LEVERAGING EARTH OBSERVATION DATA FOR INFORMED AGRICULTURAL DECISION-MAKINGA

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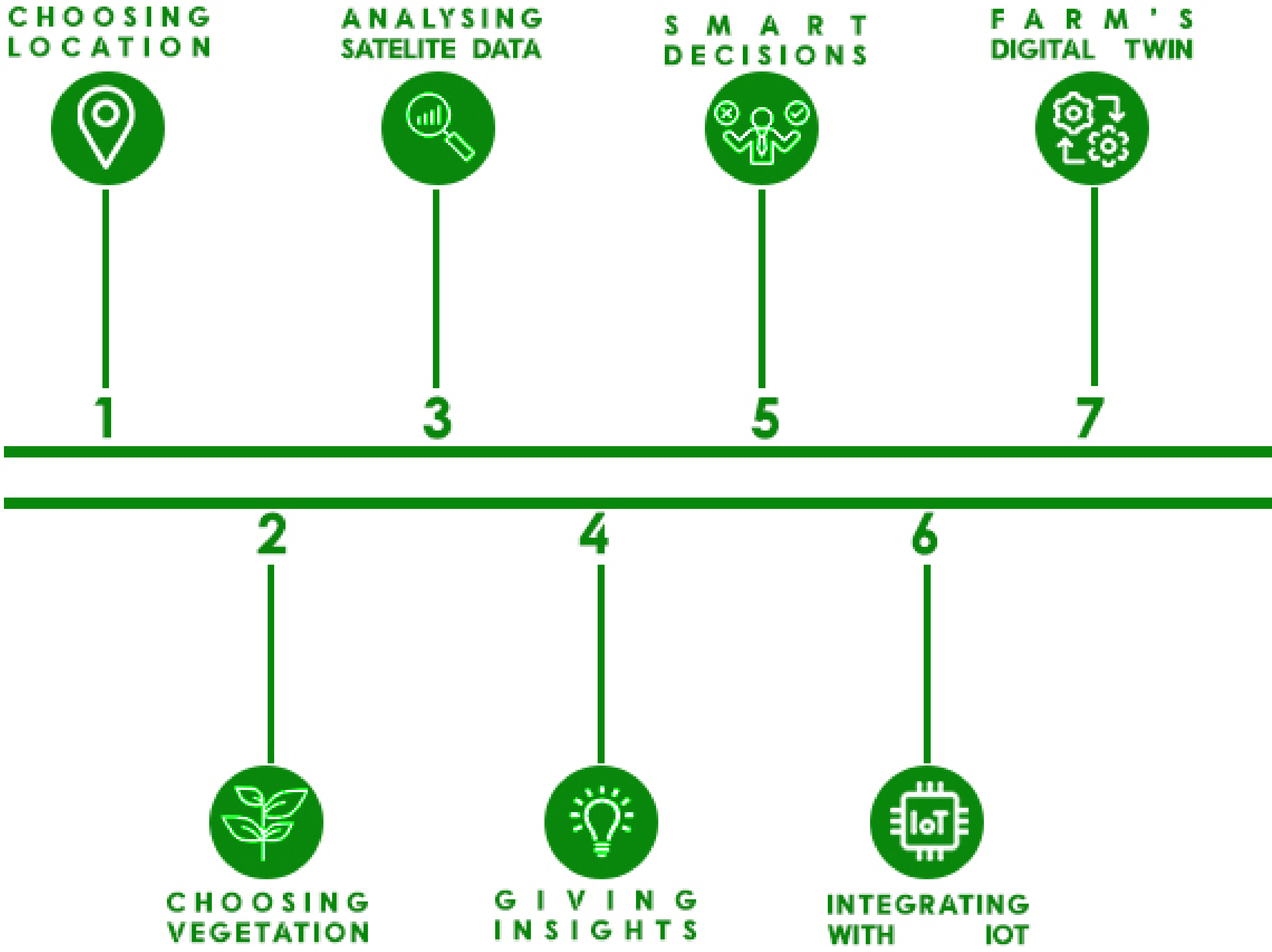
Application's Github Page

Data-driven agriculture is revolutionizing farming with satellite data, sensors, and AI. Farmers gain real-time insights on soil, crops, and weather, enabling smarter decisions to optimize water use, reduce waste, and boost yields. This innovation promotes sustainability, helping tackle global challenges like food security and climate change while enhancing efficiency.

DATA-DRIVEN AGRICULTURE

In this challenge, we developed an intuitive mobile app to help farmers make smarter, data-driven decisions. Farmers can select their location and vegetation type, and the app uses satellite data and machine learning to provide actionable insights. It also integrates real-time IoT data to create a digital twin, offering a comprehensive view of farm conditions to optimize resource use and boost productivity.



01LOCATION

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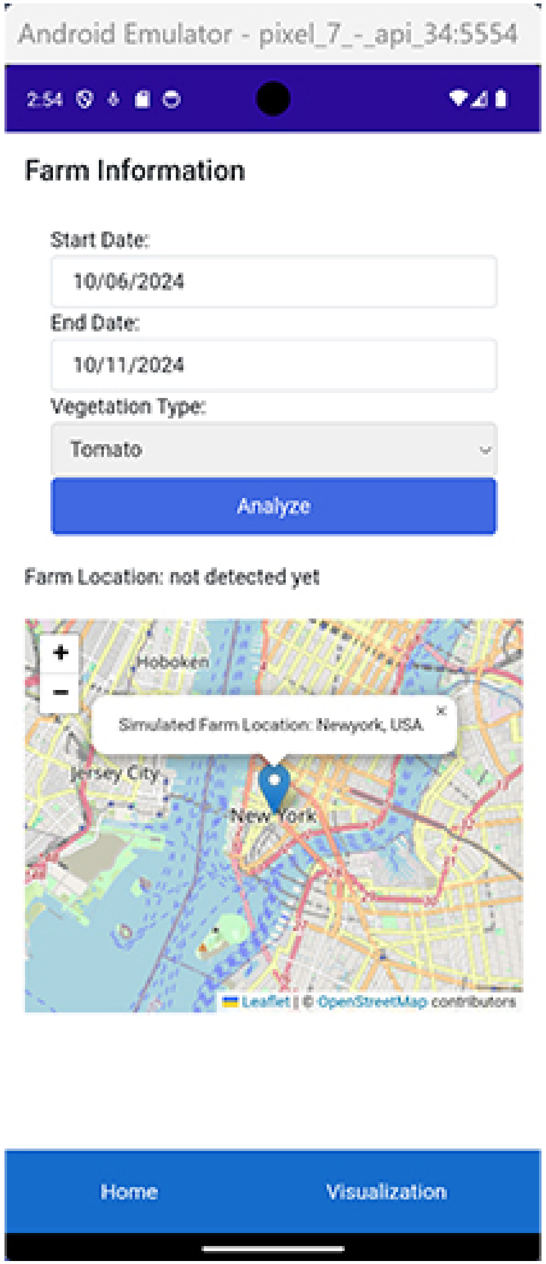
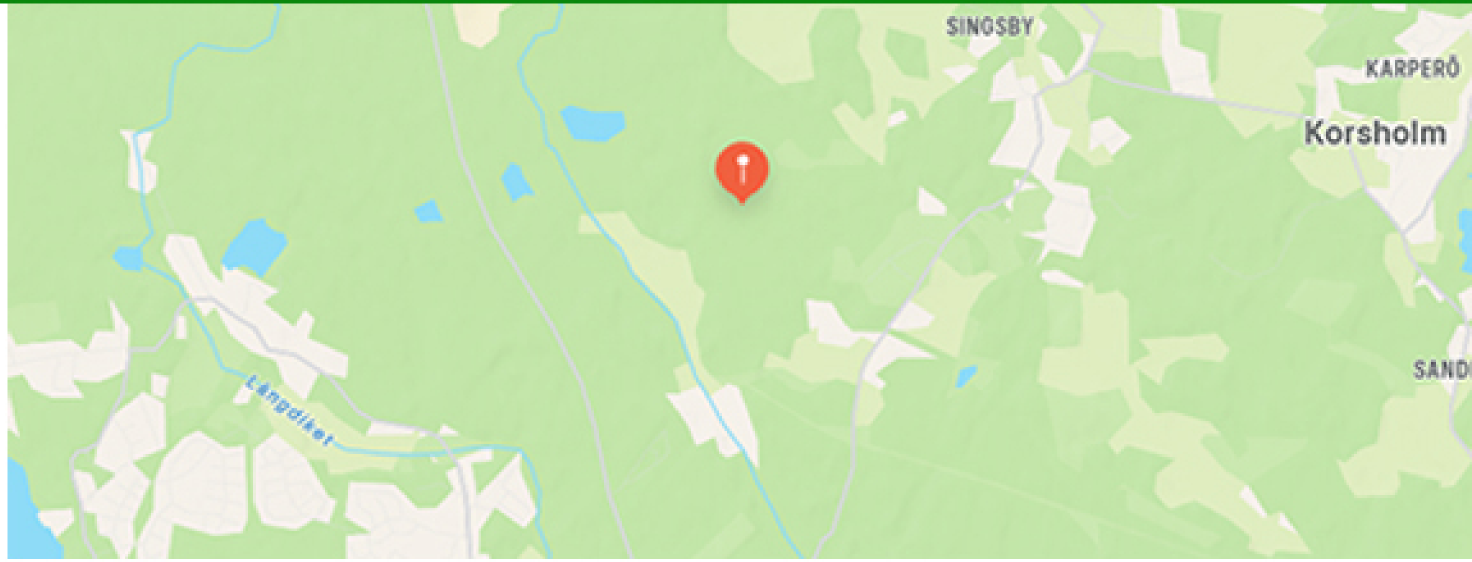
The core question that we sought to answer was how could we produce reliable and actionable data for farmers in a location agnostic manner using data provided by NASA and it's partners. The idea we came up with was an all-in-one solution app that asks for GNNS-coordinates and the set point in time that you wish to start looking at the historic data from in order to fetch relevant atmospheric and soil datasets for actionable recommendations.





02 VEGETATION SELECTION

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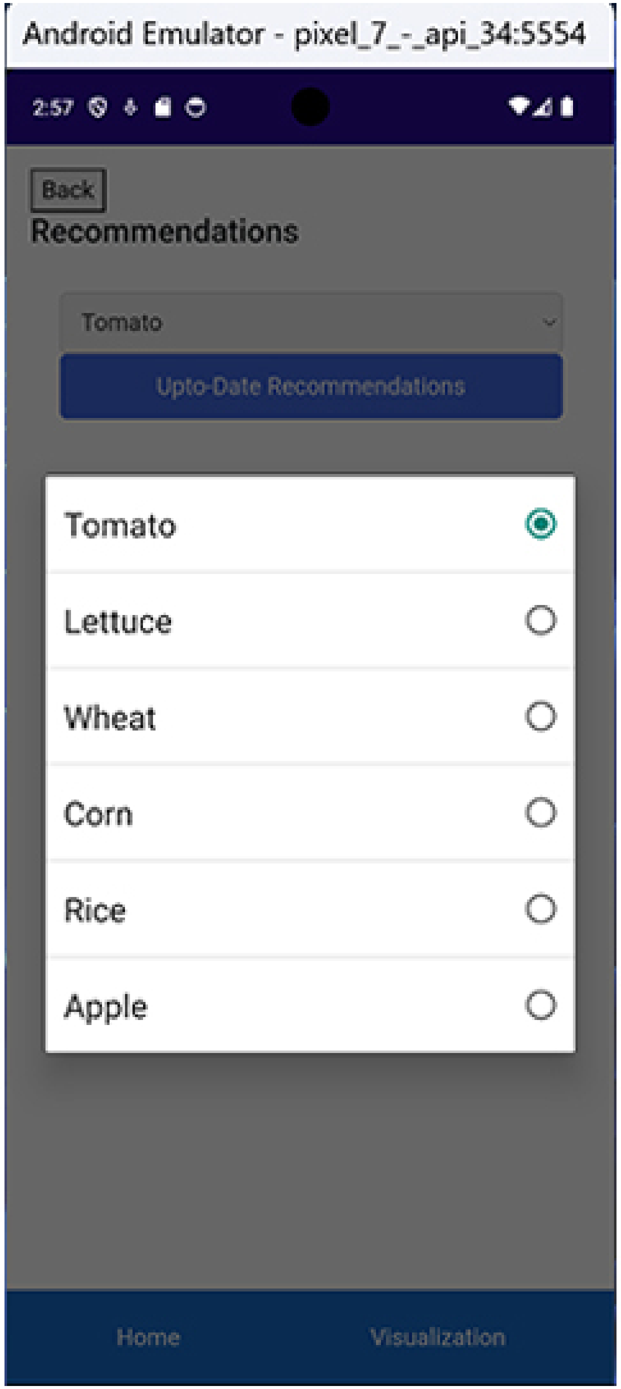

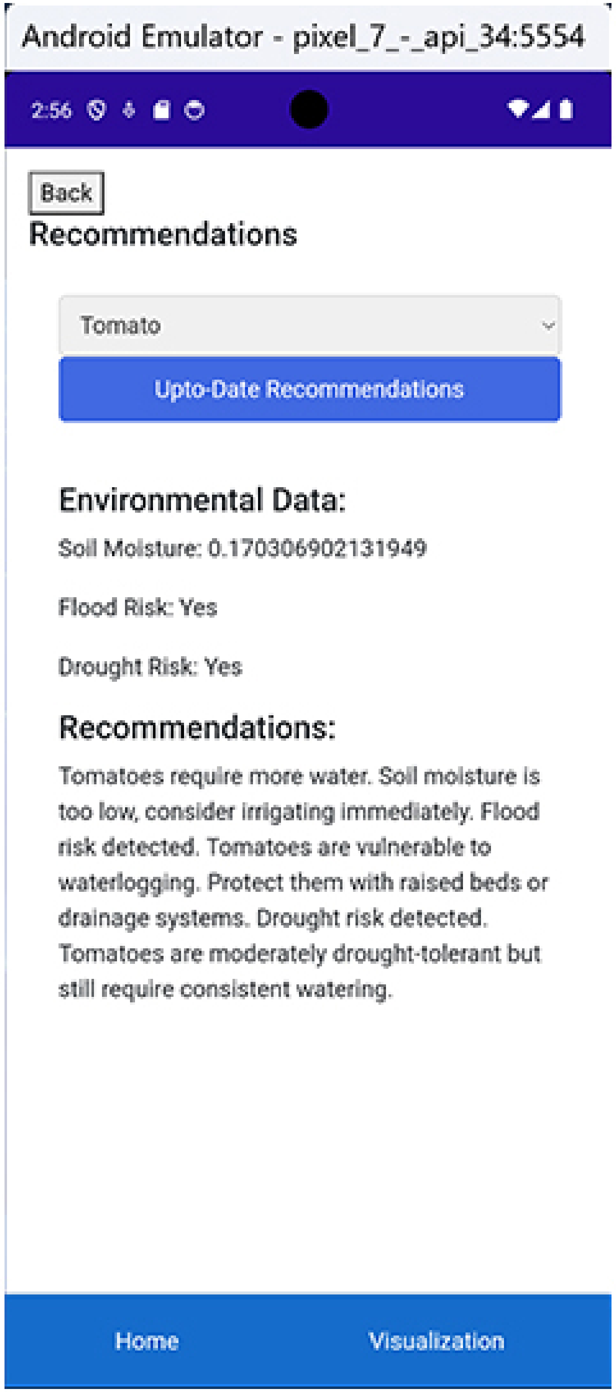

03ANALYSIS
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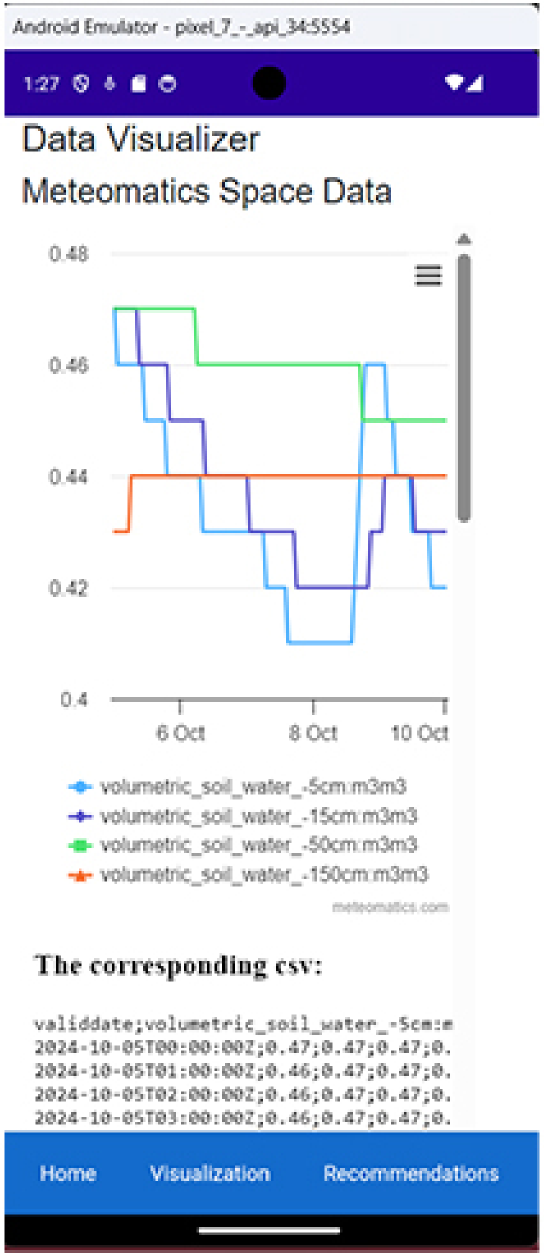
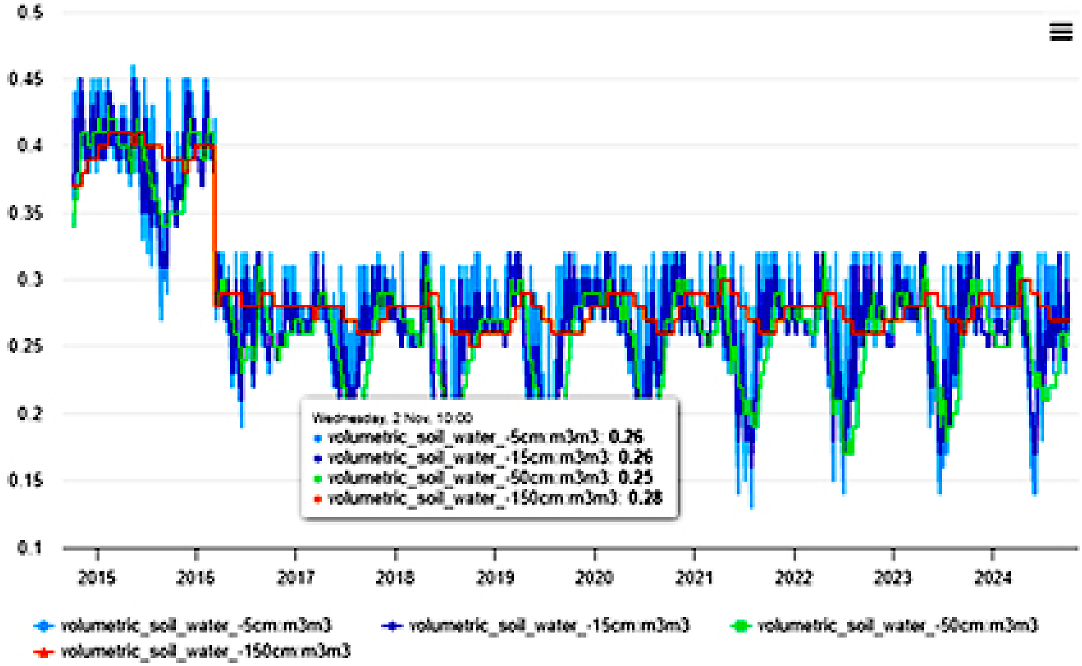
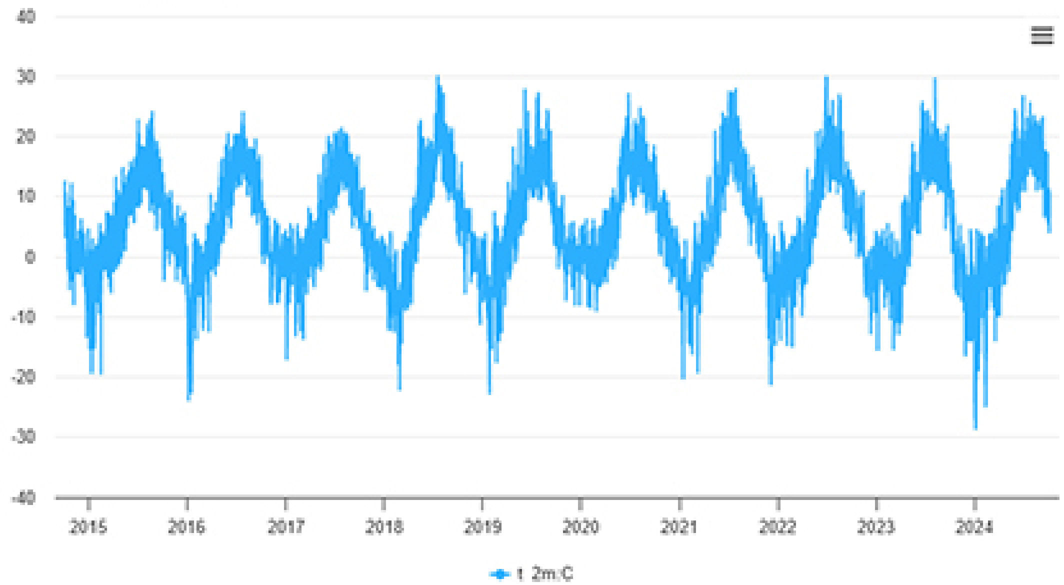
We chose to base our queries of the meteomatics database around 2 features that encapsulate the long term fluctuations in the health of the soil and the surrounding climate. First one being the temperature 2 meters above ground level in Celsius and the second being the volumetric water quantity in the soil in liters per cubic meter. These features are able to showcase how ideal the soil and surrounding atmosphere is for farming and culminate as proxy values for most concerns.





SOIL MOISTURE INDEX L/M^3(SMI)

The soil moisture index indicates the wetness of the soil. This index is computed using the permanent wilting point and the field capacity, which both depend on the geographical location (soil type). The index is 0 if the permanent wilting point is reached and 1 at field capacity.



TEMPERATURE ˚C

The Celsius temperature 2 meters above ground.

04 INSIGHTS &RECOMMENDATIONS

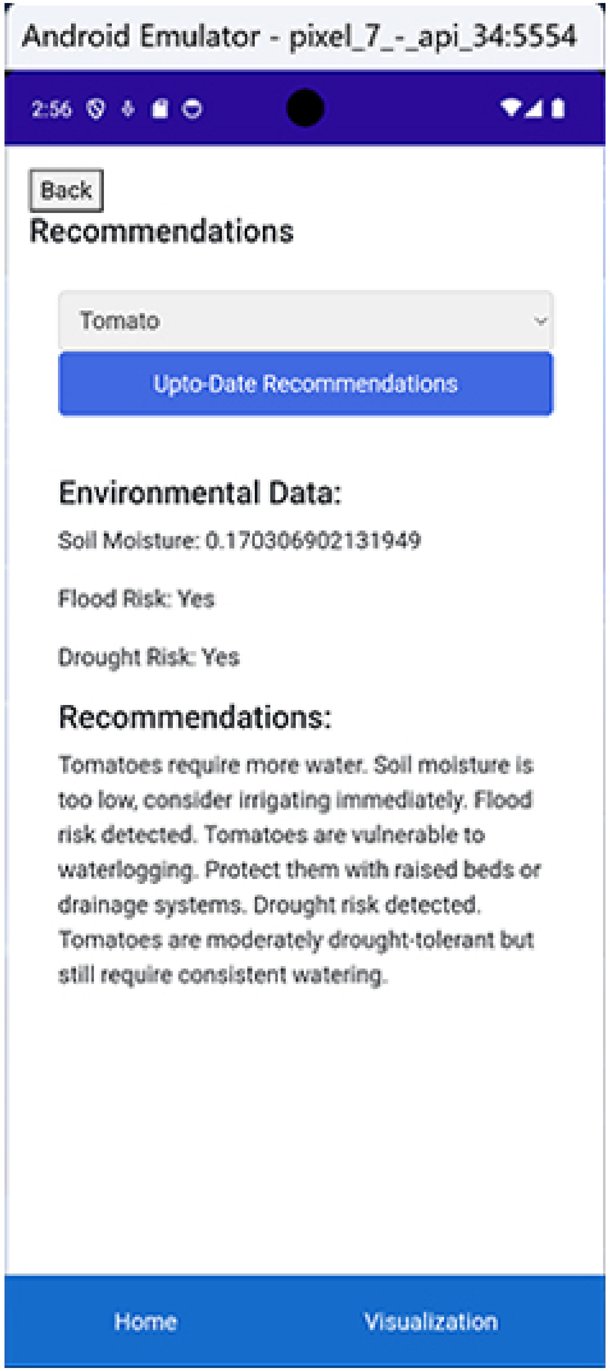
Crop success primarily depends on soil water content and sunlight, both essential for photosynthesis.

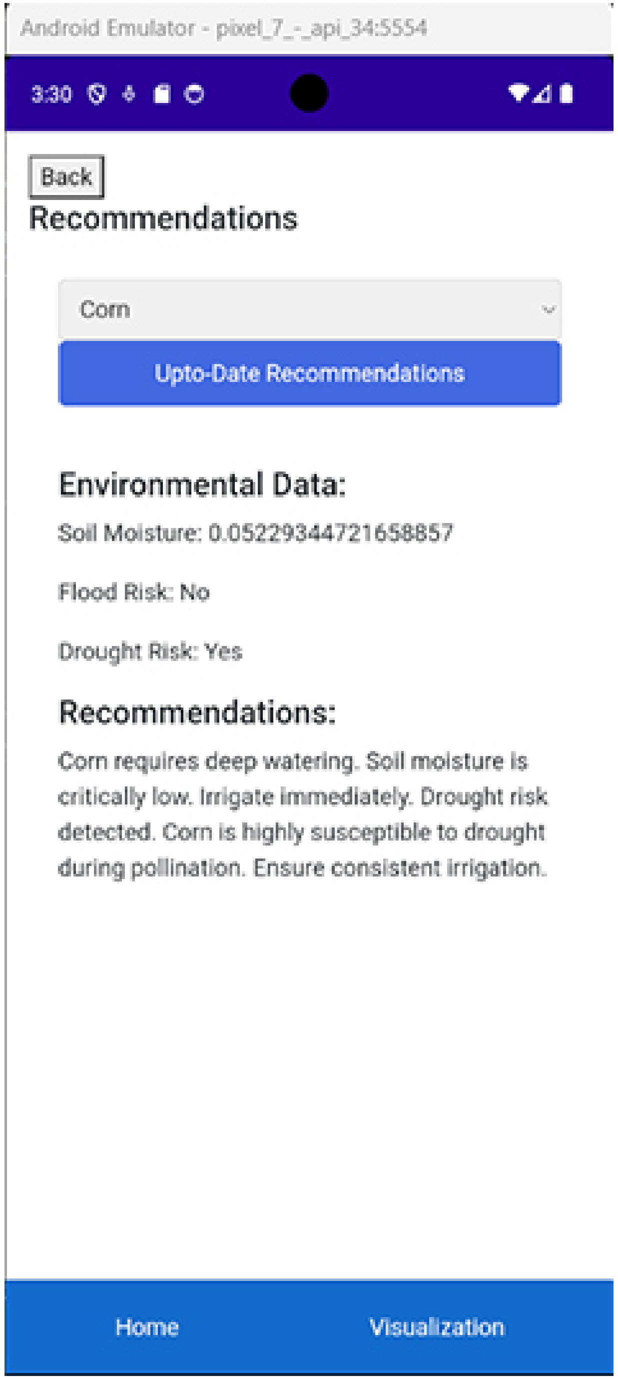
Soil Parameters

The key factor is soil water content, indicating the water volume at various soil depths. Soil type influences field capacity (maximum water content), while crop type determines wilting point (minimum water content). Each crop has an optimal soil water level for growth, with depth variations being significant. Soil temperature also affects water utilization by plants. Farmers can manage soil water through irrigation and drainage.

Sunlight Parameters

Sunlight radiation can be measured instantaneously in watts or continuously in joules. It varies by time of day and year, with location affecting penetration angles. The solar elevation angle best describes these variations, influencing sunrise, sunset, and day length.





05 IOT INTERGRATION
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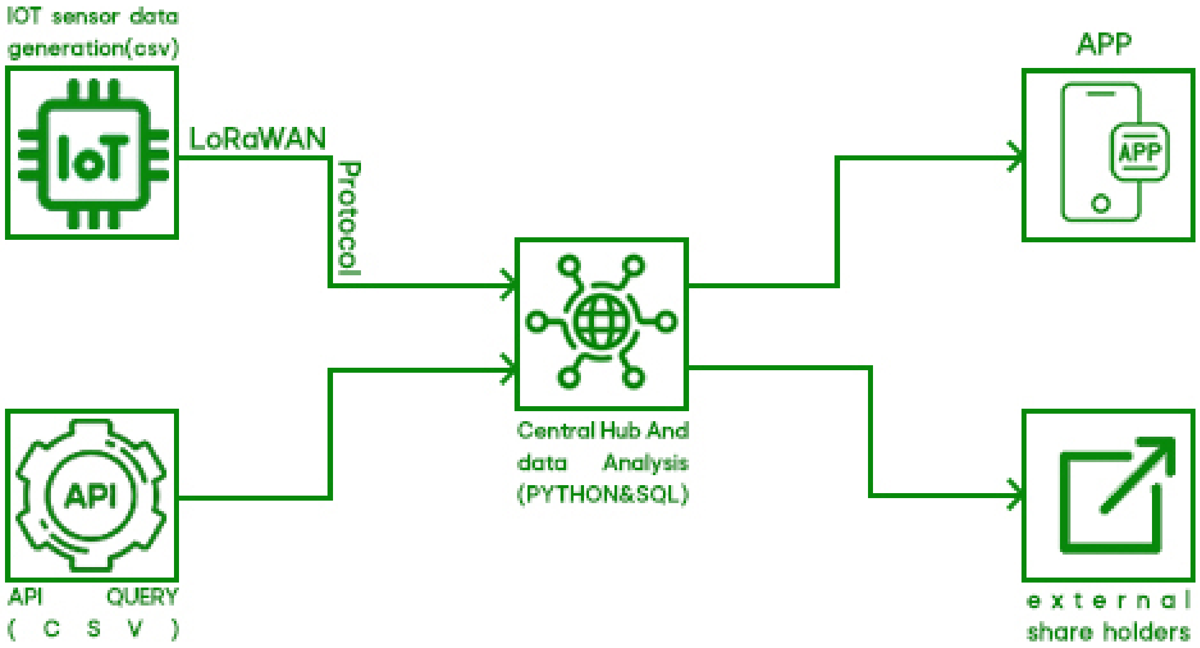
Alongside offering the farmer data insights from the meteomatic database we offer an additional module within the app that makes the phone function as a remote access point for an IoT-based sensor network around the farm. The hub between the sensors and the remote access point would process the data generated by the sensors to a form where it's able to cross-reference the results with the meteomatic evaluations and predictions. This would allow for an idealized smart farming solution that takes into account the relevant historic and real time data generated by the network ecosystem.

Suggested communication protocol method between the sensors and the hub is LoRaWAN, due to it's long-range communication capacity and it's low power usage.

Sensor data & Meteomatic data -> Hub -> app

Sensor data = csv, Meteomatic data = csv, data manipulation = Python, data storage = SQL, app = C#

Additional idea is to create a digital twin of the farm for automation and governmental regulation access. This could allow for subsidized farming solutions where the farmers are incentivized to cater to the unmet need in the market for a certain produce with funding from the government. This would also allow the possibility for regional crop rotations, which would reduce the burden on the nutrients in the soil, which in turn would require the farmers to use less fertilizers.



IOT to machine learning pipeline