**BABEȘ-BOLYAI UNIVERSITY CLUJ-NAPOCA**

**FACULTY OF MATHEMATICS AND COMPUTER SCIENCE**

**SPECIALIZATION MATHEMATICS AND COMPUTER SCIENCE IN ENGLISH**

**DIPLOMA THESIS**

**Precision Agriculture:**

**Predicting a crop based on environmental data.**

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**Abstract**

This paper aims to illustrate how integrating AI into agriculture can potentially enhance production. It also seeks to encourage documenting the yields of crops and future development with AI and agriculture data which could enhance future production. Farmers face challenges in considering all natural factors when making decisions, often relying on intuition. However, this paper will delve into these natural factors that significantly influence crop outcomes, outlining the potential long-term impact it could have on farms, leading to a better-informed population that takes advantage of the data to bring out the best productions. Introducing a tool that would make it easier for them to make such decisions while taking such data into account would greatly benefit them. By providing chemical data about the soil at the start of the year this machine learning algorithm can predict the yield of different crops. This can later be developed to use these results to recommend what crop would be best for the current year, or what the chemical levels of the soil should be for their desired crop. This model was initially trained on a public dataset from India. However, it can easily be adapted to other countries with varying climates, provided there is access to relevant training data.

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**Chapter 1**

**Introduction**

* 1. **Motivation**

In recent years, our climate has undergone significant changes, deeply impacting the agricultural sector. On top of the constant change of the climate making it harder for farmers to predict which would be the best crop to be planted, our society continues to expand while arable land is finite. At the same time, not all farmers consider all the knowledge there is about crops. Reaching better productivity out of the current resources we have would be a great improvement on top of making certain decisions easier for farmers. I was determined to look for options to implement artificial intelligence into our agricultural sector in a way that would make farming smarter and more efficient.

**1.2 Objective**

The objective of this project is to encourage the advancement of implementing ai into this field and bringing more efficiency and effectiveness to farming practices. I want to promote both the collecting and utilization of data by showing the effects it can have. With future developments in this field, we anticipate simpler decision-making processes for our farmers, coupled with reducing the waste of resources such as fertilizer. This approach ensures optimal utilization of resources where they are most needed, which provides greater efficiency and sustainability.

Additionally, the data collected, and the progress achieved in this field could have the potential to stimulate further innovations in the agricultural sector.

* 1. **Structure of the thesis**

This Paper is divided into 3 main chapters: Theoretical background, Crop Yield Prediction Application and a Synthesis.

First, this paper will describe the background for the field, discussing the importance of improving the productivity of the crops due to the population situation as well as the climate change situation. The key chemical factors to take into consideration when talking about improving productivity of crops are the three chemical elements: potassium (K), nitrogen (N), and phosphorus (P). In this chapter I will delve into their significance for various crops and how achieving optimal balances of these elements can lead to better annual crop yields.

Second, I will present the project of this thesis along with the objectives. I will present the technologies used, the selected machine learning algorithms and the reasons behind choosing them, as well as their respective results. Then I will proceed to show the application and how these algorithms and their results can be used to help the decision making of the farmers. Lastly, I will talk about encouraging future data gathering in this field to facilitate further development into making agriculture more efficient and less wasteful.

Lastly, I will summarize the contents of my paper while bringing together the conclusions made along the way. These conclusions will be examined, and their impact will be discussed, along with future developments that can be made on this project.

**Chapter 2**

**Theoretical Background**

**2.1 World population and food security**

The population of the earth experienced a rapid increase to 7 billion in 2011. It was estimated at that time that by the year 2025 we would reach 8 billion, and by 2050 it would reach 9 billion. As we have reached the year 2024, we can already see that the first prediction was accurate, as we currently reached 7.95 billion people. The following graph serves as visual aid to illustrate the demographic expansion.

A graph with a line

Description automatically generated

Although the population of the earth continues to rise, it is crucial to acknowledge that the land suitable for cultivation remains constant. As we reflect on the predictions made regarding the earth’s population growth, it becomes clear that the agricultural district should have at least a similar growth rate. The static availability of cultivable land creates a necessity for innovation in terms of productivity and efficiency.

But agriculture-driven growth and food security are at risk. Due to multiple shocks, such as Covid-19, extreme weather conditions, pests and conflicts, the food system has been greatly impacted. Climate change is also having a great impact as it is changing the conditions the crops grow in and altering productivity. The goal of ending global hunger by 2030 is currently off track [1].

The Global Report on Food Crises (GRFC) 2023 estimates that over a quarter of a billion people were acutely food-insecure and required urgent food assistance in 58 food-crisis countries/territories in 2022. This is the highest number in the seven-year history of the GRFC. Around 258 million people, the equivalent of 22.7% of the analyzed population in 58 countries/territories faced high levels of acute food insecurity in 2022 [2].

