



FarmWise



PROJECT DATA SCIENCE REPORT

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SUMMARY

01

INTRODUCTION

02

**BUSINESS
UNDERSTANDING**

03

**DATA ACQUISITION AND
UNDERSTANDING**

04

MODELING

05

DEPLOYMENT

06

CUSTOMER ACCEPTANCE

07

CONCLUSION





01

INTRODUCTION

1.1 BUSINESS CONTEXT AND PROBLEM DEFINITION

1.2 PROJECT OBJECTIVES



INTRODUCTION

1.1 Business Context and Problem Definition



Agriculture is a fundamental pillar of the global economy, providing food security and employment for millions of people. However, the sector is facing unprecedented challenges due to climate change, inefficient resource management, and the increasing demand for higher yields. Farmers often struggle with limited access to real-time data, making it difficult to make informed decisions about irrigation, fertilization, and disease control.

In Tunisia, agriculture plays a crucial role in economic development, but farmers face rising production costs, water scarcity, and unpredictable weather conditions. Traditional farming methods do not always optimize resource usage, leading to waste and environmental impact. Moreover, crop diseases and pest infestations can severely impact yields if not detected and treated early.

To overcome these challenges, FarmWise proposes an AI-powered solution that enables farmers to optimize their agricultural practices using data-driven insights. By leveraging machine learning, satellite imagery, and historical agricultural data, FarmWise aims to increase efficiency, reduce waste, and improve productivity. The project focuses on resource management, disease detection, and land segmentation to ensure that farmers can make the best possible decisions to maximize their yields and profitability.

INTRODUCTION

1.2 Project Objectives

The main objective of the FarmWise project is to revolutionize agriculture through AI-driven solutions that provide personalized recommendations to farmers. These recommendations will help optimize resources, detect plant diseases early, and improve agricultural planning. The specific objectives of the project are:

1. Develop an Intelligent Agricultural Recommendation Platform

- Provide personalized advice on irrigation, fertilization, and crop selection based on soil data, climate conditions, and yield history.
- Help farmers make data-driven decisions to increase productivity and sustainability.

2. Build an Automatic Plant Disease Detection Model

- Use AI and computer vision to analyze plant images and detect diseases with high accuracy.
- Reduce excessive pesticide use by targeting only affected crops, improving crop health and sustainability.

3. Segment Farmers and Agricultural Land for Better Resource Allocation

- Use data-driven clustering techniques to categorize farms based on size, crop type, soil condition, and climate factors.
- Optimize agricultural offerings and support strategies to enhance productivity.



02

BUSINESS UNDERSTANDING

2.1 TDSP METHODOLOGY OVERVIEW

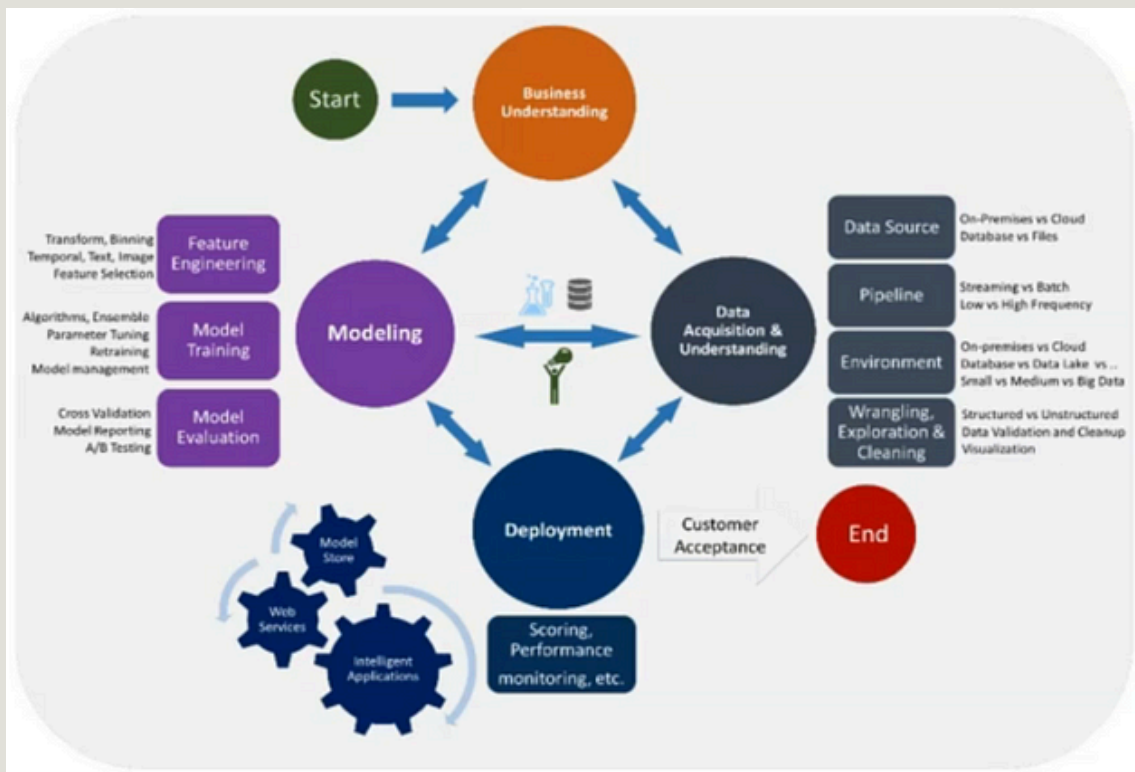
2.2 PROBLEM UNDERSTANDING

BUSINESS UNDERSTANDING

2.1 TDSP Methodology Overview

TDSP methodology

The Team Data Science Process (TDSP) is a structured methodology designed to guide data science projects from conception to deployment. Unlike traditional approaches, TDSP emphasizes collaboration, iterative development, and business alignment, ensuring that data-driven solutions meet real-world needs.



TDSP consists of five main phases:

1. **Business Understanding** – Defining the project's business objectives and expected impact.
2. **Data Acquisition and Understanding** – Collecting, cleaning, and exploring relevant data.
3. **Modeling** – Developing, testing, and refining machine learning models.
4. **Deployment** – Integrating models into real-world applications for end users.
5. **Customer Acceptance** – Validating the solution with stakeholders and ensuring usability.

BUSINESS UNDERSTANDING



2.2 Problem Understanding

The agricultural sector is increasingly turning to data-driven solutions to enhance productivity, sustainability, and resource efficiency. Farmers face growing challenges, including climate change, inefficient resource allocation, unpredictable weather patterns, and crop diseases that threaten food security. These issues impact yields, increase costs, and reduce profitability, making it essential to integrate advanced technologies such as Artificial Intelligence (AI) and Machine Learning (ML) to improve decision-making.

One of the most pressing concerns in agriculture is the inefficient management of resources such as water, fertilizers, and pesticides. Misuse of these essential inputs not only increases production costs but also contributes to soil degradation and environmental pollution. Furthermore, early detection of plant diseases is critical to preventing significant yield losses, yet traditional disease monitoring methods are often manual, slow, and inaccurate.

Additionally, farmers frequently struggle with real-time decision-making, as they lack access to accurate and timely insights regarding irrigation, fertilization, and crop health. Similarly, understanding land value and agricultural potential remains a challenge, making it difficult for farmers and investors to optimize land use and make informed investment decisions.

Machine learning provides an opportunity to overcome these challenges by analyzing soil, climate, and historical yield data to generate predictive insights. By leveraging AI-powered decision-making tools, FarmWise aims to help farmers optimize resource allocation, detect crop diseases early, and forecast land prices, ultimately leading to higher efficiency, increased productivity, and long-term agricultural sustainability.



BUSINESS UNDERSTANDING



Business Objectives



The objective of this project is to enhance agricultural productivity and sustainability by leveraging AI and data-driven decision-making tools. The FarmWise platform will provide farmers with real-time recommendations for resource management, disease detection, and land optimization.

More specifically, FarmWise will:

- **Optimize the use of agricultural resources** (water, fertilizers, and pesticides) to reduce waste and costs.
- **Identify crop diseases early** using **AI-powered image analysis** to prevent losses and improve treatment strategies.
- **Increase agricultural yields** by analyzing **soil composition, climate conditions, and historical data**.
- **Recommend optimal crop rotation strategies** to enhance soil fertility and long-term productivity.
- **Predict agricultural land prices in Tunisia** to support **informed investment and land-use planning**.
- **Classify spontaneous plants** (volunteer plants) to determine their medicinal value or potential harm to crops.



BUSINESS UNDERSTANDING



Data Science Objectives

The primary aim of the data science aspect of this project is to utilize machine learning, computer vision, and predictive analytics to assist farmers in making data-driven decisions.

The specific objectives include:

- **Predict the optimal amounts of water, fertilizers, and pesticides** needed for each crop based on soil and climate data to improve resource efficiency.
- **Develop a computer vision model** to detect early signs of crop diseases and pests by analyzing plant images.
- **Create a machine learning model** to forecast crop yields using historical data, soil quality, and weather patterns, helping farmers plan more effectively.
- **Build a recommendation system** to suggest the best crop rotation strategies, balancing profitability and soil health.
- **Predict land prices in Tunisia** by analyzing factors like location, market trends, and soil quality, aiding investment decisions.
- **Automate the classification of volunteer plants** to identify harmful weeds and useful medicinal plants.



BUSINESS UNDERSTANDING



Sustainable Development Goals (SDGs)

This project contributes to several United Nations SDGs by promoting sustainable farming practices, improving resource efficiency, and addressing key global challenges like climate change and hunger. Through data science and AI, the project supports the creation of a more sustainable and equitable agricultural future.

Here's a brief description for each SDG:

13
CLIMATE
ACTION



SDG 13: Climate Action

This project supports climate action by optimizing resource use (water, fertilizers, pesticides) to reduce environmental impact and help mitigate climate change in agriculture.

15
LIFE
ON LAND



SDG 15: Life on Land

By enhancing crop health, disease detection, and biodiversity through crop rotation recommendations, this project promotes sustainable farming that protects land ecosystems.

12
RESPONSIBLE
CONSUMPTION
AND PRODUCTION



SDG 12: Responsible Consumption and Production

This project encourages responsible consumption and production by recommending optimal resource use (fertilizers, pesticides) and sustainable crop rotation practices.

8
DECENT WORK AND
ECONOMIC GROWTH



SDG 8: Decent Work and Economic Growth

The project fosters economic growth by improving productivity and profitability in agriculture, providing farmers with data-driven insights to make better financial decisions.

2
ZERO
HUNGER



SDG 2: Zero Hunger

By improving crop yields and disease management, the project helps enhance food security and combat hunger by boosting agricultural productivity.

6
CLEAN WATER
AND SANITATION



SDG 6: Clean Water and Sanitation

The project promotes efficient water use in agriculture by predicting water needs for crops, supporting sustainable water management and conservation efforts.