MILAN Omdena

Challenge

Identifying potential areas for urban agriculture in Milan, Italy

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Content

Summary

The focus of this project was to improve urban agriculture through the utilization of data from different sources such as satellite imagery, tabular data, and scientific papers to generate synthetic datasets. These datasets were used to analyse and develop strategies for enhancing food security in urban areas. Additionally, our efforts involve integrating AI-powered decision support systems that provide web-based tools to assist users with determining the best locations, crops, and managing pests. This strategy has the potential to assist communities in enhancing urban farming techniques and establishing green areas to combat the adverse effects of climate change.

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Introduction

Sustainable farming practices are being implemented to tackle issues related to food security and to adjust to climate change using sophisticated technological resources such as remote sensing and GIS.

This project aimed to identify suitable urban areas for green gardens to enhance food security, using remote sensing technology and data analytics to assess factors like land use, soil conditions, crops, pests and pathogens.

Machine learning algorithms were employed for accurate predictions, with continuous feedback loops for improvements.

The project resulted in the development of data analytics dashboards for visualising and extracting insights on the potential of urban agriculture in Milan.

Additionally, web applications were designed to enhance stakeholder engagement and encourage the adoption of sustainable agricultural practices in response to technological advancements and environmental issues.

Can artificial intelligence tools enhance agriculture with minimal expenses?

Goals

The challenge goals were accomplished by organising the participants into three distinct groups: Task1, Task2, and Task3, with each group composed of Leads and co-leads.

The responsibilities delegated to each group encompassed data collection, dataset curation, exploratory data analysis (EDA), modelling, and web application development.

Task1

Selection of optimal areas

- Develop models for the identification of optimal urban locations for community gardens through the analysis of soil and climate data, sunlight exposure, and local conditions utilizing satellite imagery and tabular data.

Task2

Crop Selection and Yield Prediction

- To use machine learning algorithms for the prediction of optimal crop varieties by analysing past climate data and specific local factors.
- Create predictive models to forecast crop yields, enhancing strategic planning and efficient resource allocation.

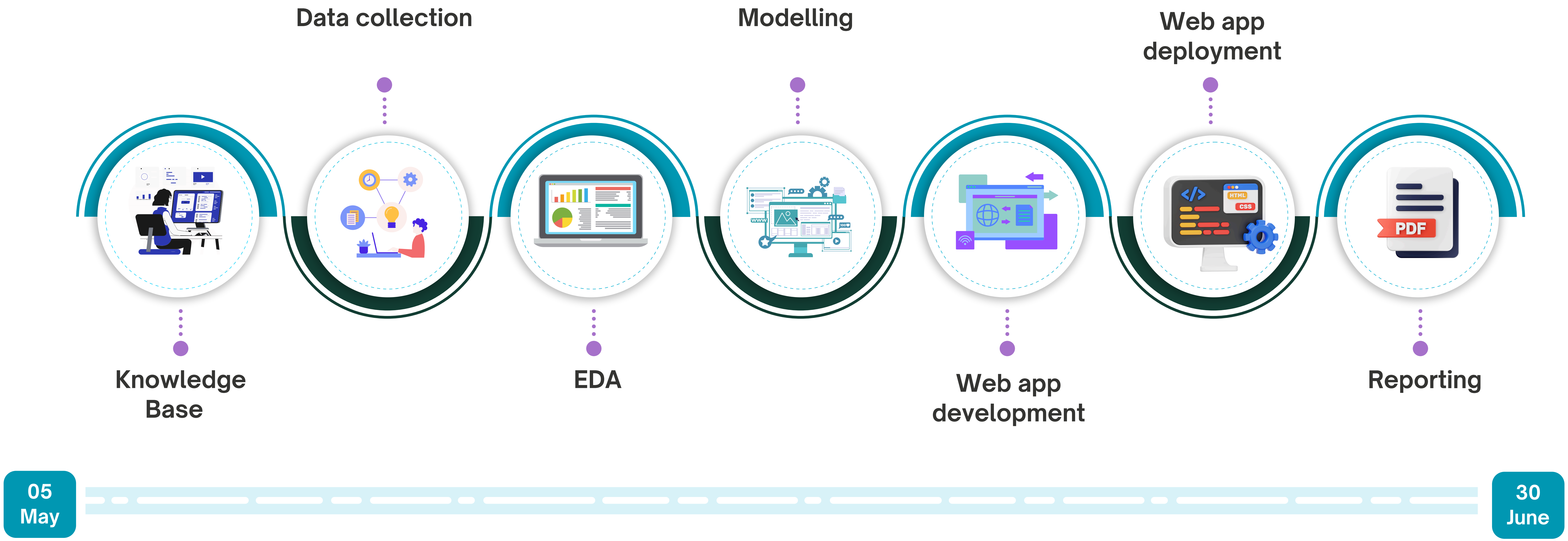
Task3

Smart Pest Management

- Employing AI tools for the prediction of pests and pathogens to enhance agricultural management strategies and mitigate food losses.

Challenge Timeline

During 8 weeks all tasks 1, 2 and 3 completed activities and showcase the steps taken and the efforts made to progress the project. how team members coordinated and worked together to ensure smooth execution and alignment with project goals.



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Methodology

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Data collection

Each team collected data for their specific assignments, which included acquiring high-resolution satellite images from organizations like the European Space Agency, NASA, and Google Earth Engine.

These images were processed and prepared for analysis, enabling the extraction of crucial details such as land use classification, vegetation analysis, surface temperature estimation, topography, land use change detection, environmental monitoring, and infrastructure mapping.

Additionally, a comprehensive dataset on crops suitable for urban agriculture, including climate requirements, soil preferences, and growing seasons, was compiled. Synthetic datasets were also created based on scientific information. Moreover, information on pests and diseases relevant to these crops was gathered to assist in effective urban agriculture planning and management.

Selecting Areas for Urban Farming

Task1

Collect satellite, climate, infrastructure, and social data for Zones 4 and 9 in Milan, Italy

Selecting suitable crops for urban farming

Task2

Data collection of vegetables, fruits, and salads that grow in Milan, Italy.

Pests and diseases relevant for urban farming

Task3

Data collection of pests and diseases relevant to the crops growing in urban areas of Milan, Italy.

EDA

During Data Preprocessing, techniques such as handling missing values, removing duplicates, and standardizing data were used to ensure dataset accuracy, crucial for analysis and modelling preparation.

In EDA, statistical tools and visualization techniques like scatter plots, histograms, and heat-maps were used to explore datasets and uncover patterns, aiding in understanding data and identifying relationships between variables.

The EDA dashboard enabled interactive exploration of datasets, generating customized reports for stakeholders and providing insights and recommendations for urban agriculture project locations.

Investing in Data Preprocessing and EDA in weeks 3 and 4 laid the foundation for predictive modelling and optimization, extracting valuable information for strategic planning and implementation of urban agriculture initiatives.

Task1

Selecting Areas for Urban Farming

- Conducted EDA on variables such as Land Slope, NDWI, NDVI, and Sunlight Exposure for zones 4 and 9.
- Generated descriptive statistics and visual representations to improve data understanding.

Task2

Selecting suitable crops for urban farming

- Developed an artificial vegetable dataset and carried out preliminary exploratory data analysis to verify the quality of the data.
- Merged the datasets from all crop types and conducted thorough exploratory data analysis to extract valuable insights.

Task3

Pests and diseases relevant for urban farming

- Samples underwent visual inspection in order to evaluate their quality.
- An in-depth analysis was carried out on image sizes and pixel distributions.
- The assessment of image blurriness and noise involved the calculation of various metrics.
- The identification and analysis of outlier images aimed to comprehend their impact on the dataset.

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Modelling

Tasks 1, 2, and 3 focused on developing and validating predictive models for urban agriculture in Milan. These models considered environmental and agricultural factors to make precise predictions about crop yields and pest outbreaks.

2. The predictive models were validated for accuracy and reliability, with adjustments made based on stakeholder feedback to improve performance and practicality.

3. A regression model was used to predict crop yields, while a classification model was created to differentiate between crop types. The Crop Disease Classification models went through data splitting, augmentation, model selection, training, and performance evaluation steps.

Task1

Selecting Areas for Urban Farming

- Developed and taught 15 supervised and 10 unsupervised learning models, utilizing data from Zone-4 and Zone-9 (2014 and 2023).
- Monitored various performance metrics on both types of models using MLflow.
- Provided instructional materials on supervised and unsupervised modelling techniques.
- Validated all models and ultimately chose two - one supervised and one unsupervised - for deployment.

Task3

Pests and diseases relevant for urban farming

- The original data will be divided into training, validation, and testing sets.
- Implementing data augmentation methods on the training sets to improve the model's generalization.
- Choosing and adapting model architectures like EfficientNet B1, ResNet, and other options.
- Training the model with suitable loss functions and optimizers, incorporating techniques like early stopping and hyperparameter adjustment.
- Assessing the model's performance on test sets by utilizing metrics like confusion matrix, precision, recall, F1 score, and accuracy.

Task2

Selecting suitable crops for urban farming

- Create models for crop classification and yield prediction containing various vegetables, fruits, and salads.
- Model training and predictions.
- Providing accurate insights into different crop types and their potential yields.

Web app

The web applications were designed with user-friendly interfaces to make it easy for stakeholders to interact with the data and explore different scenarios.
The visualisations provide a clear representation of the potential urban agriculture sites, allowing users to easily identify key areas for further investigation

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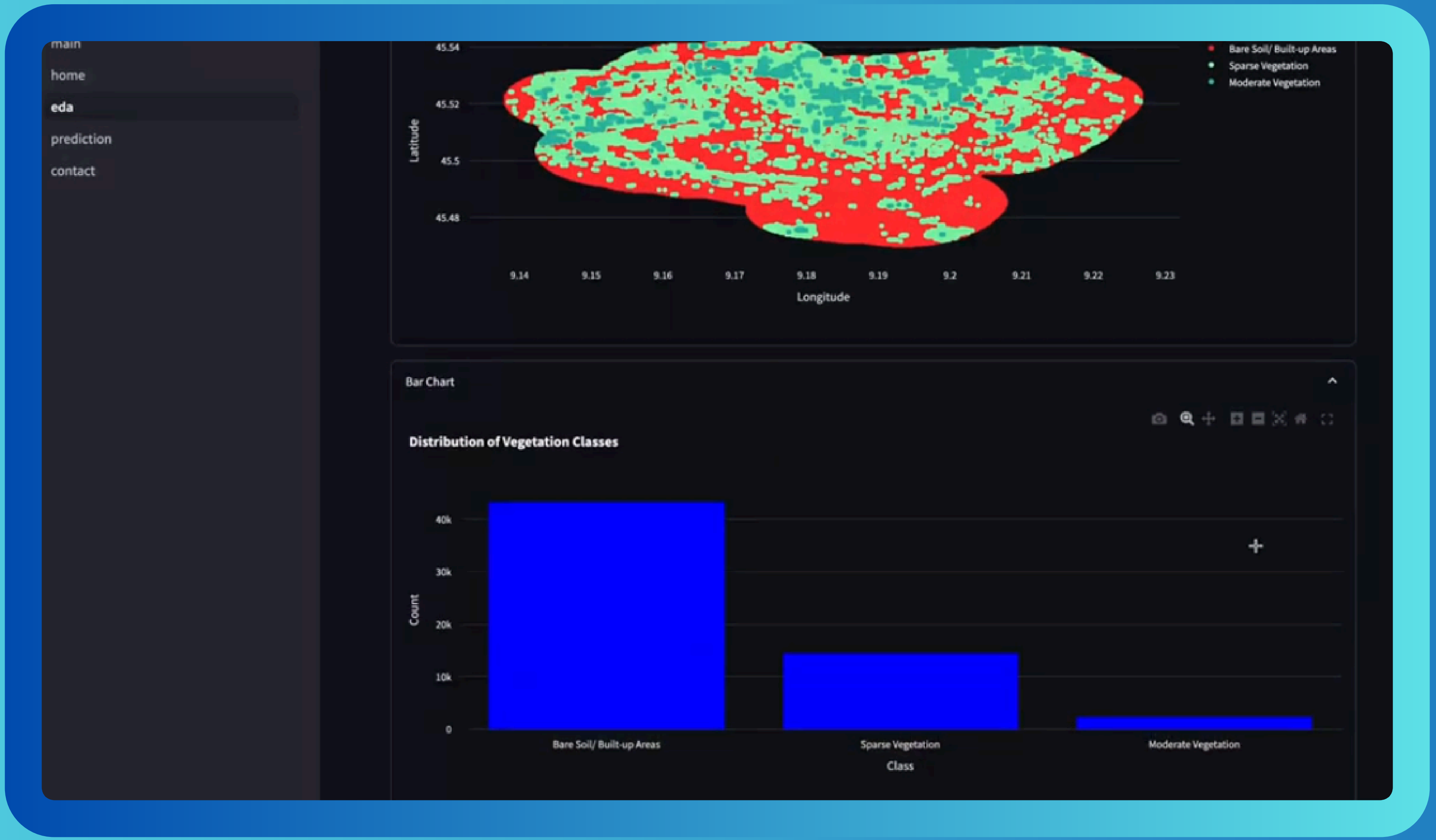
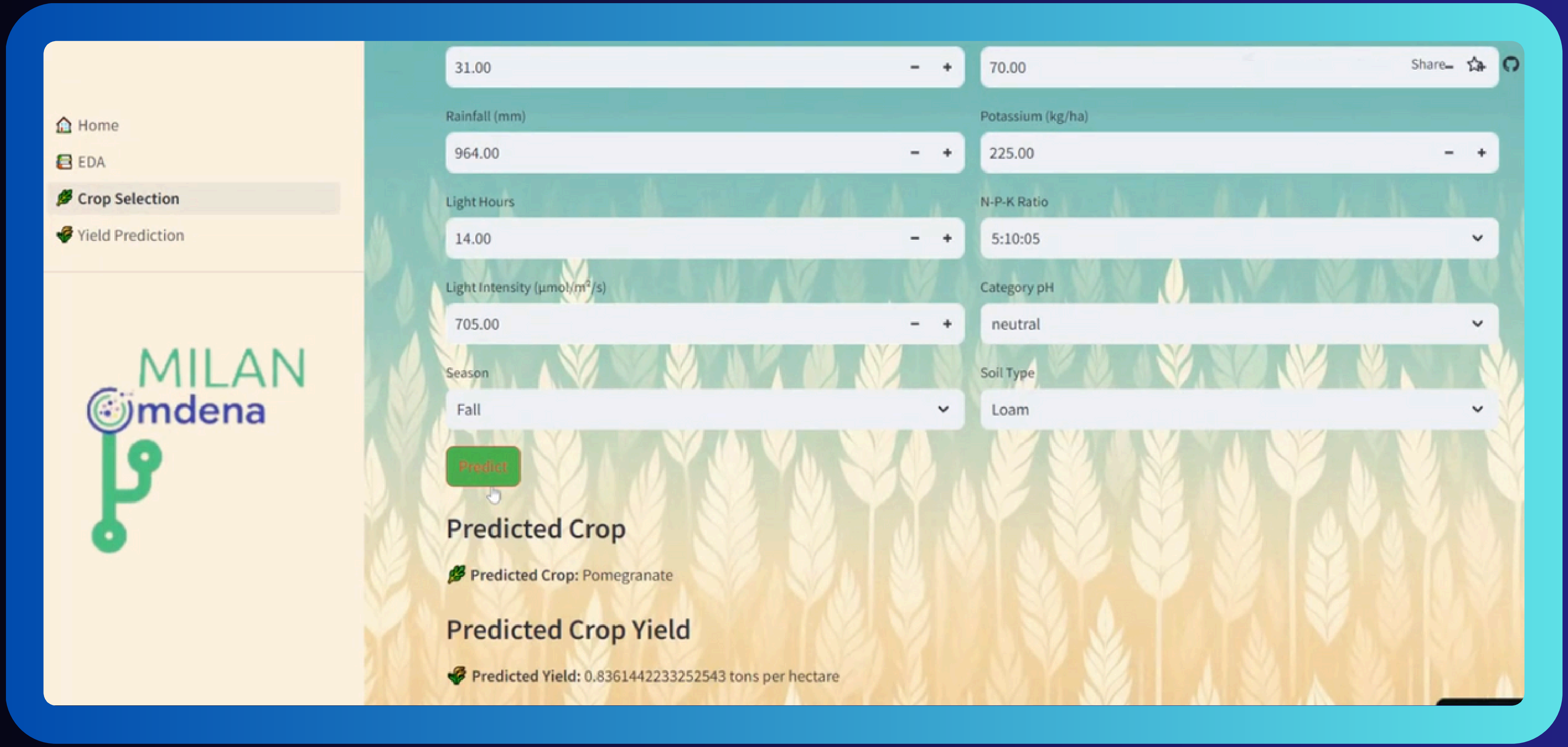
Task1 - Selecting Areas for Urban Farming



To access the app
scan the RQ code

Task2 - Selecting suitable crops for urban farming



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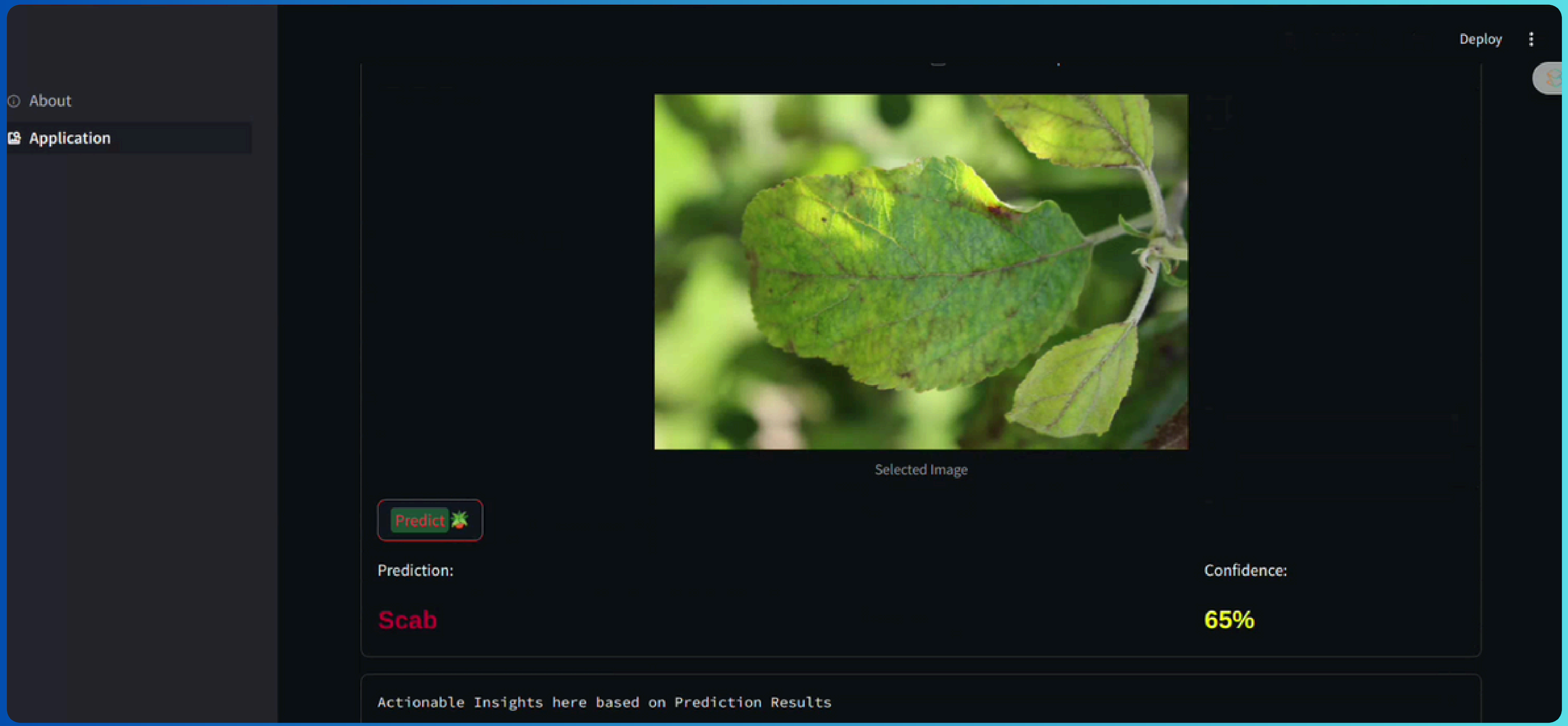
Task3 - Pests and diseases relevant for urban farming



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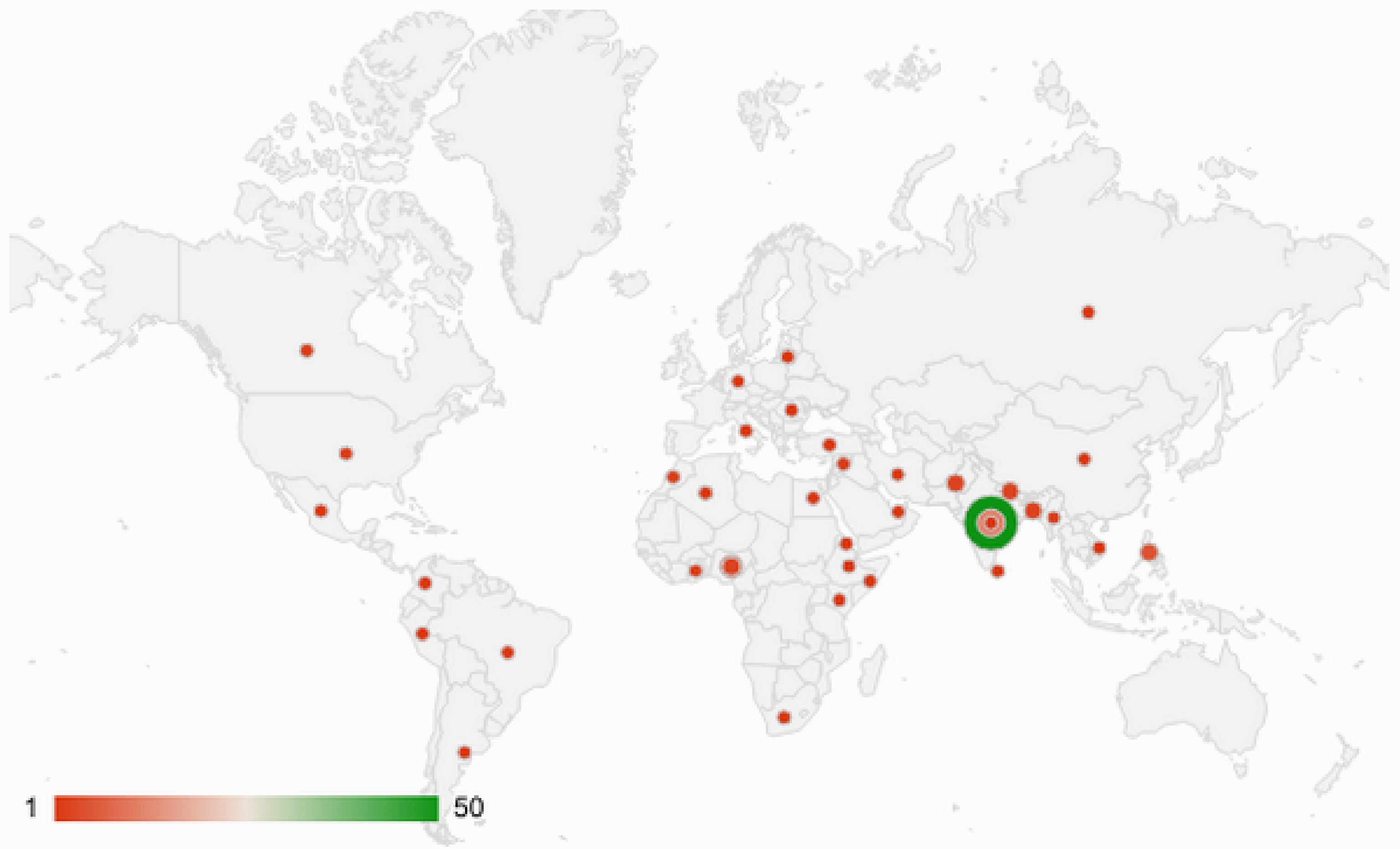
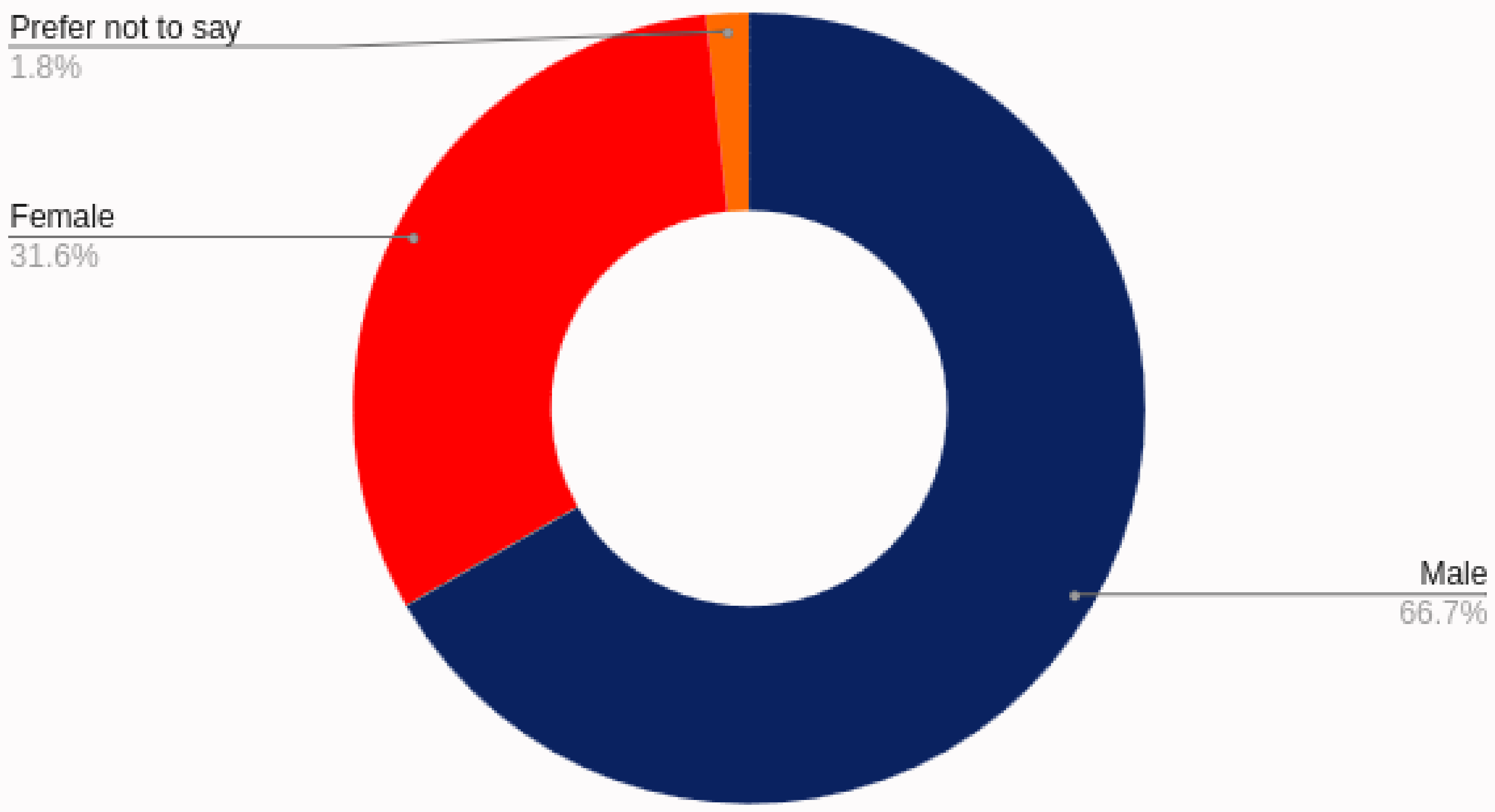
Challenge

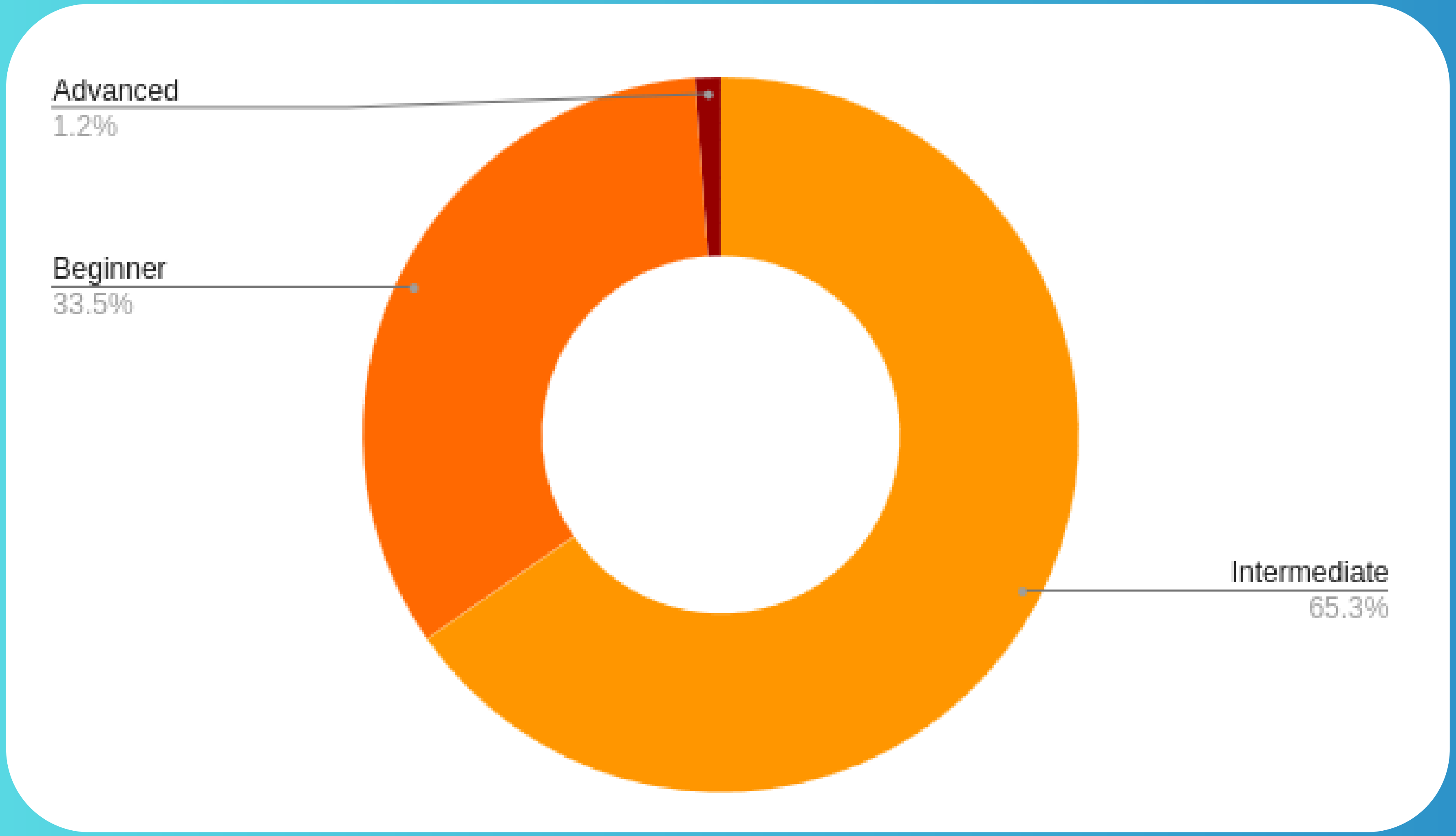
Participants

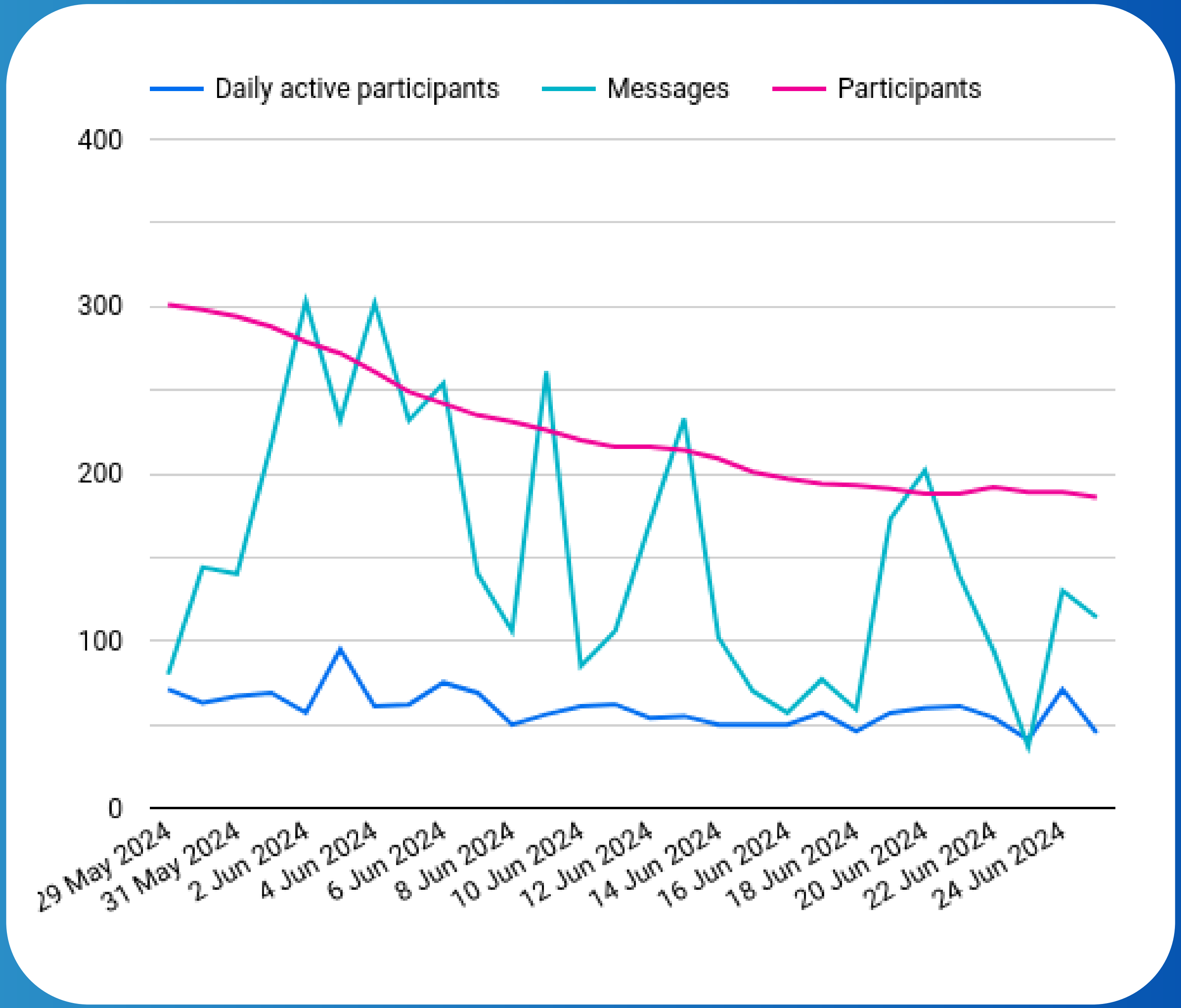
Participants distribution and gender





Participants experience and participation





Impact and Future Directions

The potential to use AI tools in advancing agriculture practices in urban areas by leveraging technology to inform decision-making, promote sustainable farming practices, and mitigate challenges associated with urban food production. They empower stakeholders, including farmers, policymakers, and community members, to actively participate in and benefit from urban agriculture initiatives.

- **User Engagement:** Encourage user feedback and community involvement to improve the accuracy and relevance of data within the applications.
- **Continuous Updates:** Regularly update the applications with new data and insights to ensure they remain current and effective in addressing evolving agricultural needs.
- **Integration:** Explore opportunities to integrate these applications with local agricultural networks, educational institutions, and governmental initiatives to maximise impact and scalability.

Acknowledgments

●●● I want to extend my sincere gratitude to all those who contributed to this project. Your hard work, knowledge, and teamwork have played a key role in reaching our objectives and coming up with effective solutions. We have made great progress in promoting urban agriculture ●●●

Thank you all for your hard work and commitment!

Thank you!

Omdena-Milan

Maria Fisher