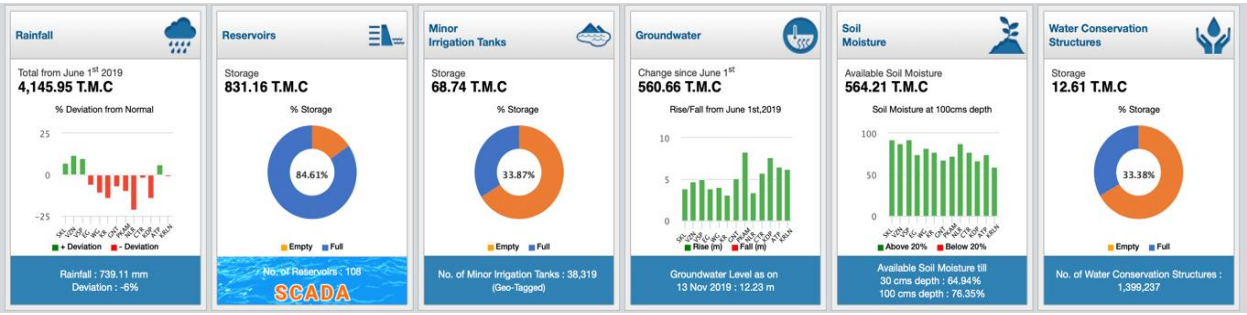
The system will provide visibility and data support system to restore the prosperity to Bundelkhand. Let's look at the components which will allow this to happen:-

1. Water Visibility Dashboard
2. Water Budget & Audit
3. Water Supply Management
4. Drought Warning System
5. Flood Warning and Flood Plain management
6. Agro-Climatic Zone Planning
7. Watershed
8. Assests Monitoring
9. Project Planning and Management
10. Information Dissemination & user engagement

By combining all above modules, its will be a powerful system not only to provide visibility of water but also empower key decisions and track progress of projects to empower sustainable growth at Bundelkhand by reviving its most precious asset "The Water". Lets look at all these components in detail.

Water Visibility Dashboard

WRIMS provides real-time visibility into water available across rainfall, reservoirs, canal released, minor irrgation tanks, ground water, ground water and soil moisture through a combination of IoT Sensors, satellite data, drone data, hydrology models and crowd sourced data.

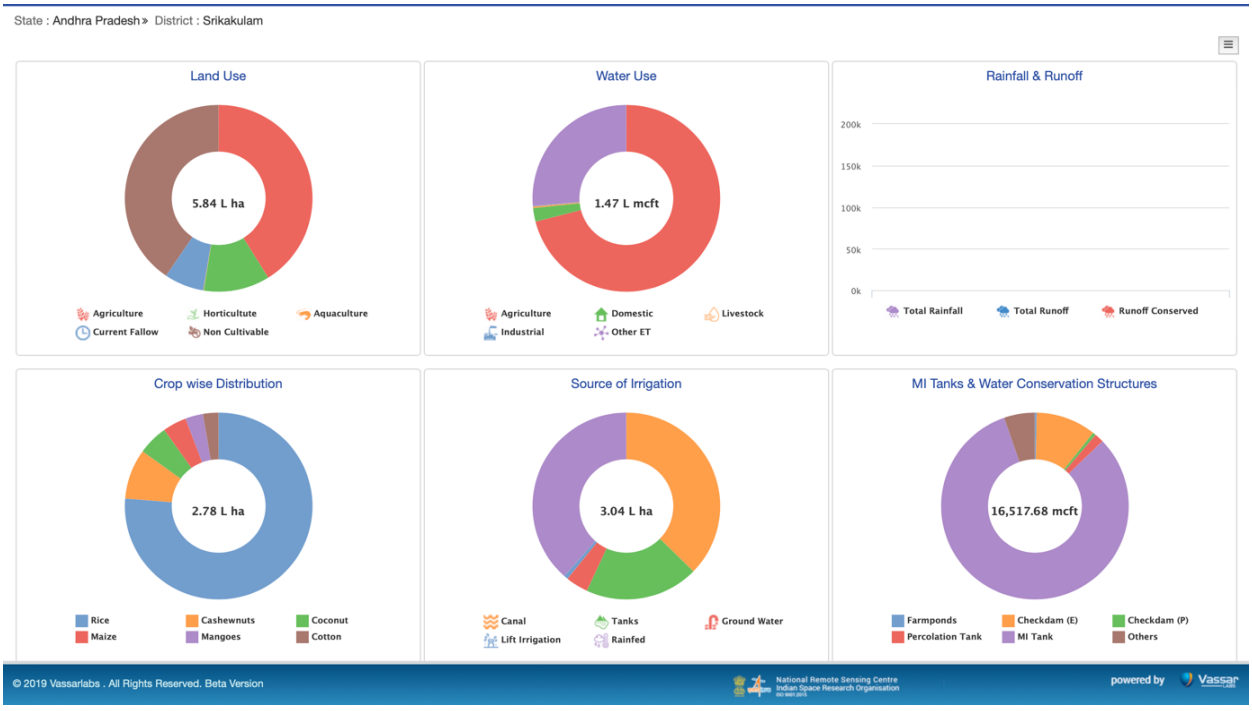


Water Budget & Audit

Village water budget helps in micro-level planning of water management. Based on the village water budget surplus/deficit villages are identified Water supply is estimated based on:-

- Water available from rainfall to cropped area during the crop life cycle, taking into account the soil moisture during the beginning and end of crop life cycle.
- Water available from canal irrigation. Different policies such as equal deficit sharing, head-first, tail-first etc can be applied.
- Water available from ground water based on ground water estimated methodology.
- Runoff conserved vs. excess runoff based on a network model that considers all the water.
- conservation structures as well as minor irrigation tanks.

On the demand side system considers crop water demands, drinking water requirements from human beings as well as livestock, industrial water requirements. For deficit villages, system recommends supply side management practices such as improved water conservation practices as well as demand side management with the right crop planning.



Water audit is done at a basin/sub- basin/micro-basin level to estimate which basin/sub-basins are in surplus or deficit to develop a macro level plan and inter-basin transfer of water.

Water Supply Management

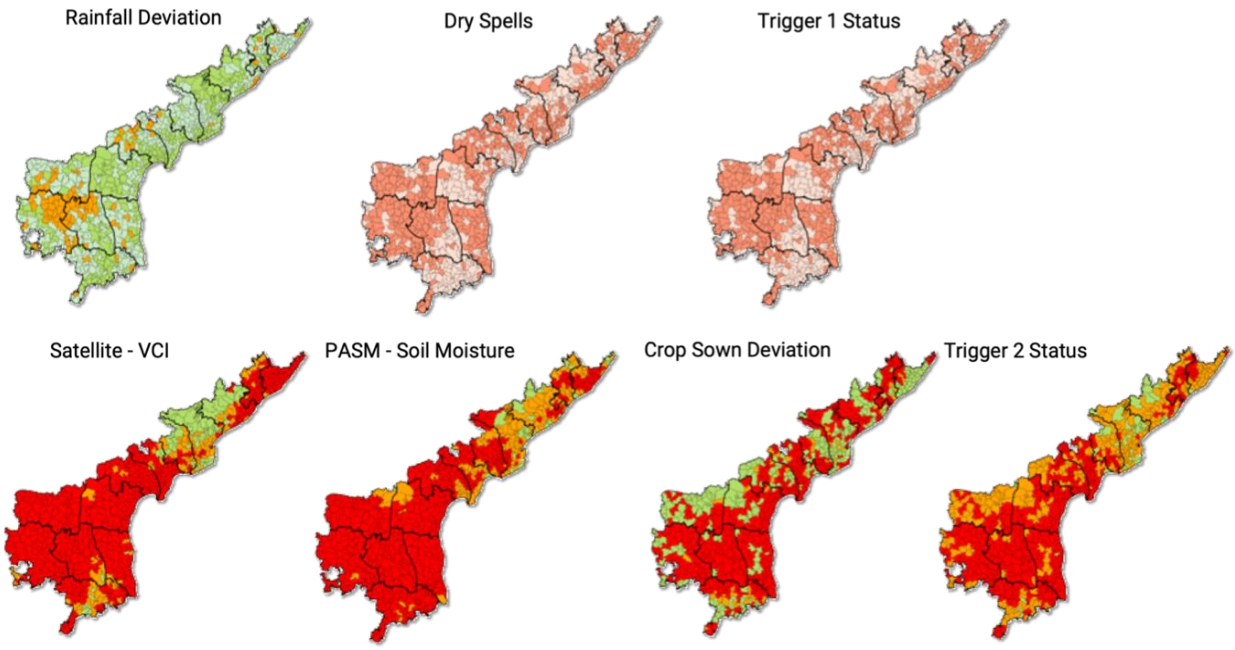
Estimates the amount of water required over the next 2 weeks at the reservoir level or individual off-take point level based on the crop sown, acreage sown, date of sowing, crop phenology, water releases season to-date, weather forecast and crop water requirement. Based on the estimated water requirement canal releases at the project level as well as off-take point level can be efficiently managed. In case of deficit at the basin or project level, the appropriate deficit sharing policy can be applied. Same will be applied with contrast to drinking water as well with a detailed mapping of source to destination with water quality parameters in account.

Drought Warning System

Early Drought Warning System based on the following mandatory and impact parameters:-

- Rainfall Deviation
- Dry Spell
- Vegetation Condition Index (VCI)

- Percent Available Soil Moisture (PASM)
- Area Sown

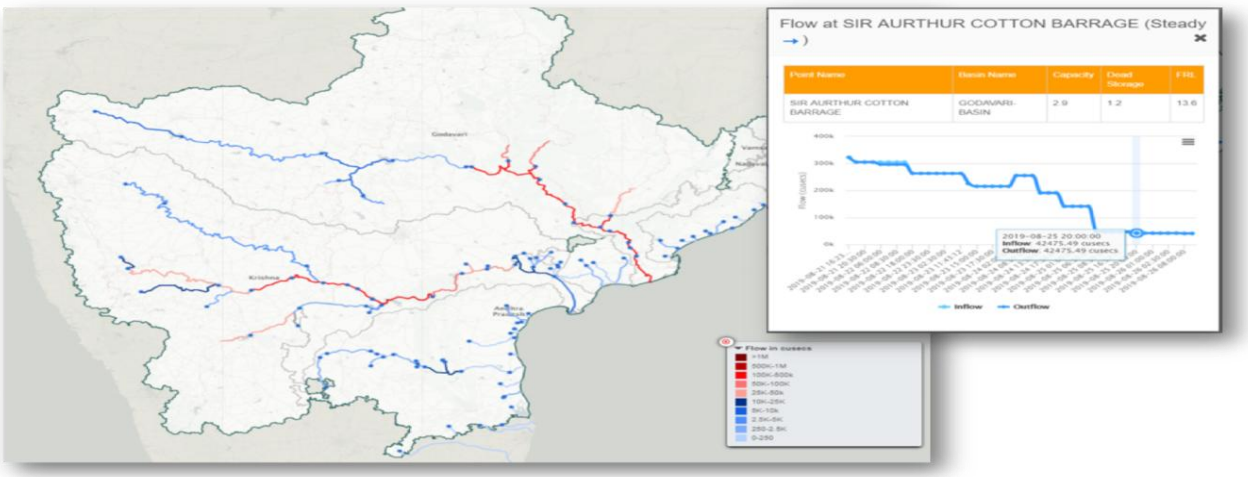


Flood Warning and Floodplain Management

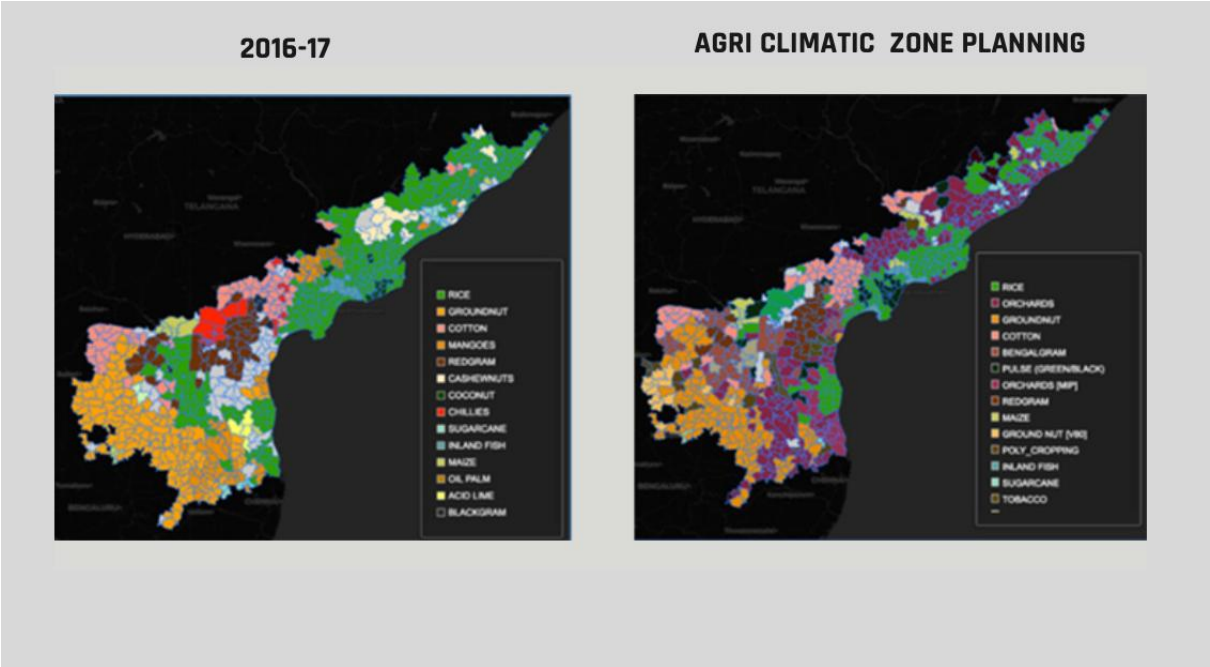
Get to know about flood in advance and get advisories for reducing its impact. The assessment is made with IoT/Hydrology based AI/ML Models. The flow forecast delivered as short range, medium range and long range forecast, with maximum accuracy at short range level. The simulation model allows to see the impact of flood in advance.

Agro-Climatic Zone Planning

Crop Planning module takes multiple input factors into account, analyses the current situation and recommends ideal cropping pattern. Various factors go into a large-scale



optimization model and recommend the cropping pattern considering soil type, rainfall, e sources of water and other external factors. The above methodology resulted in the most optimal crops that can be grown in Andhra Pradesh. The below picture shows the change in the cropping pattern.



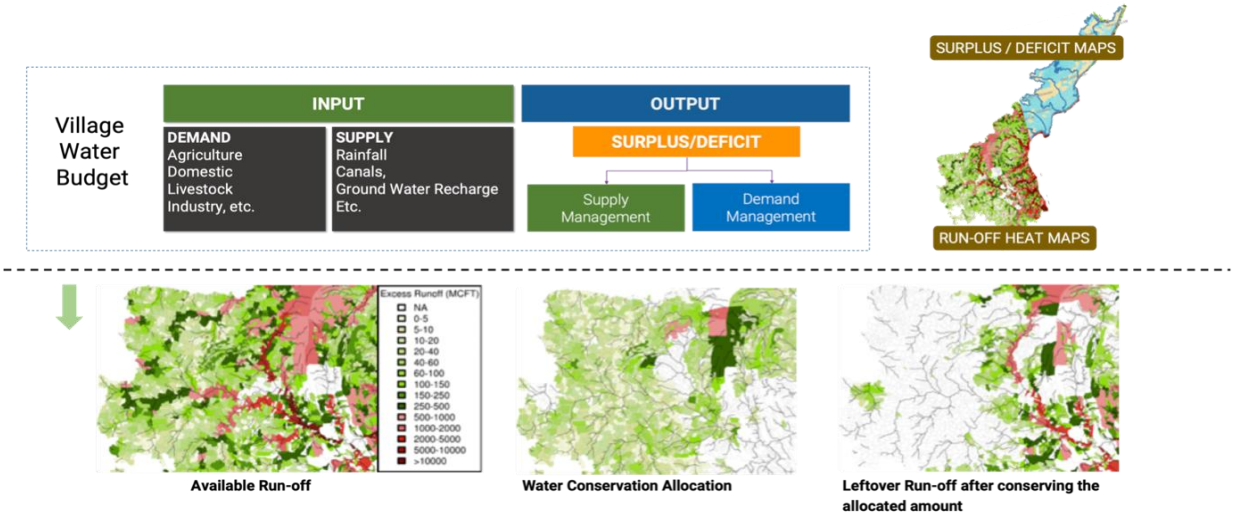
Watershed Management

Watershed Management System is an integrated decision support solution that helps the public policy planners, administrators, watershed management officials, NGOs and citizens to plan their watershed activities more scientifically and maximize the impact. This solution helps in identifying the villages in deficit and estimating runoff available at the required reliability level, recommending additional water conservation activity that can be taken up taking into account the deficit and available runoff including the location and type of water and soil conservation activities to be taken up.

Watershed Management System helps the stakeholders in making key decisions such as:-

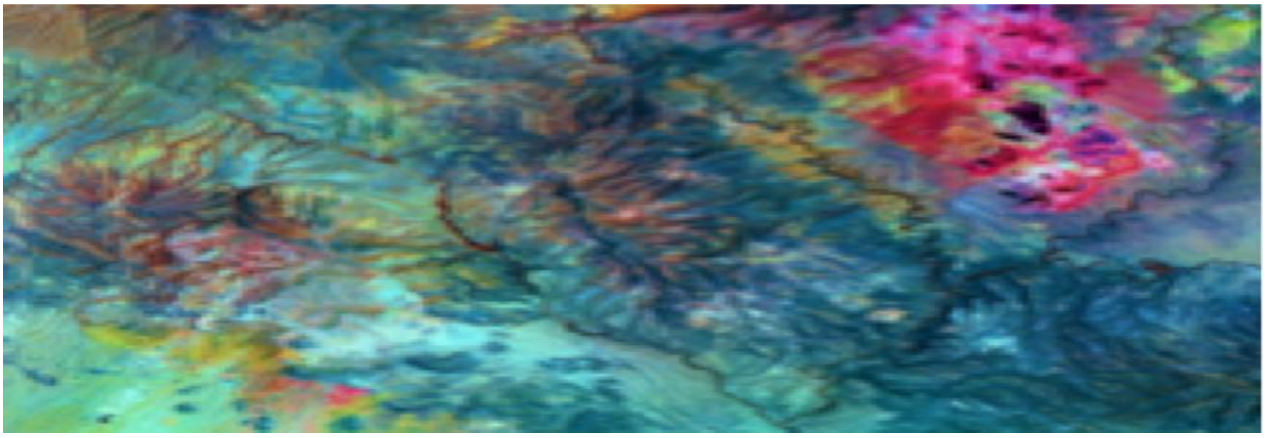
- Which villages should be prioritized for water conservation works
- What water management strategies (supply/demand side) should be implemented.
- How much additional runoff is available at the required reliability level
- What is the minimum additional capacity required to mitigate the identified water deficit or conserve available run-off in the deficit region
- How many water and soil conservation structures should be built in the village based on the village deficit and available run-off
- Location and type of water and soil conservation that can be taken up in the village based on geology, geo-morphology, lineaments, soil type, LULC, slope and other GIS layers

- Enable field functionaries to validate the location and type of structures or modify as required using a mobile application
- Prioritise the soil and water conservation activities on a ridge to valley basis and funds available
- Track the progress of the activities



Asset Monitoring

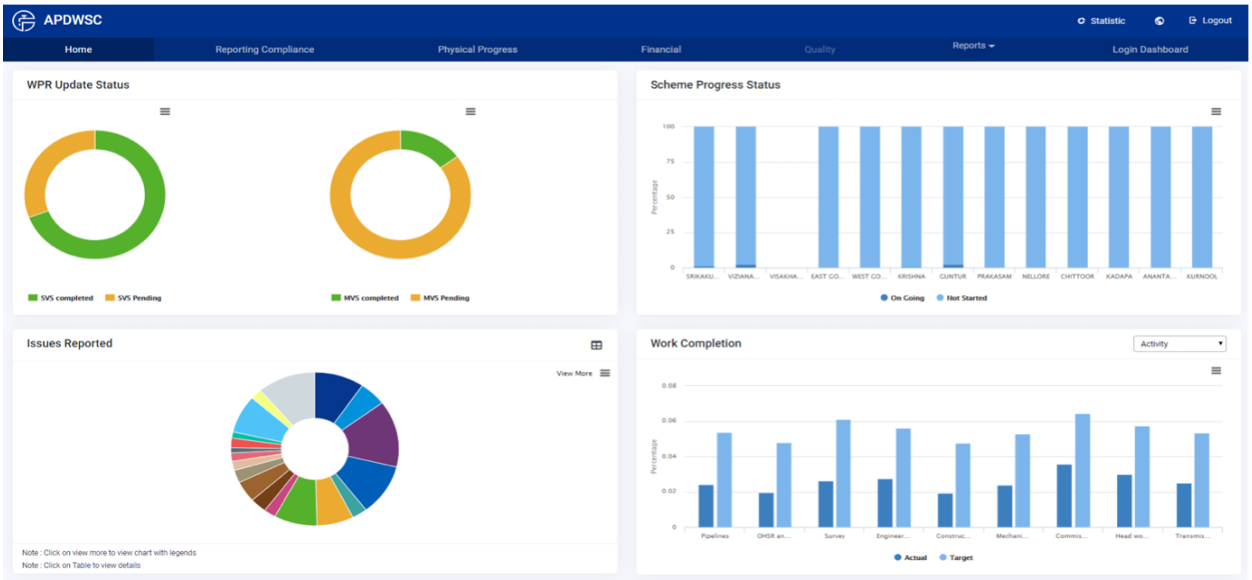
Its very important to keep an eye on Special zones like river shores, mining areas, water bodies to ensure their good health and protection against illegal encroachments. By installing additional in-field IoT devices and using satellite we can also monitor zone in near real time. High resolution satellite imagery gives increasingly up-to-date geospatial data and by using neural networks processing, reliable statistics are obtained for management and conservation activities.



Project Planning & Management

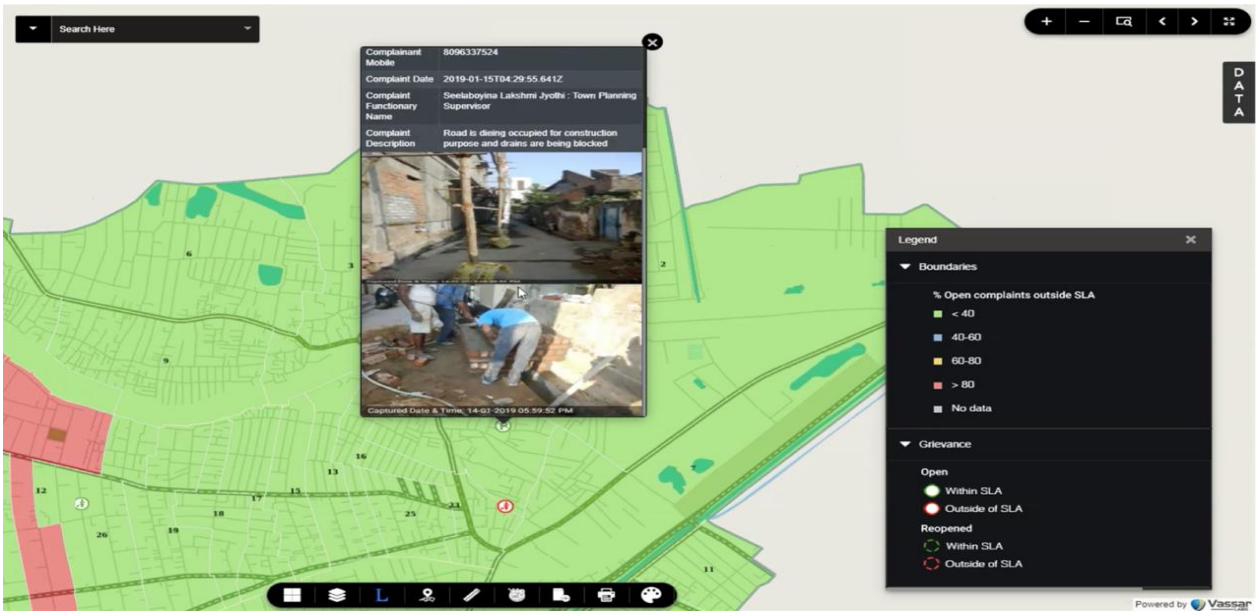
As there are multiple projects going under watershed programs, water supply, and other developments planning and monitoring become one of the essential thing to have. It allows not only to view progress in real time but also make aware of approval status and funds available for each project. This ideally includes but not limited to:-

- Real time project Status Monitoring
- Physical Progress monitoring
- Financial Progress monitoring
- Project Implementation - Issues/Alerts/permissions monitoring
- Reports and Advisories (Daily/weekly/Monthly)
- Reporting Compliance
- Activity Reports



Information dissemination & user engagement

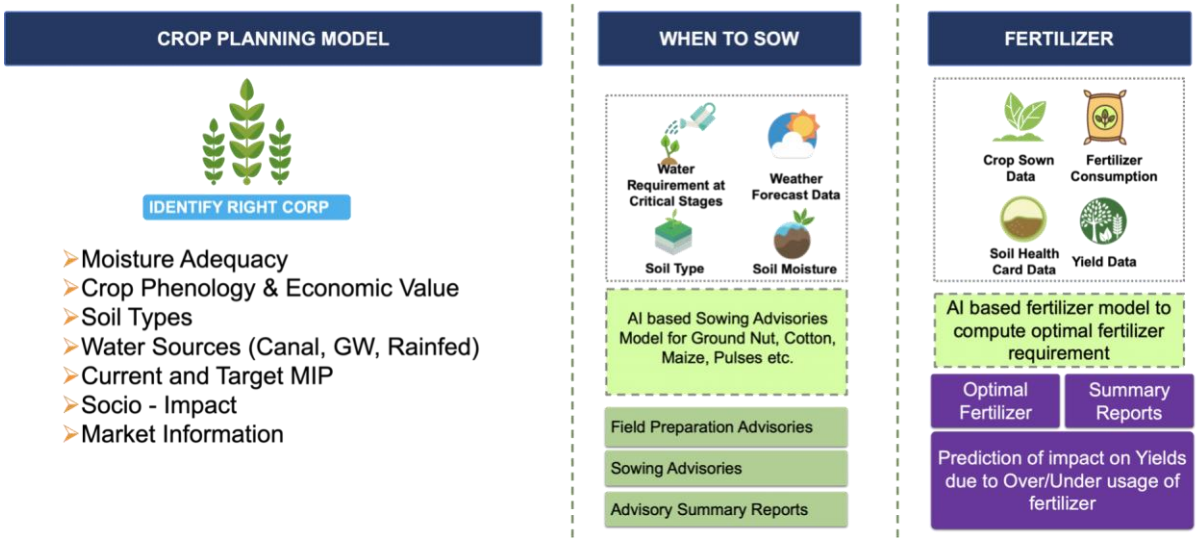
Keeping stakeholders in sync and informing last mile user with advisories and status are fundamental to have increasing support of communities. Hence, this final modules takes care of information delivery via multiple GIS layers, sms, mobile apps, email and any other specified mean. This also alerts user in case of Flood and Drought to be ready for interventions.



Other Solutions

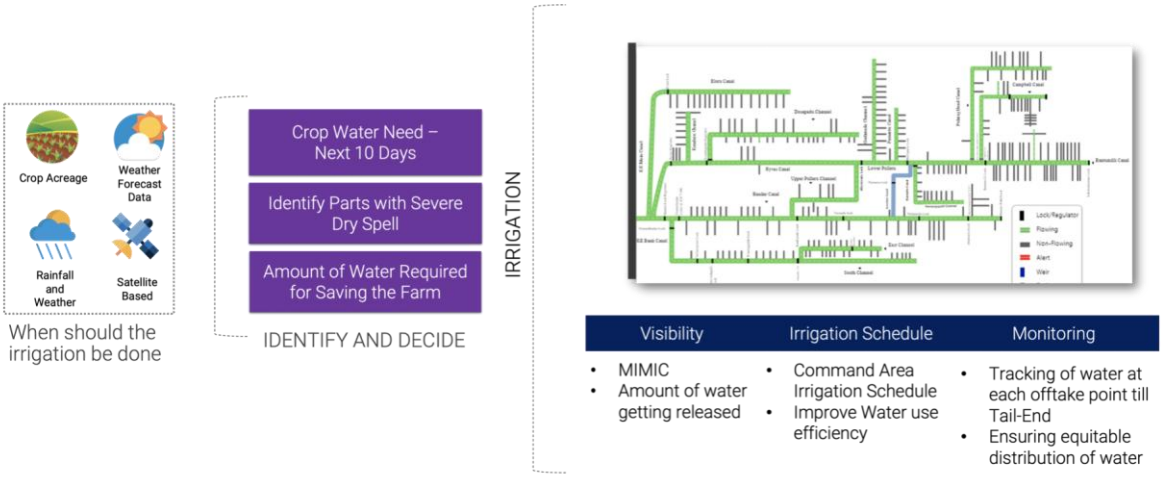
Apart from managing water there can be various adjoint activities to improve livelihood in Bundelkhand. One of the primary user of water is agriculture. Hence monitoring and managing agriculture to provide food security is one of the key activity. They system can integrate with other data related to migrations, population, gender, human health index, animal husbandry and many other to establish accurate relationship with water. This will help authorities to plan their action from a singular authoritative dashboard.

Agriculture Information and Management Systems (AIMS) is an integrated crop management system from Vassar Labs that provides decision support and raises advisories to stakeholders during the entire lifecycle of the crop – from sowing to harvest.

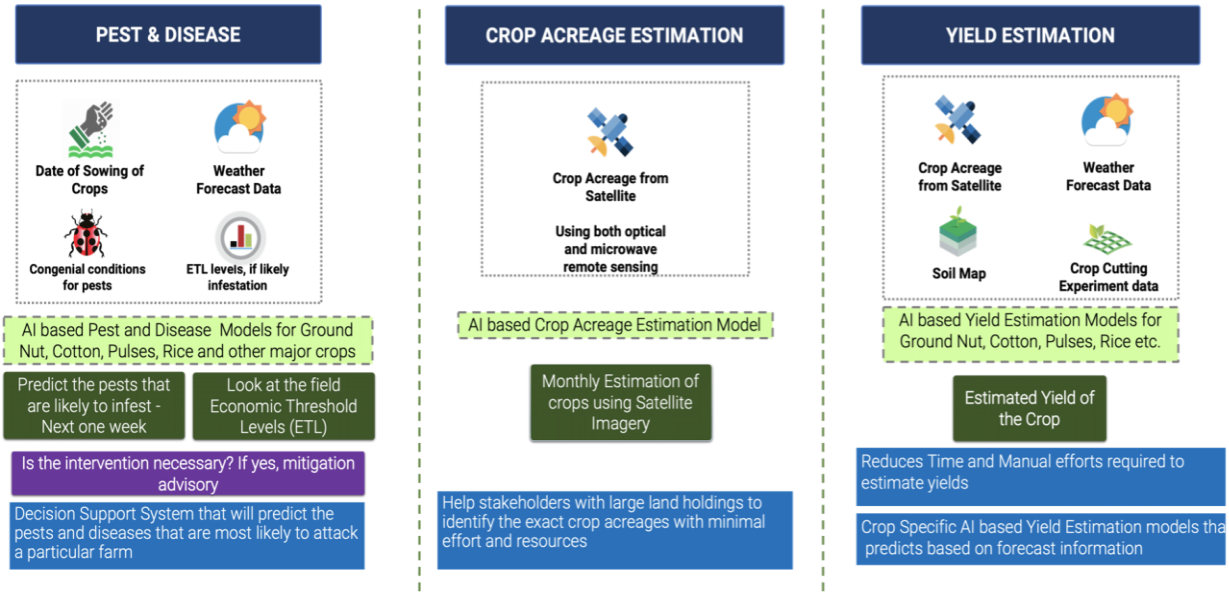


AIMS helps the stakeholders in making key decisions such as

- What crop to sow based on localized conditions of rainfall, soil type, market demand and access etc.
- When to prepare the fields for the agricultural season, when to sow the crops
- Whether the crops are under water stress and the Interventions required to mitigate the stress
- Whether the crops are likely to get infested by pest or disease and the interventions required to mitigate the damage
- The right mix of fertilizer to be used based on the current soil conditions and the crops that are sown
- Estimating crop and yield



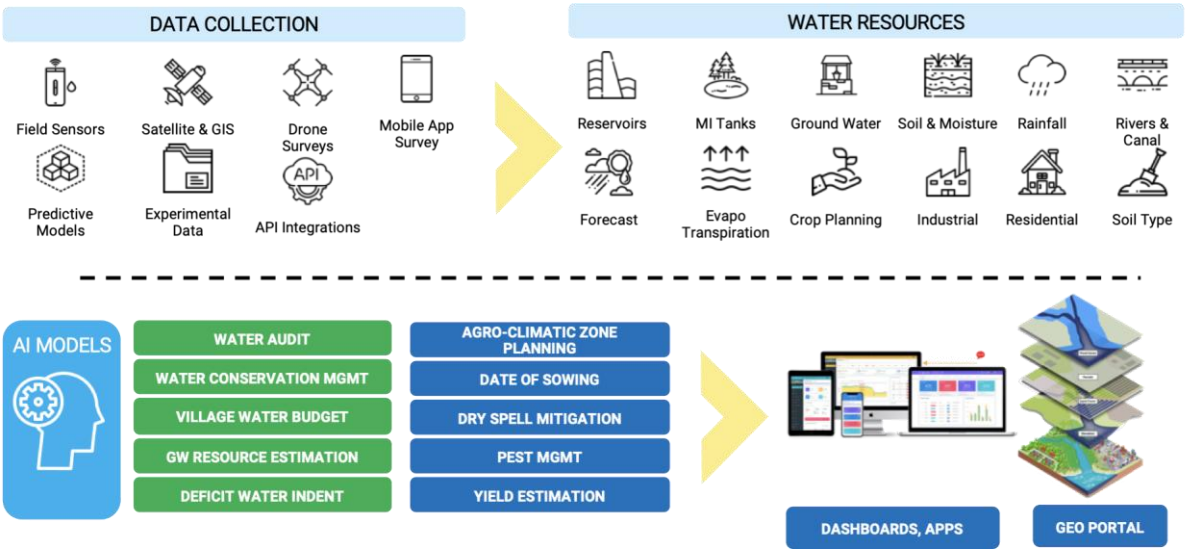
The AIMS modules also provide insights to the policy makers such as the acreage of crops that are sown based on satellite imagery analysis. The module also has an automated Early-Drought Warning manual that classifies areas as drought prone based on various indices.



Solution Implementation

For any solution, the proof is in the productivity. From goal setting, implementation to go-live, we're in lockstep with you all the way to make sure you're up and running and leveraging solution as fast as possible.Just like we've done for Govt of Andhra Pradesh. As we have implemented such solution before, we already have frameworks and modules developed for most of the components. Our technology and solutions are disruptive, but not our implementation process. That's because we take the time to listen and comprehend needs, then respond quickly and accurately.The hydrology of each area is different and hence detail study for area with experts are required to draft the implementation roadmap. But in general once scope and models are defined it goes like below.

- Project charter, schedule and detailed work plan.
- Detailed functional requirements, assumptions and constraints.
- Technology architecture plan, software design specifications, system design, logical and physical data model; data dictionary and data migration plan.
- Develop screens and reports; physical database enhancements; configuration of system, network architecture and development environment; install and configure database; application installation and configuration.
- Data conversion plan; data mapping, data conversion software, successful data conversion.
- Test cases, test plans and test results for system integration, interfaces, network performance tests; user acceptance test plan, scripts and retesting.
- Training and outreach materials, training sessions, and system documentation.
- Implementation plan, final data migration, production application.
- Final project documentation and technical knowledge transfer.



The design incorporates visualization techniques such as circle views, grid layout, small

multiple maps, and node simplification to improve the data readability of water distribution systems from macro to micro-level, with intuitive GEOPORTAL.

There are complex hydrological relationships which need to be decoded by understanding of Hydrologic processes. They include reservoir operations, flow distribution, conveyance and recycling, irrigation water use, and interactions between surface and groundwater. This can be extended further to describe the water balance at the crop field level and the balance at M&I demand sites, respectively.

The geoportal serves the purpose of one Authoritative System for all water-related data Supply, Demand, Operational, Environmental factors, etc with near real-time visibility into 90% of all available water such as Ground Water, Surface Water components such as Reservoirs, Canals, Minor Irrigation Tanks, etc. The artificial intelligence and machine learning play a pivotal role to integrate all the information and produce the ultimate results which empower decision making as illustrated in figure above.

The ideal development phase moves as below:-

- Water resource information management system
- Integration of Secondary Satellite data, IMD data and other Applications and associated visibility dashboards
- Development of Mobile App
- Development and Implementation of Hydrology models
- Advance compute models to analyze data
- Water Audit, Trail, Water Use Efficiency, Conservation KPIs
- Final DSS and Visibility Dashboards
- Operation and Maintenance

Expected Outcome

Water and food are fundamental needs for humanity. Fresh water is a finite resource whose availability is becoming more uncertain with climate change. Water availability directly impacts food security and livelihoods of millions of small landholding farmers in India (and many more across the world). A small improvement in water management has a multiplicative effect on these livelihoods: starting from the primary impact on water availability for agriculture, to the downstream impacts on increased crop yields and rural incomes which lead to better health and education outcomes for small landholding farmer families. The singular objective is to achieve "Sustainable Bundelkhand". But in order to accomplish this, below outcome has to qualify:-

1. **Water and Food Security for Bundelkhand:** In Bundelkhand water scarcity has left people with no choice to migrate or choose the extreme. Agriculture is the largest user of water; and in Bundelkhand, agriculture employs the largest share of people. By securing water for them, will help them achieve better life and sustained growth.
2. **Developing ownership of water resource management at the local level:** By

knowing about available water, local water user associations will have better understanding of upcoming scenarios and take ownership of same.

3. **Trans-boundary River Management:** Bundelkhand is divided in two states, and hence a transparent water resource management system will help managing basin properly without conflicts.
4. **Women empowerment:** The burden of fetching water is on women. The Bundelkhand witnessed worst of it, as many women faced health issues, social pressure and even child loss during pregnancy. The solution, which makes water to reach them will change the entire landscape and improve life of women, which in turn improve life of bundelkhand.
5. **Social Improvement:** The equitable sharing of water will improve social harmony and break the bias of people thinking about water distribution as a matter of political, religion or caste bias.

Press Releases

- Bundelkhand is to achieve sustainable water resources with the help of latest technology
- No more women to stand in question for water at Bundelkhand
- Water Riots: A matter of past in Bundelkhand region
- Farmer Income has been doubled in Bundelkhand region with improved agriculture and animal husbandry
- Har Ghar Ko Jal - Witness the vision at Bundelkhand
- Wiser water retention strategies rejuvenate the wasted land of Bundelkhand that has been battling drought for years

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4. **Bundelkhand Drought – NIDM**
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