Applied Data Science-1 Assignment-1

Impact of Climate and Agricultural practices on Crop Yield and Economics

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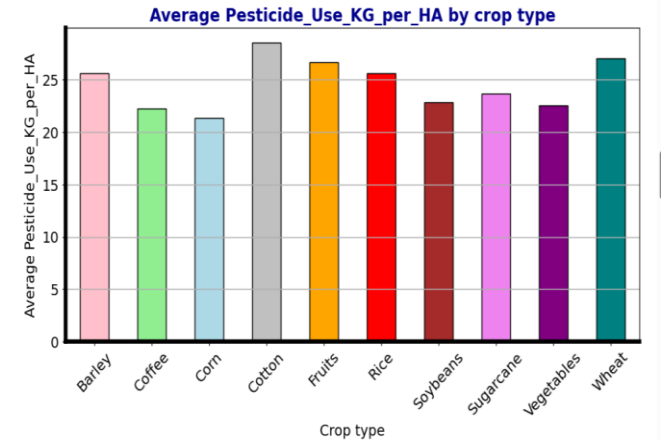
GitHub: https://github.com/aishwarya-shekar-babu/Applied-Datascience-1-Assignment1
Dataset: https://www.kaggle.com/datasets/waqi786/climate-change-impact-on-agriculture/data

Introduction

Agriculture serves as a crucial foundation for the survival of the global population while also contributing to economic development; however, unpredictable climate changes significantly impact this sector. This dataset, covering the years 1998 to 2024, examines the effects of climatic variables, such as average temperature, factors like soil health index, Pesticide usage, on the yields of key crops.
It also explores how different agricultural practices influence productivity outcomes. To ensure food security amid climate change, the report will investigate these aspects to identify trends and insights that can guide best practices for enhancing agricultural systems.

Significant decrease in crop yield and economic growth are indicated in mean values and significant variability is indicated by large standard deviation in several areas like pesticide usage, soil health and economic effect Detailed analysis is provided in subsections in the report.

A. Average Pesticide usage by crop type



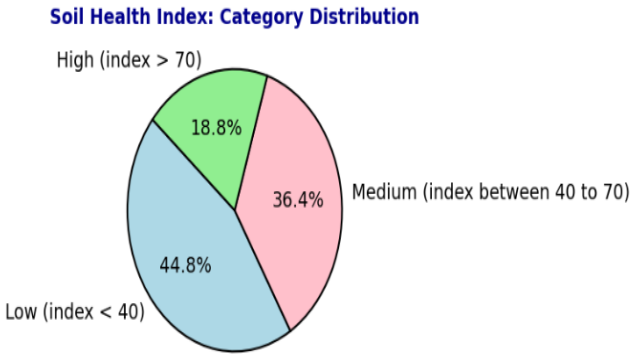
The above bar chart shows the average pesticide used in kilograms per hectare (kg/ha) (obtained by mean of pesticide usage by crop) for each crop type present.

The cotton and wheat have the largest pesticide applications, almost 27 kg/ha. Fruits, barley and Rice also show comparatively major pesticide use. This pattern raises the possibility that these crops need strict and sustainable pest management practices.

With pesticide consumption of about 23-25 kg/ha, soyabeans, sugarcane and vegetables are in the middle range and require moderate pest control. Coffee and corn use the least number of pesticides (20–22 kg/ha) because their management methods are more sustainable.

While crops with lesser pesticide use may better support sustainable soil management, heavy pesticide use for some crops may pose dangers to soil health, compromising soil biodiversity and long-term production.

B. Soil Health index categories



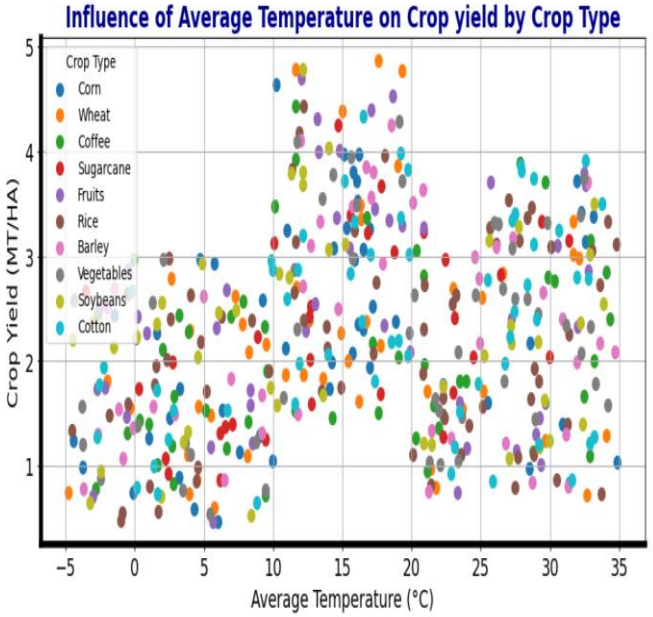
This pie chart shows how soil health is distributed across three groups according to the Soil Health Index: Low (index < 40), Medium (index 40–70), and High (index > 70).

The data shows that **44.8%** of soils are classified as low, indicating poor soil health that could have an impact on sustainability and production. A moderate level of health is indicated by the **36.4%** of soils that fall into the medium category, which may be improved to reach ideal conditions.

Only **18.8%** of soils are categorized to have good soil health and as a superior resilience to environmental pressures.

With over half of the soils in poor condition now, this distribution suggests that high pesticide usage has a great impact on soil health and a better soil management technique may be necessary to improve soil health.

C. Average temperature influence on crop yield



The scatter plot shows the correspondence between average temperature (°C) and crop yield (MT/HA) across various crop types.

Crop yields look to change significantly within the **10 – 20°C range**, with yields reaching up to **5 MT/HA** for most crops, indicating that moderate temperatures are generally promising for crop production.

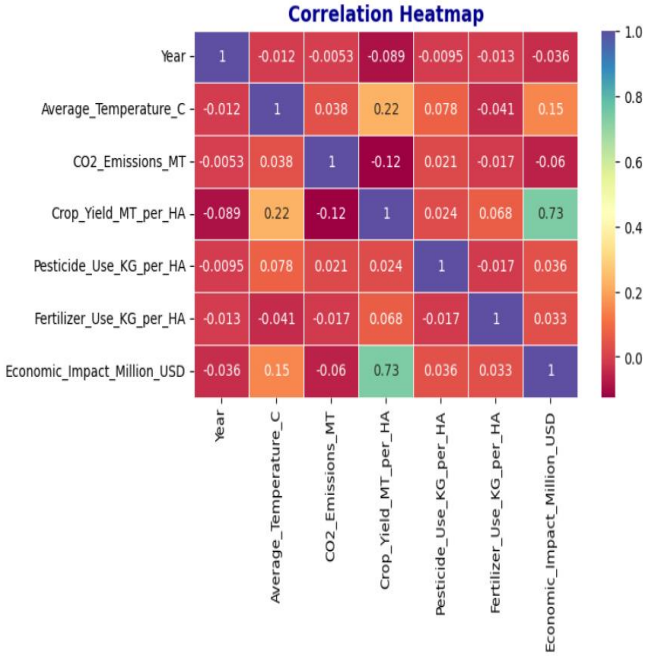
Crops like Wheat, Corn, and Vegetables appear to thrive within this temperature band, might be optimal.

Colder weather tends to reduce yields; crops like coffee, sugarcane, and fruits yield little to nothing. Even still, cold-tolerant crops like barley and wheat continue to produce some, demonstrating their ability to withstand colder temperatures.

This analysis shows that while excessive heat or cold usually affects crop productivity, with some variation in tolerance among crop kinds, moderate temperatures are best for high yields.

These trends imply that although some crops do better in particular temperature ranges, the variation in yield at both lower and higher temperatures suggests that other environmental elements, like sunlight, soil quality, and water availability, also play a significant role in crop productivity.

D. HEATMAP



Crop yield and economic impact have a substantial positive association (0.73), according to the correlation heatmap, indicating that increased agricultural productivity has a direct positive impact on the economy. Additionally, there is a positive connection (0.033) between fertilizer use and economic impact, suggesting that fertilizer supports agricultural yields.

Conversely, there is a moderately negative correlation (-0.06) between CO2 emissions and economic impact, suggesting that high emissions may have negative economic effects. Furthermore, there is a little negative correlation between temperature and crop yield (-0.22), indicating that greater temperatures may result in lower yields.

Conclusion

High pesticide use, unhealthy soil, and the effects of temperature fluctuations all point to difficulties in attaining sustainable crop production and economics, Agricultural sustainability and production could be increased by concentrating on improving soil health, choosing different process that require fewer pesticides, and matching crop varieties to local climate conditions.