

3MTT HACKATHON 2.0

TECH FOR GOOD!

**Climate Change and Agriculture:
Impacts and Predictions
for Nigeria**

PRESENTED BY

FE/23/21076938 – Data Science

FE/23/40181467 – Data Analysis & Visualization

Outline

- Introduction
- Objective 1
- Objective 2
- Objective 3
- Recommendations
- Conclusion



Climate change are long-term shifts in climatic variables caused by natural factors and human activities.

Introduction

Aim: To evaluate the impact of Climate change on Agricultural Production in Nigeria

Objectives:

- 1. To visualize how Climatic, Agricultural, and Economical variables has changed in Nigeria from 1961 to 2022**
- 2. To evaluate the correlation/relationship between;**
 - i. Climatic variables and Agricultural variables**
 - ii. Agricultural variables and Economic variables**
- 3. To build and train a model that can predict Crop production index based on climatic variables.**

Variables :

Climate Variables

- Average temperature (oc)
- Precipitation (mm)
- Relative humidity (%)

Agric Variables

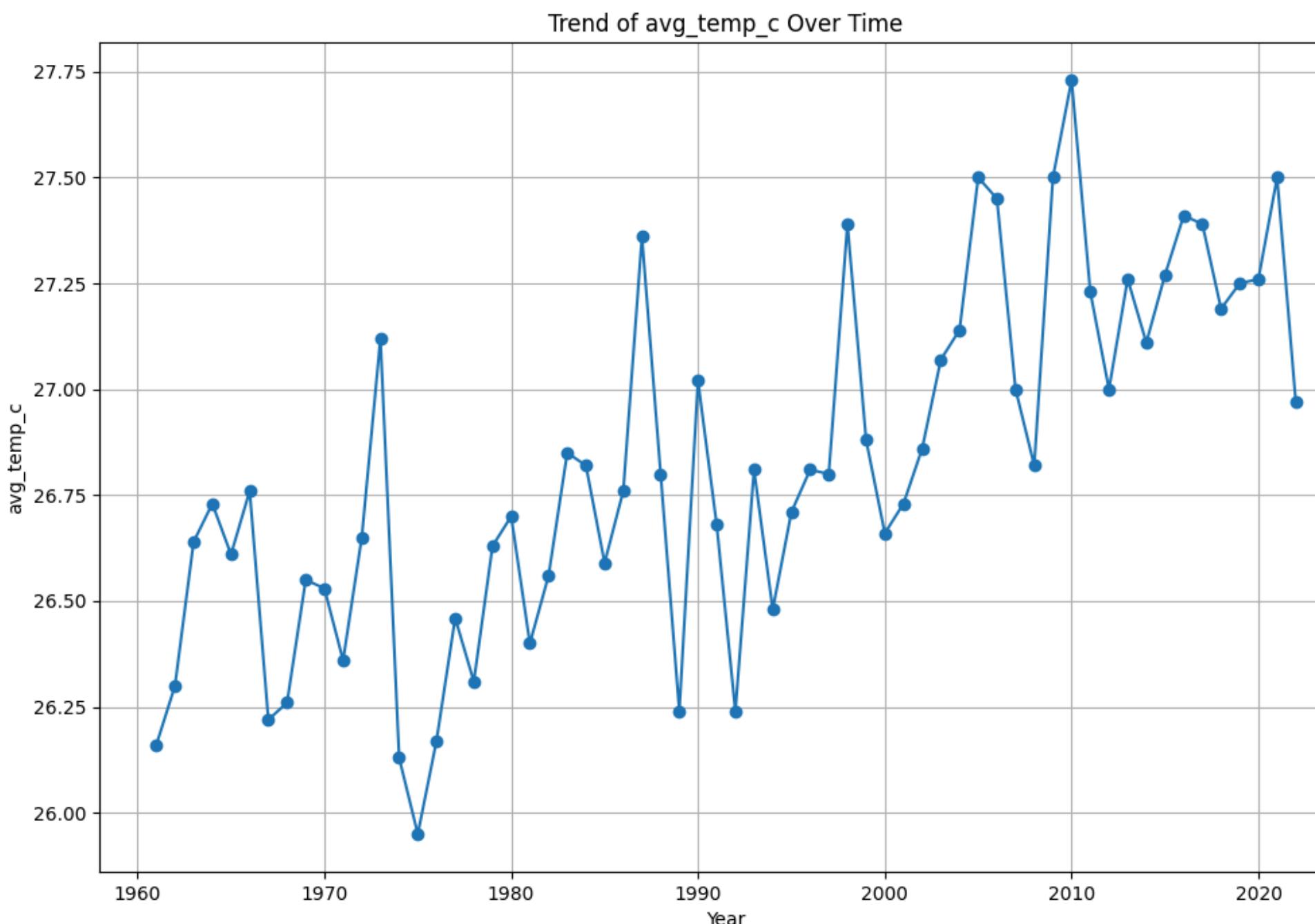
- Crop Production Index
- Livestock Production Index
- Total Fisheries Production (metric tons)
- Agricultural Land (sq.km)

Economic Variables

- Gross Domestic product (GDP)
- Inflation Rate (CPI)

Objective 1: Visualization

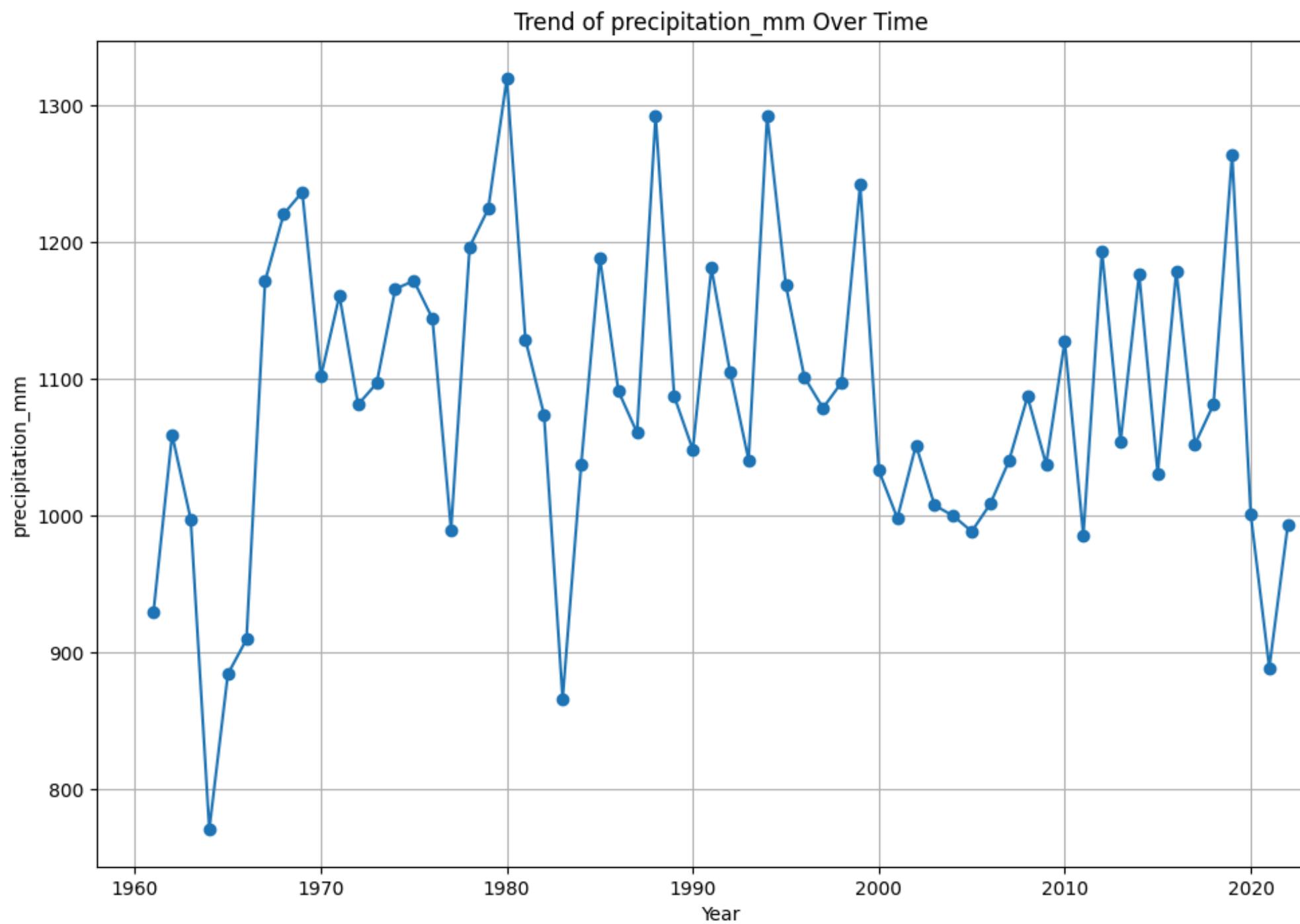
Climatic variables: Average Temperature



Insights

- The highest average temperature (27.73 oC) was recorded in 2010,
- The lowest (25.49 oC) was recorded in 1975.
- It has been on the decline since 2021

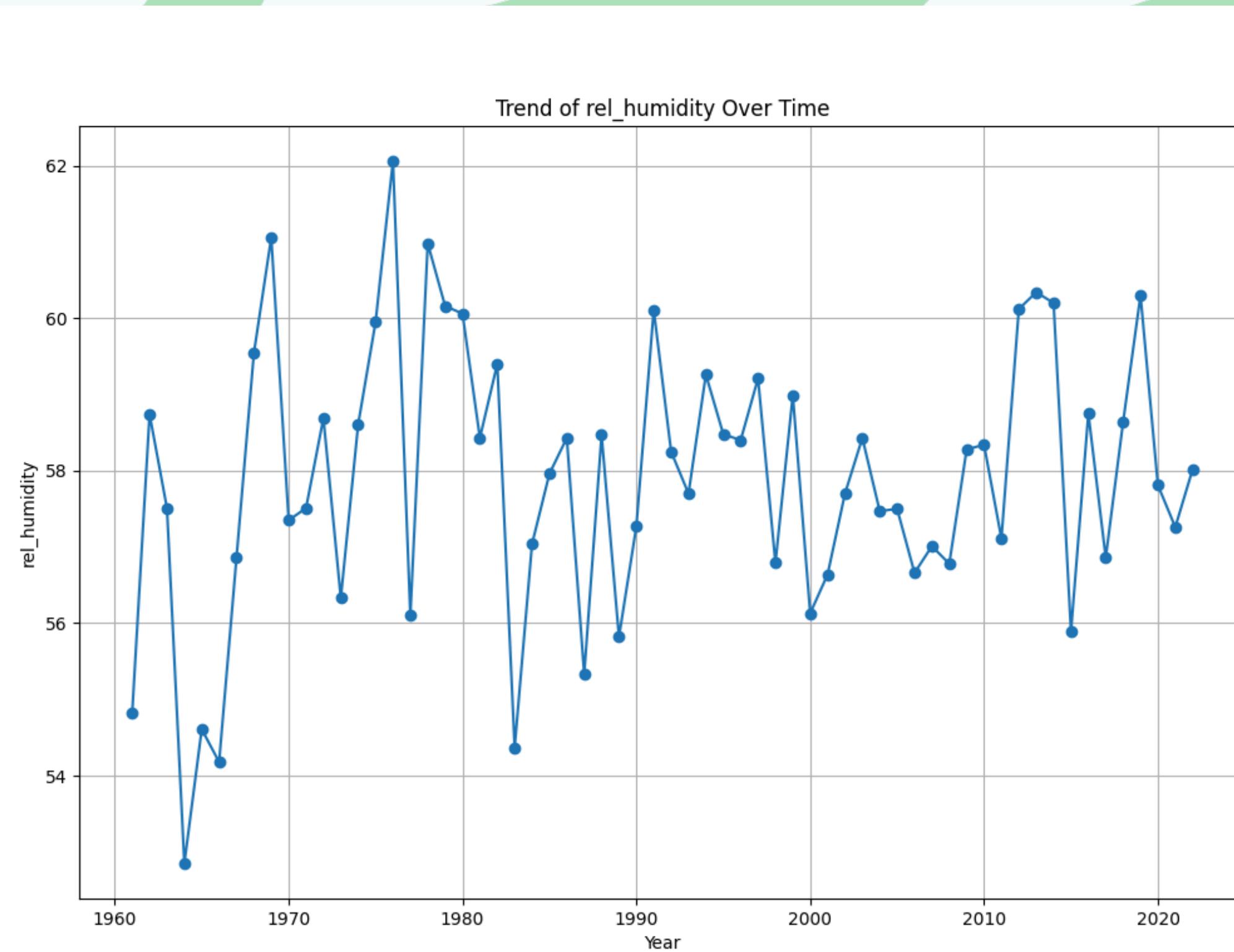
Amount of water that falls from the atmosphere (Precipitation)



Insights

- The highest precipitation (1319.71mm) was recorded in 1980,
- The lowest (770.75mm) was recorded in 1965.
- It declined from 2020 to 2021. However, it showed potential for increase in 2022.

Amount of water vapour in the atmosphere (Relative Humidity (%))

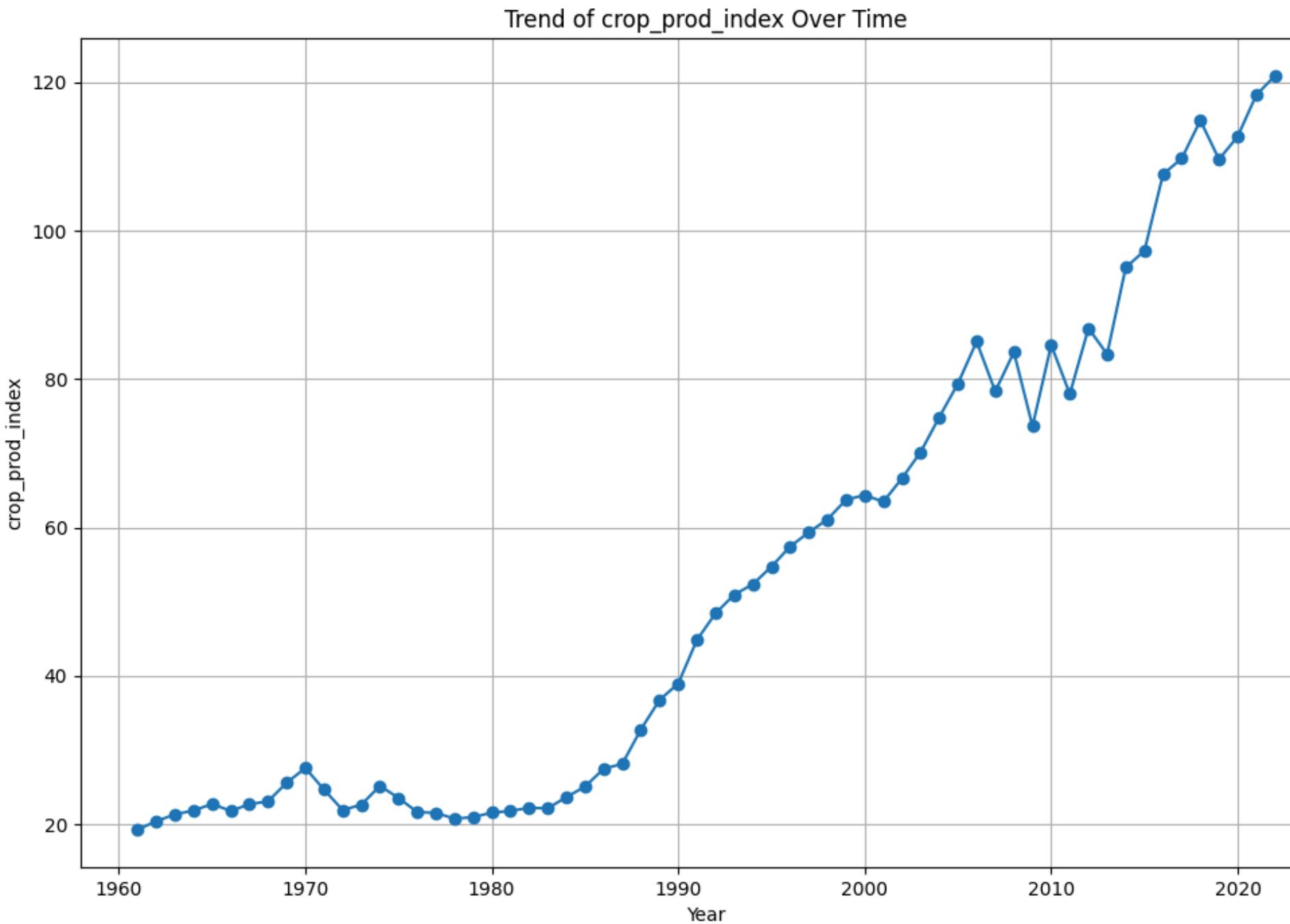


Insights

- The highest relative humidity (63.09%) was recorded in 1975.
- The lowest was recorded in 1965.
- Similar to Precipitation, there was also a decline from 2020 to 2021, and a potential increase from 2022.

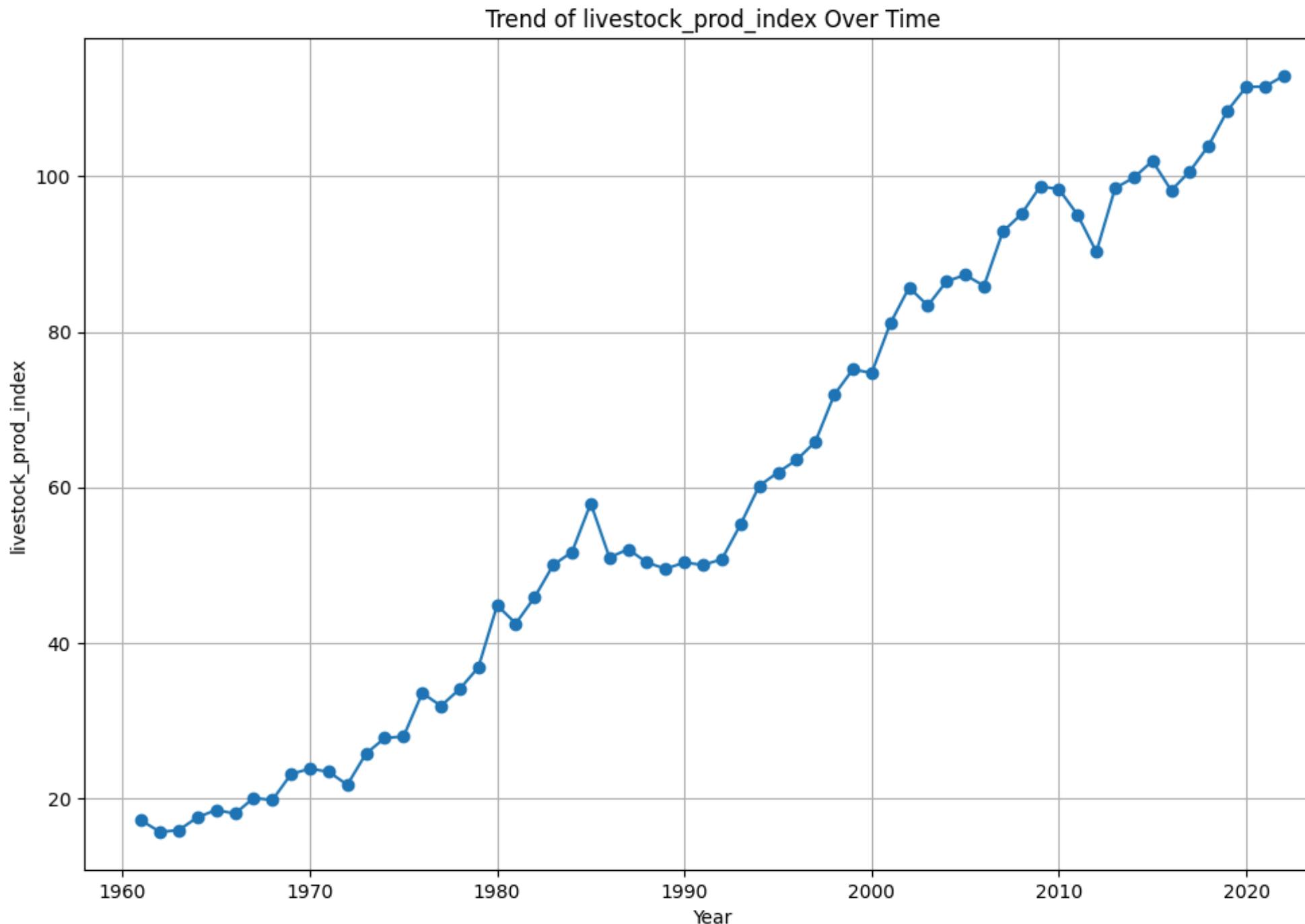
Agric variables: Crop Production Index

Insights



- The total amount of crop produced has been on the increase over the years,
- However, there have been fluctuations;
- For example, there was a sharp decline between 2018 and 2019.
- The trend reversed in 2020 and has been consistent since then.

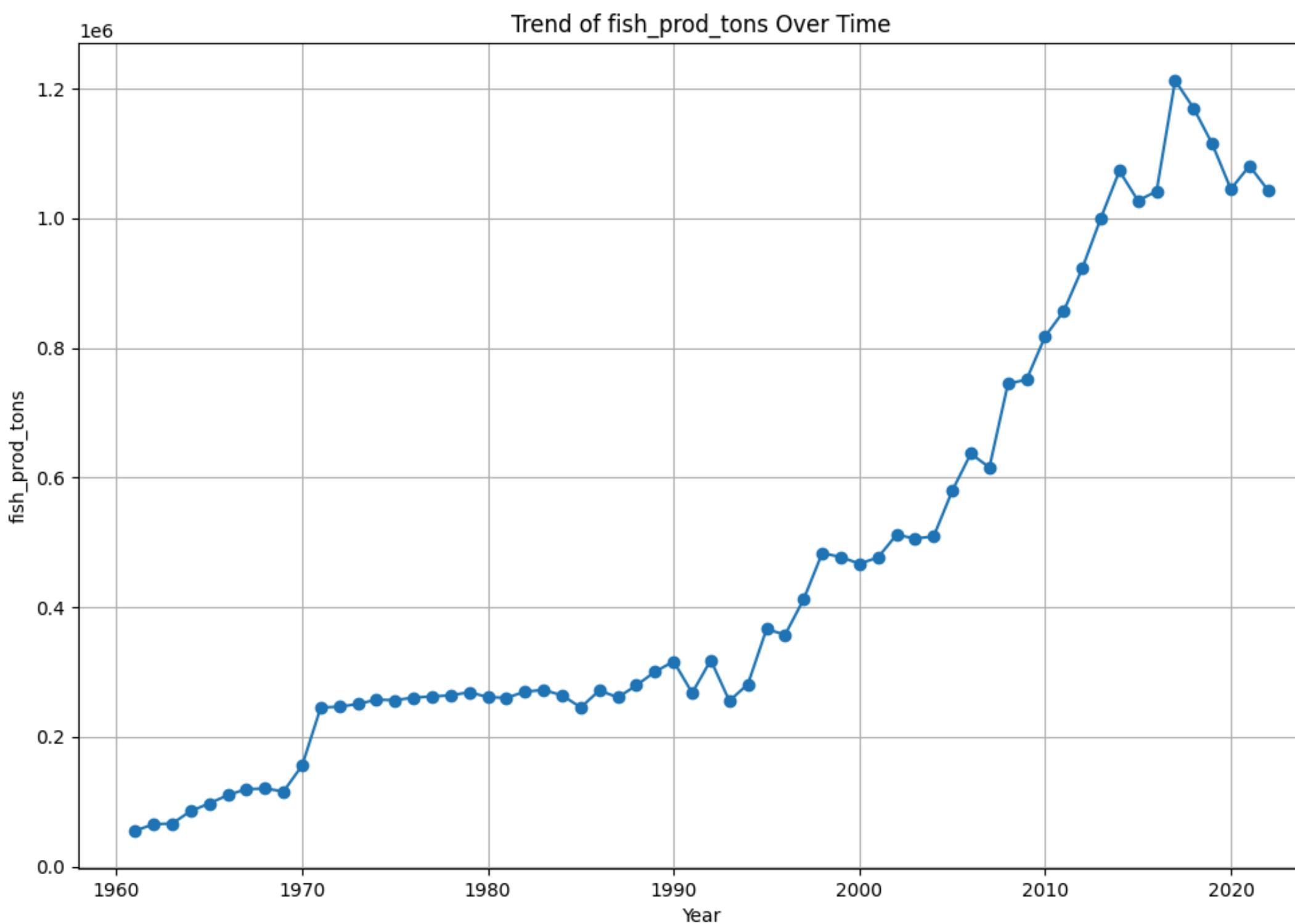
Livestock Production Index



Insights

- Total livestock production has been on the increase, a similar trends like Crop production index with several fluctuations.
- In 2020, there was a noticeable level in the upward trend, which could be due to the COVID-19 pandemic,
- However, the trend continued on the upward trend in 2021.

Total Fisheries Production

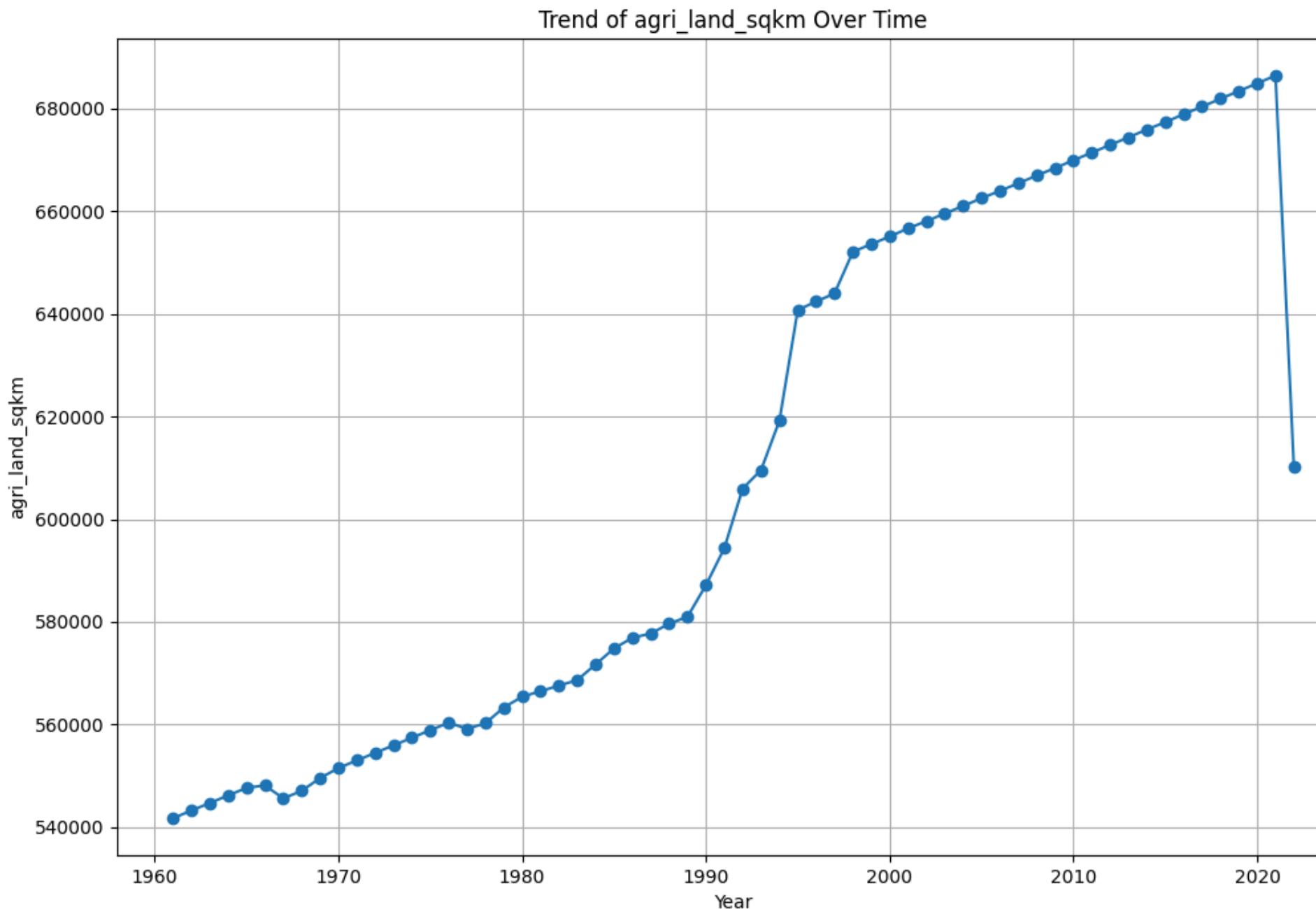


Insights

- Similar to the other 2 agricultural variables, total fisheries production has also been on an upward trend.
- However, from 2016 onward, the trend reversed and has continued that way.

Agricultural Land

Insights

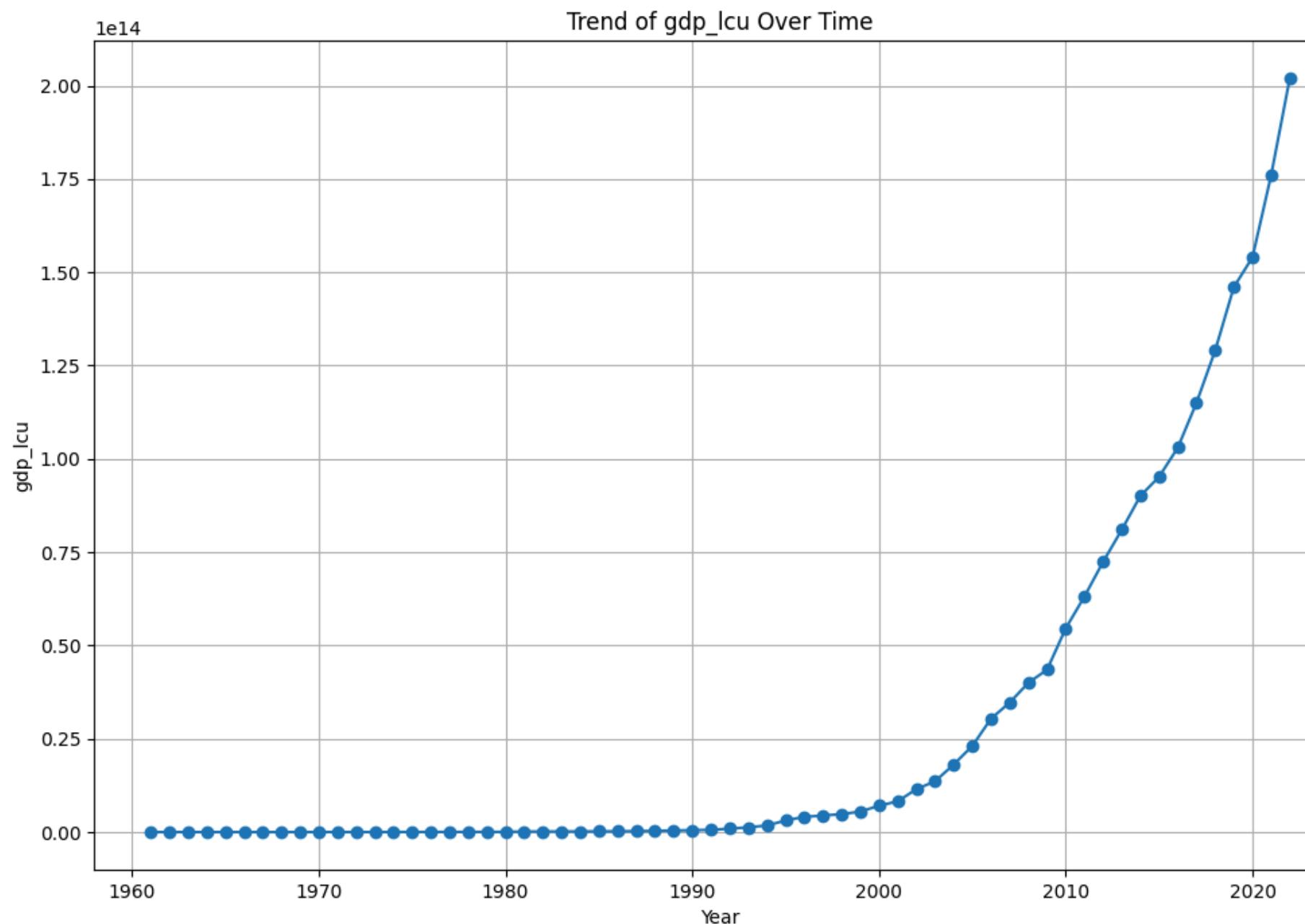


- **Agriculturable land increased over the years until it reached its peak 686440sqkm in 2021**
- **It has greatly declined since then, reaching 610000sqkm as at 2022**

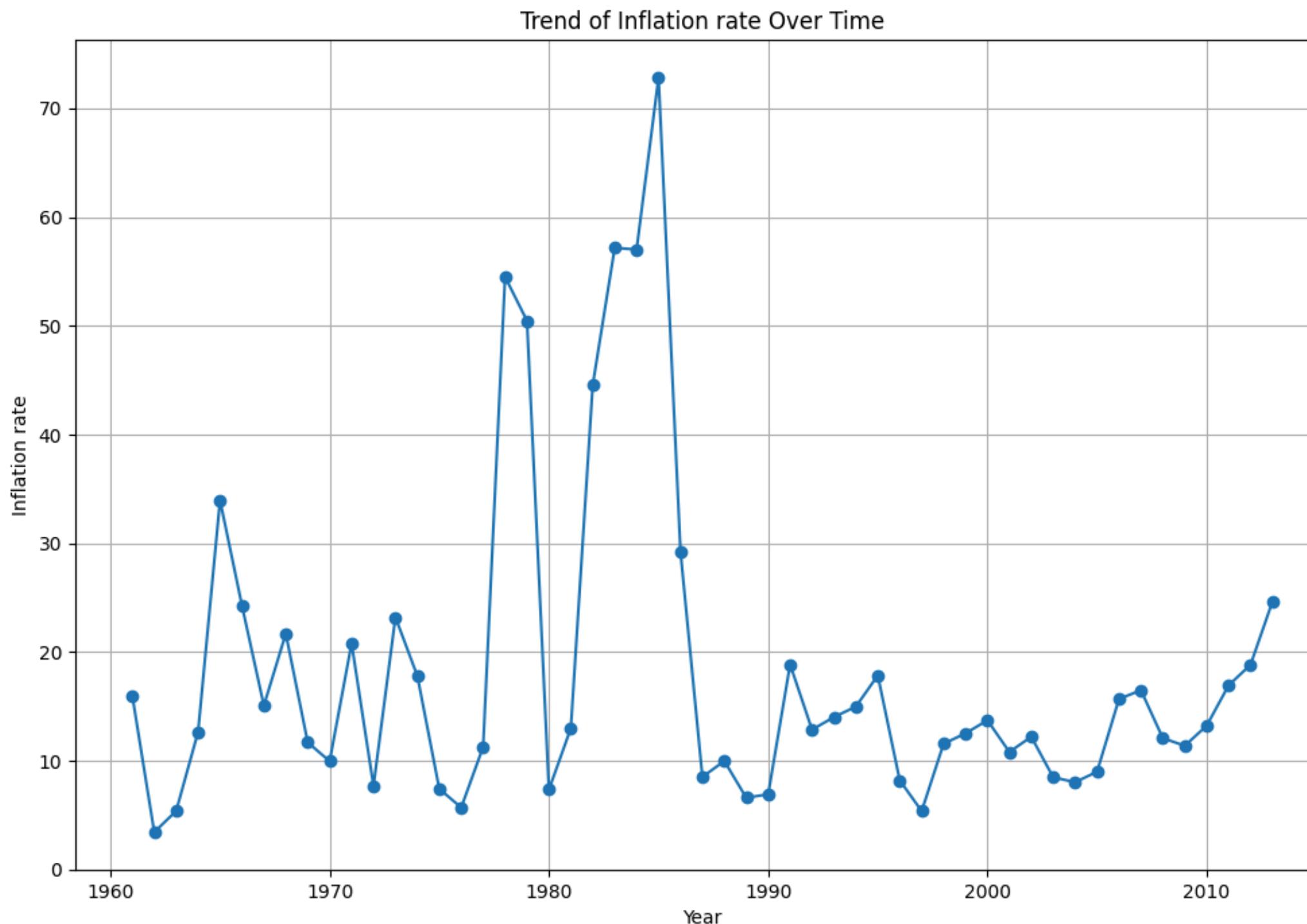
Economic variables: GDP

Insights

GDP has had an upward trend over the years, reaching a max value of $2.020000e+14$ as at 2022



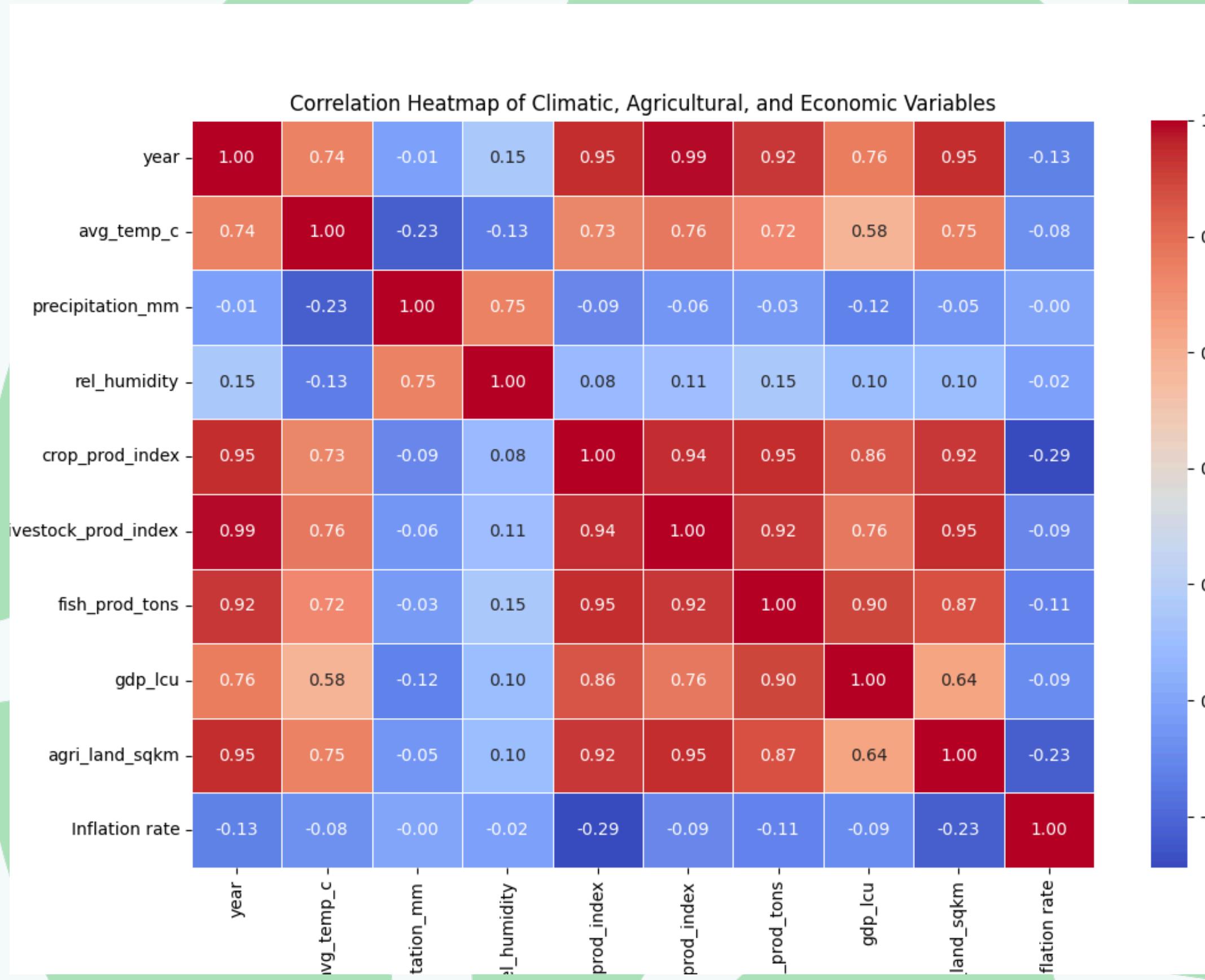
Inflation rate



Insights

- Highest inflation rate (72.83%) was recorded around 1985
- The lowest (3.45) was recorded around 1964
- From 1990 onward, there have been fluctuations in the trend,
- Specifically, there have been an upward trend from 2010, showing increase in inflation rate

Objective 2 – Correlations Analysis



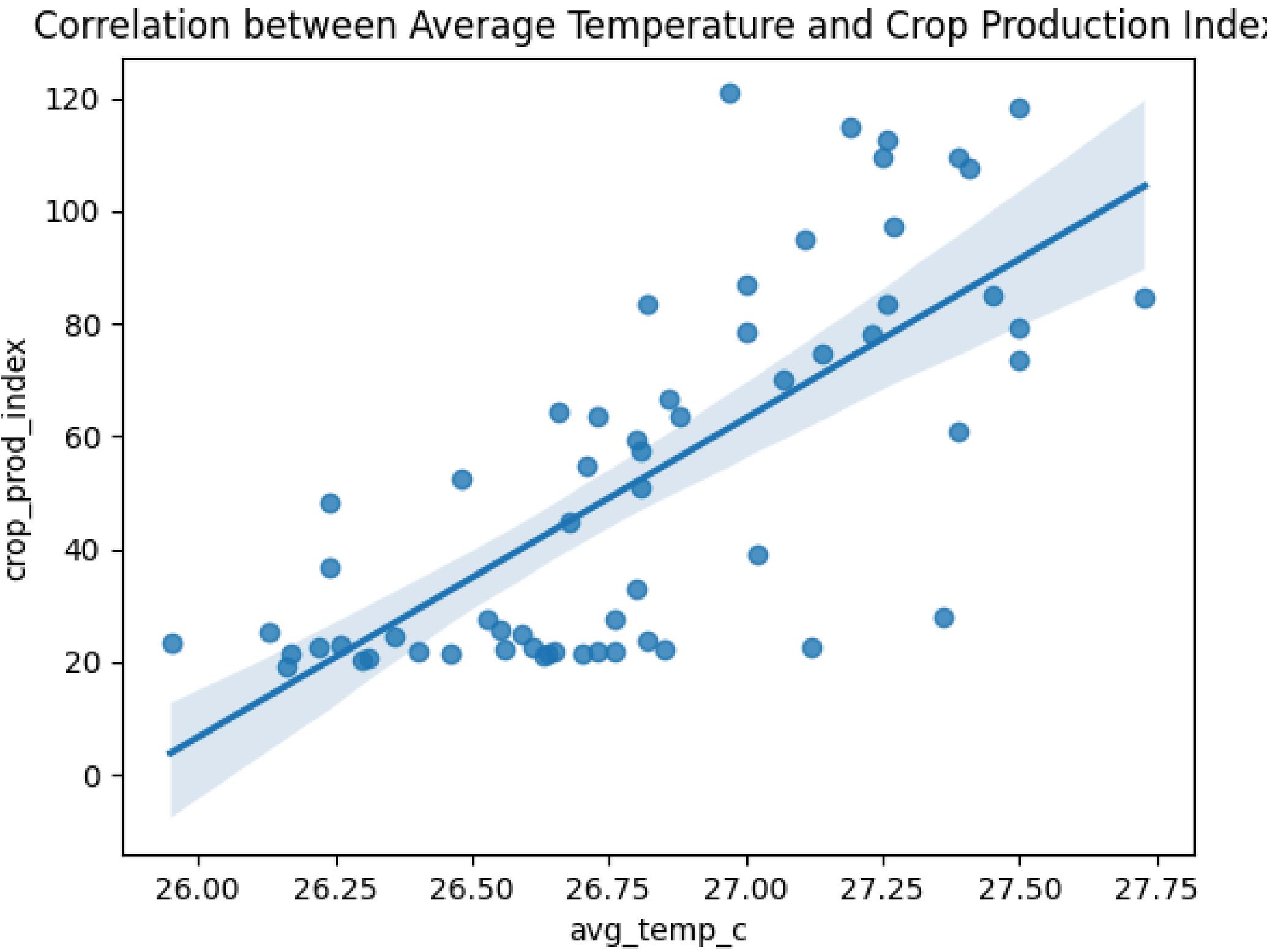
Red color indicate a positive relationship between the variables; “as one variable increase, the other increases as well”.

Blue color indicates a negative relationship between the variables; “as one variable increase, the other decreases”

The strength of the relationship decreases as the color intensity decreases and vice versa.

Correlation is not equals to Causation

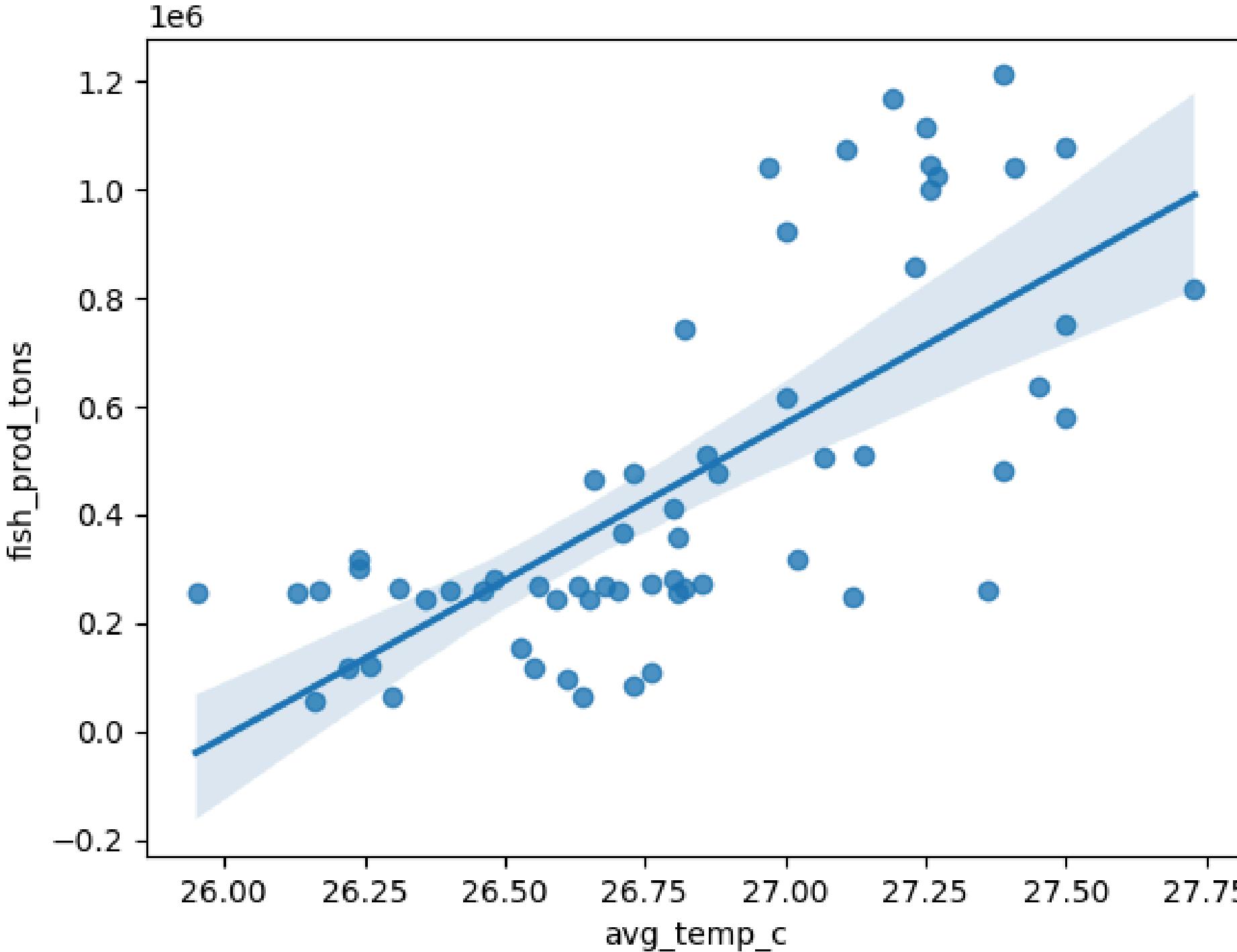
Avg Temp vs Crop Production



The linear line shows that there is a positive relationship between Avg temperature and Crop production, meaning that; “increase in average temperature can lead to increase in crop production”

Avg Temp and Total Fisheries Production

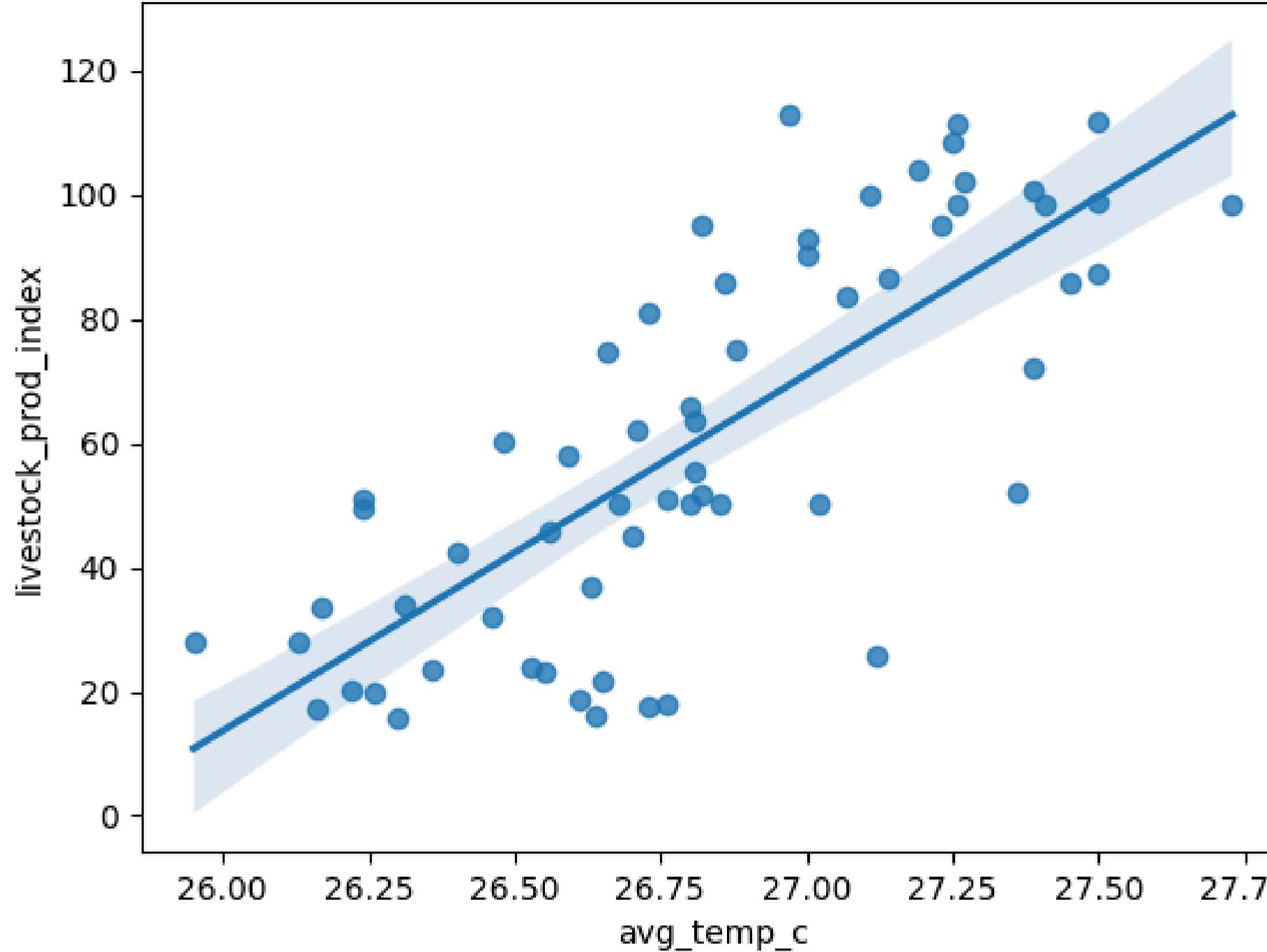
Correlation between Average Temperature and Total Fisheries Production



There is a positive relationship between Avg temperature and total fisheries production, meaning that; “increase in average temperature can lead to increase in total fisheries production”

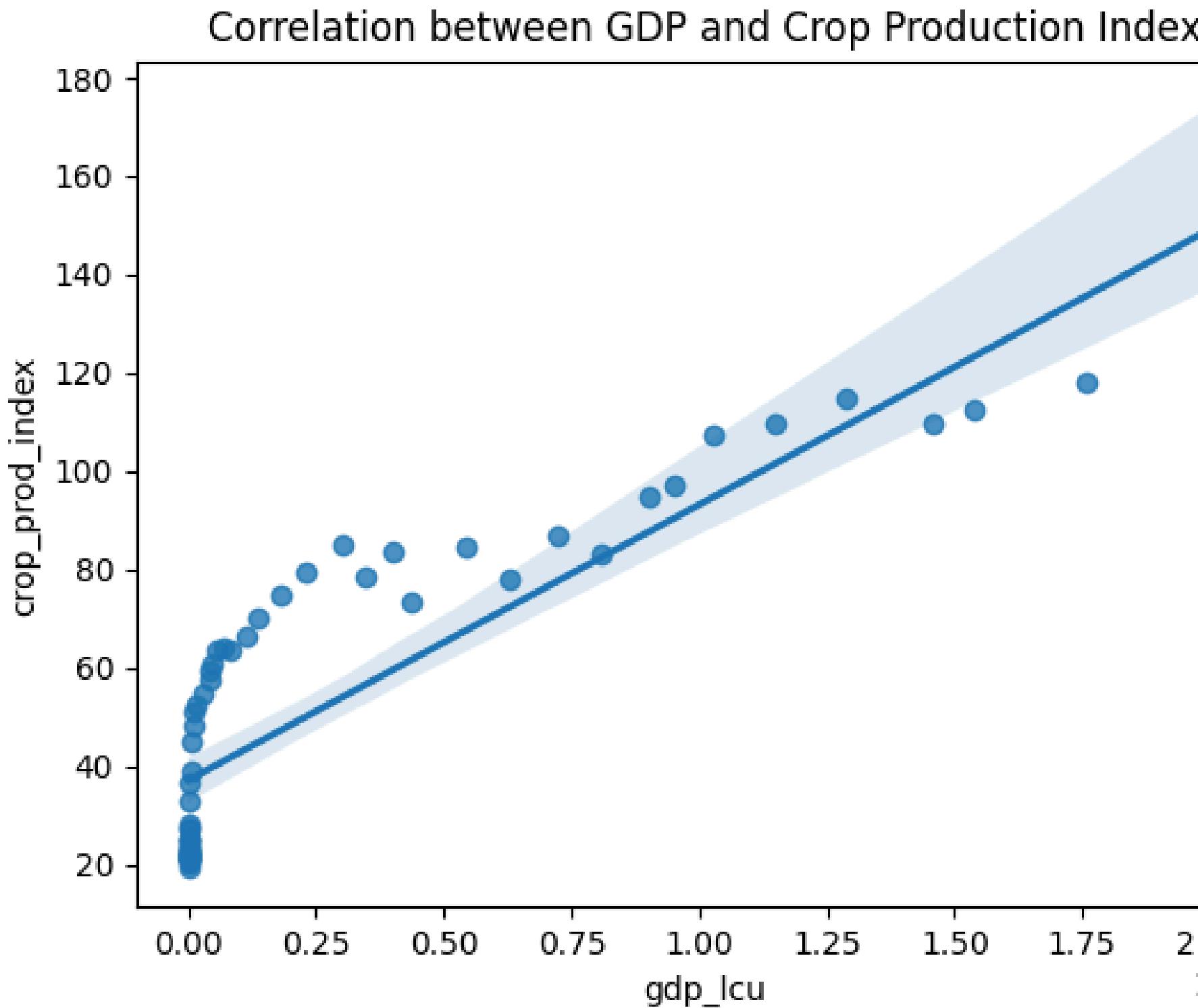
Avg Temp and Livestock Production

Correlation between Average Temperature and Livestock Production Index



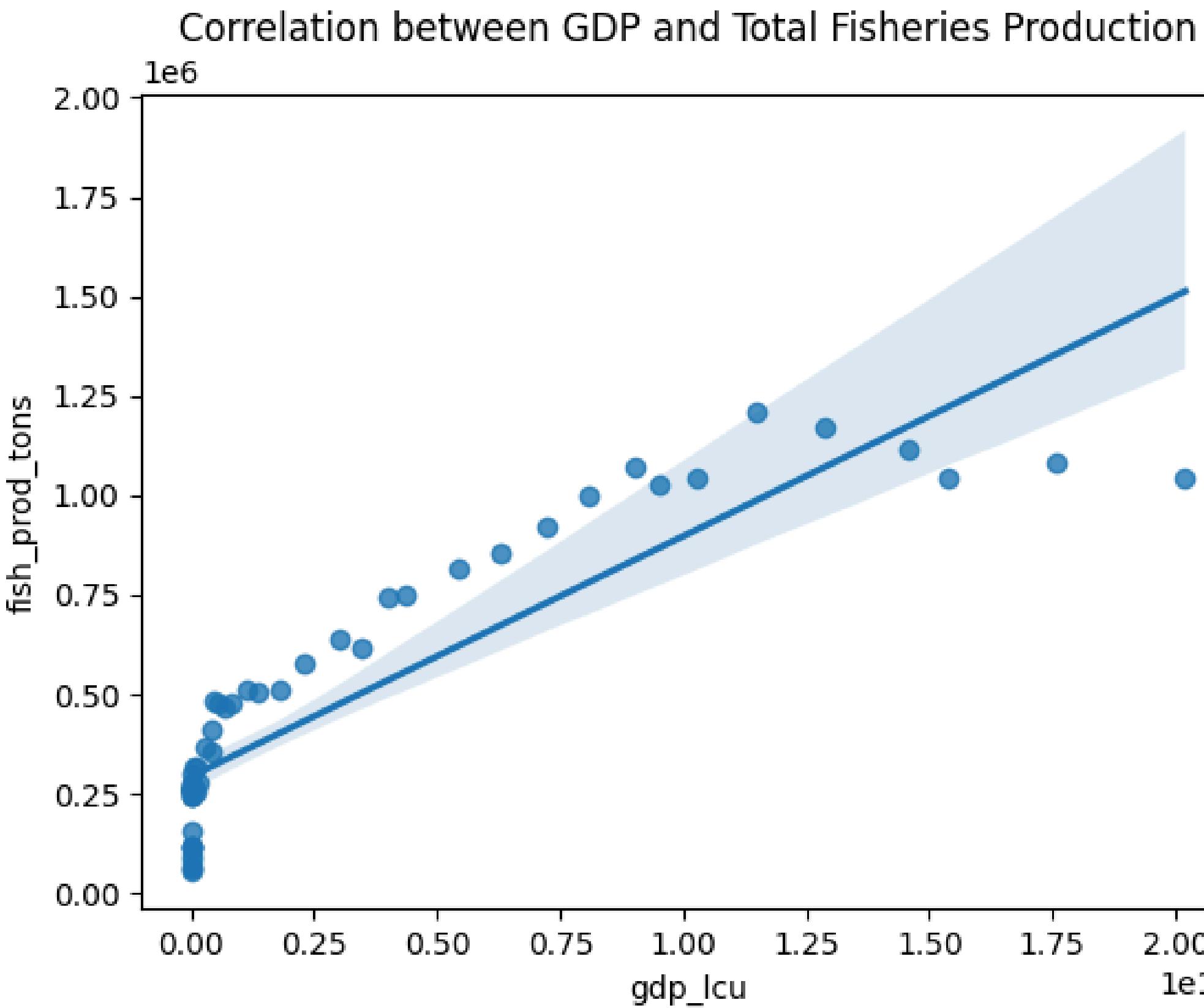
There is a positive relationship between Avg temperature and Livestock production, meaning that; **"increase in average temperature can lead to increase in livestock production"**

GDP and Crop Production



There is a positive, but weak relationship between GDP and crop production, meaning that; “increase in GDP can lead to increase in crop production”

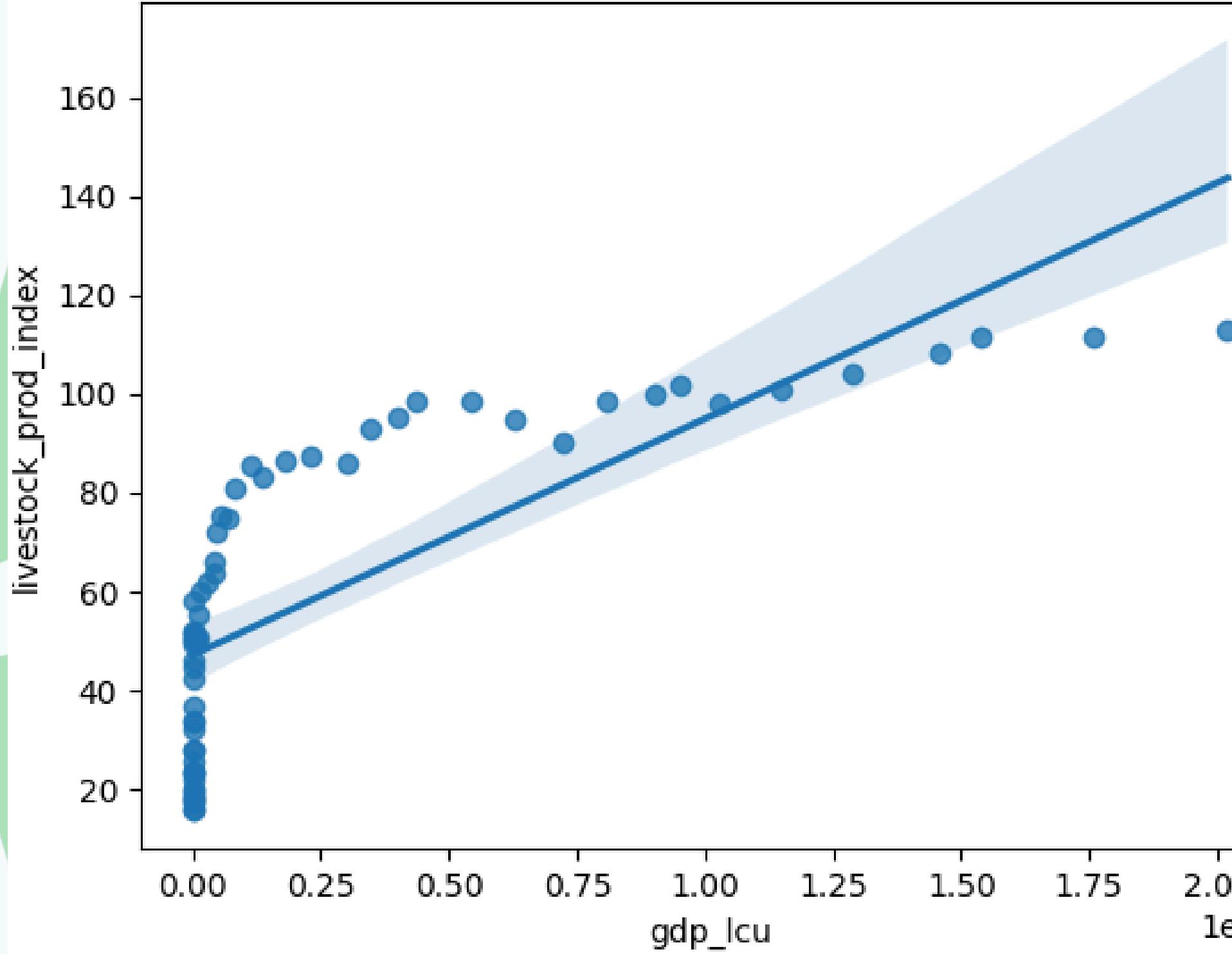
GDP and Total Fisheries Production



There is a positive, but weak relationship between GDP and total fisheries production, meaning that; **"increase in GDP can lead to increase in total fisheries production"**

GDP and Livestock Production

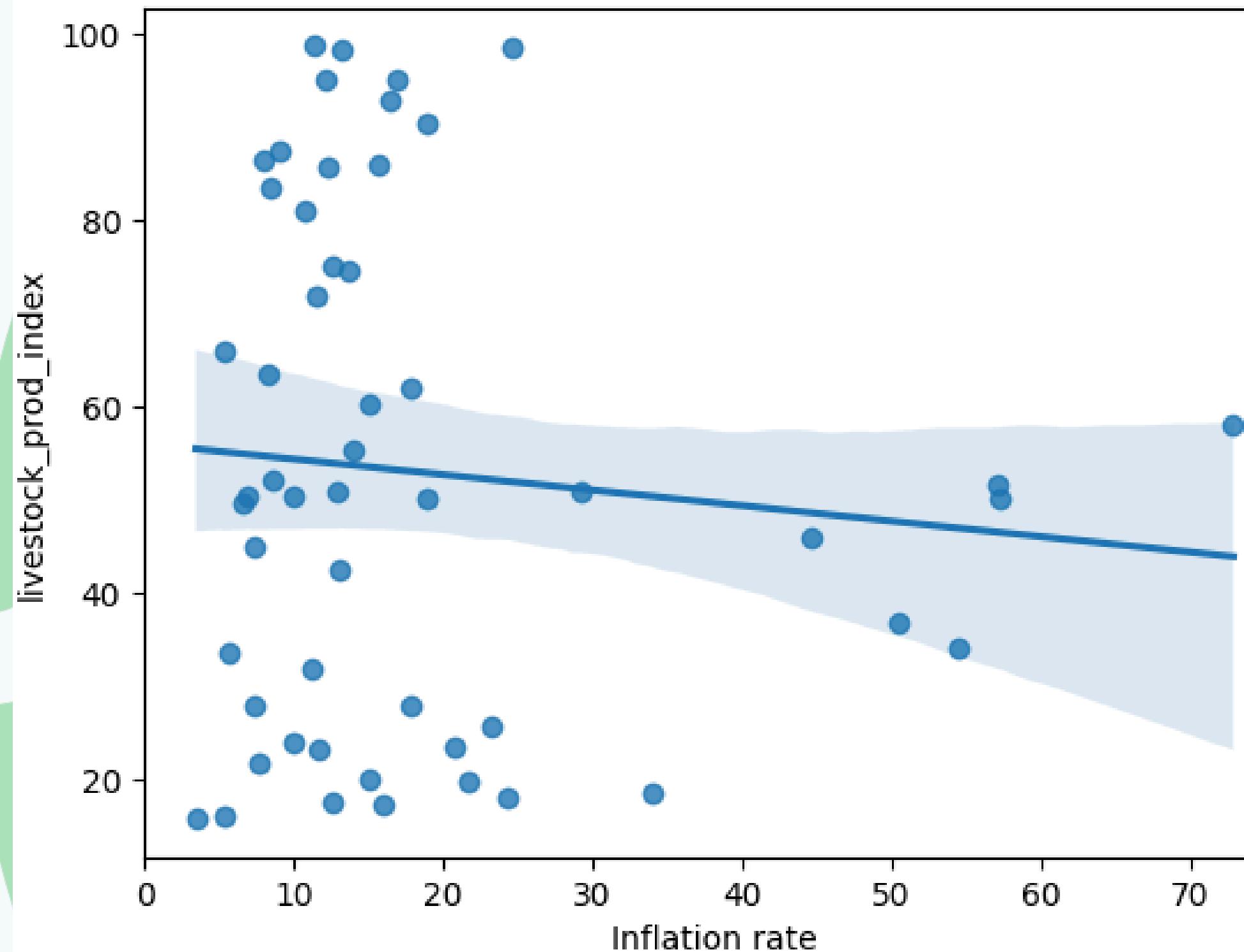
Correlation between GDP and Livestock Production Index



There is a positive, but weak relationship between GDP and livestock production, meaning that; “increase in GDP can lead to increase in livestock production”

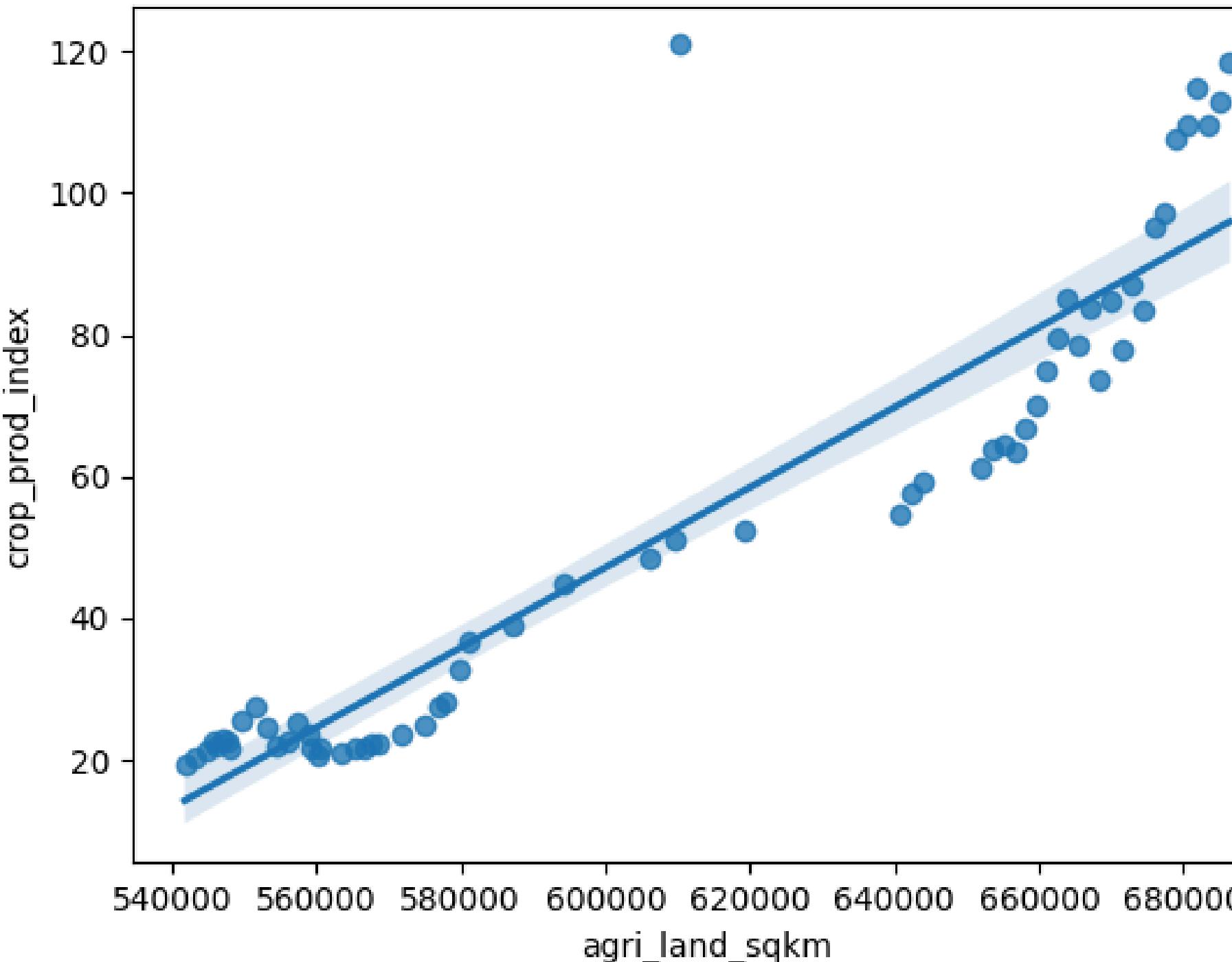
Inflation Rate and Livestock Production

Correlation between Inflation Rate and Livestock Production Index



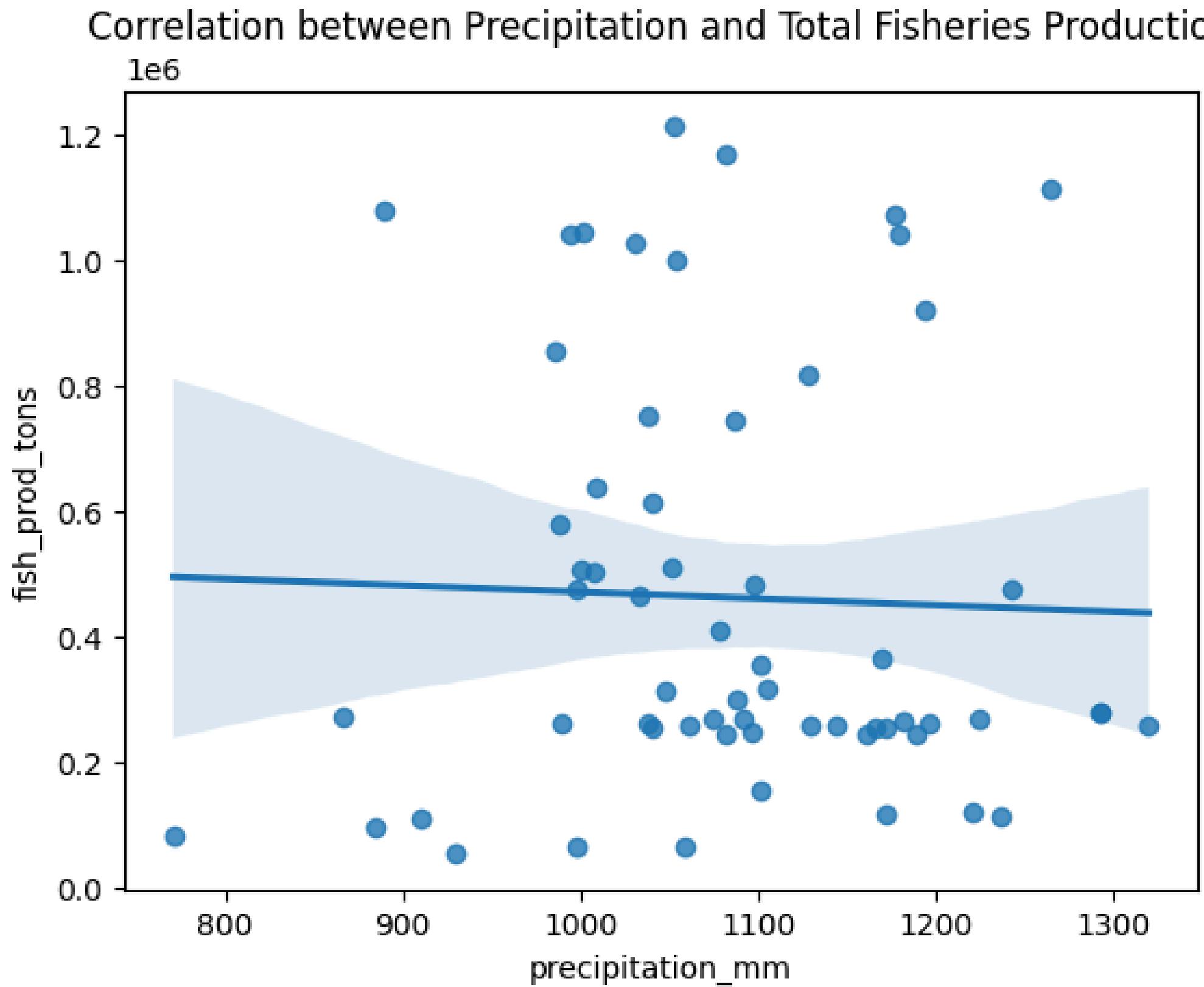
Total Agricultural Land and Crop Production

Correlation between Total Agricultural Land and Crop Production Index



There is a positive relationship between total agricultural land and crop production, meaning that; “increase in total agricultural land can lead to increase in crop production”

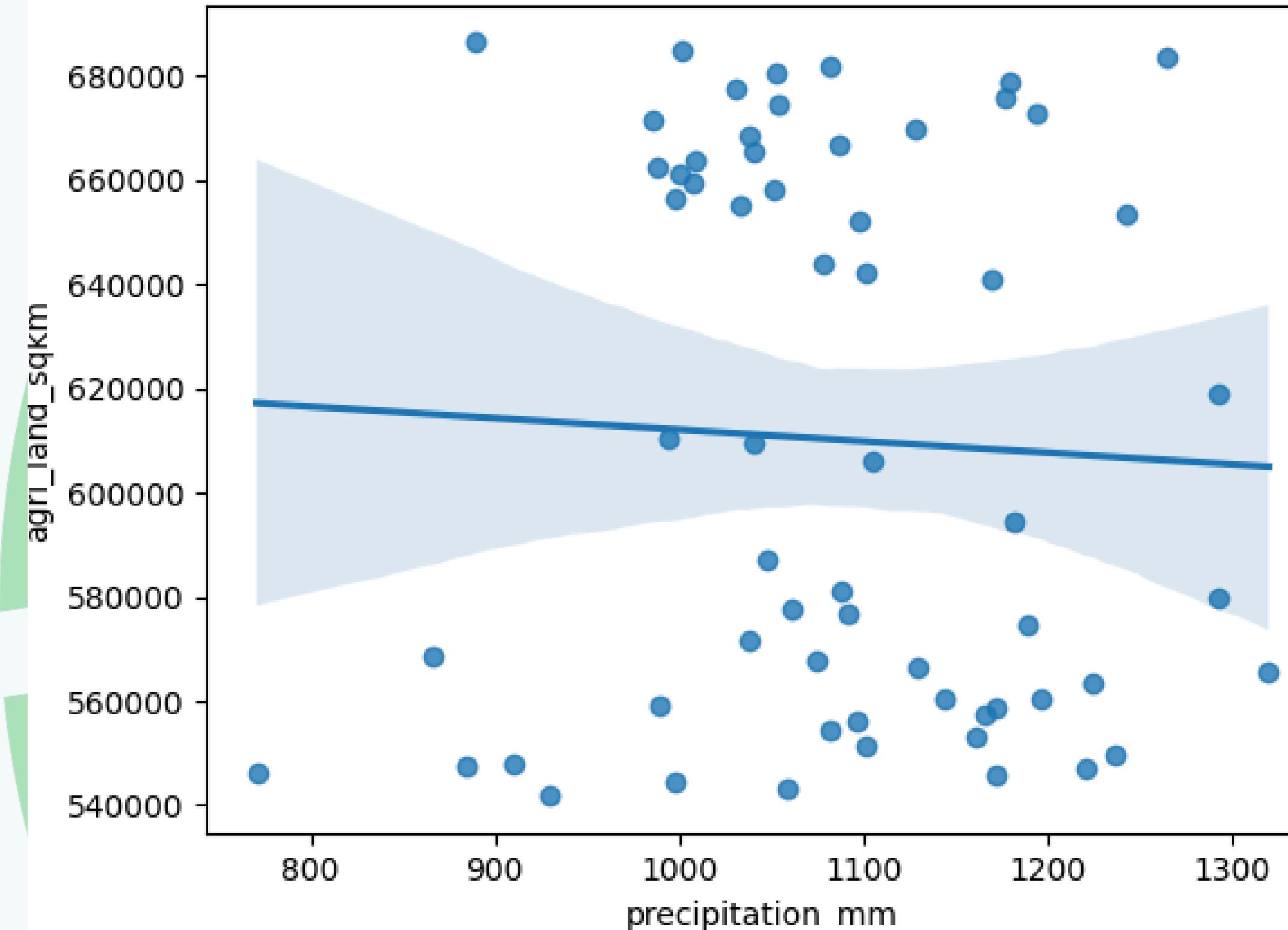
Precipitation and Total Fisheries Production



There is a **weak negative relationship between precipitation and total fisheries production**, meaning that; “**increase in precipitation can lead to decrease in total fisheries production**”

Precipitation and Total Agricultural Land

Correlation between Precipitation and Total Agricultural Land



There is a weak negative relationship between precipitation and total agricultural land, meaning that; "increase in precipitation can lead to decrease in total agricultural land"

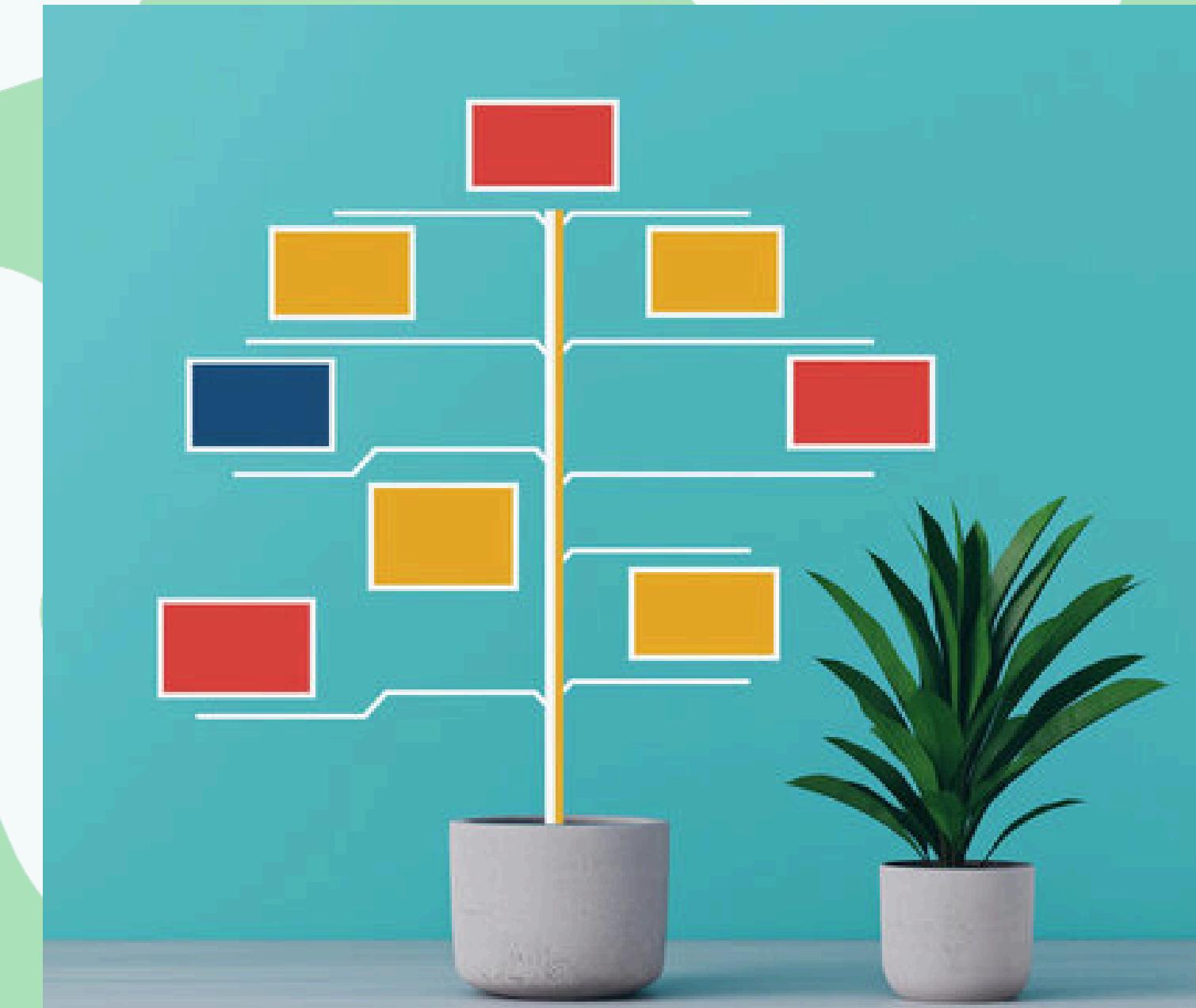
Objective 3: Predictive Modelling

Target variables (x):

- Average temperature
- Precipitation
- Relative humidity
- Agricultural land

Predictor variable (y):

- Crop Production Index



Decision Tree Algorithm

How Does The Model Works?

Start

Input Data:
X and y variables

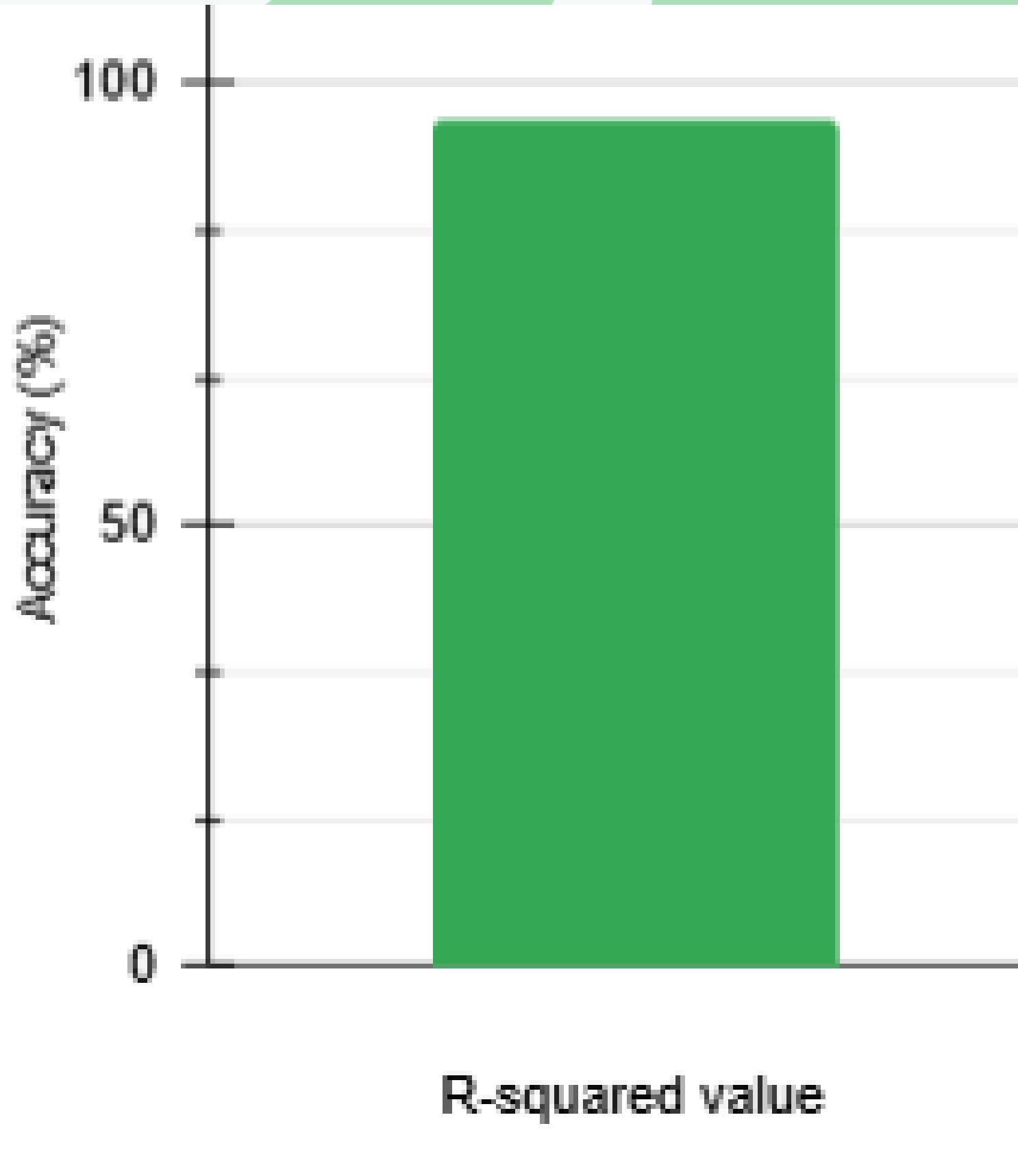
Decision Tree Regressor
80% training set
20% training set

Predicted output
(Crop production index)

Model Evaluation

End

Model Evaluation



R-squared = 96%

96% indicate that the model is highly accurate

MSE = 46.40

MSE represents the average error in predictions.
Lower values indicate better predictions

Prediction with Different Scenarios

| Scenarios | Crop Production Prediction |
|---|--|
| Testing with historical and already available data (1961–1963) | 1961 = 20.41 1962 = 20.41 1963 = 21.35 |
| If average temperature, precipitation, humidity and agricultural land were to decrease exponentially, what would be the predicted crop production index? | 38.98 |
| If average temperature, precipitation, and relative humidity were to increase exponentially, and agricultural land were to decrease, what would be the predicted crop production index? | 21.58 |

Recommendations

The Federal Government should Adopt Sustainable Climate Practices like:

- Investment in renewable energy, shifting towards solar, wind, and other clean energy sources to reduce greenhouse gas emissions.
- Encouraging tree planting and forest conservation to combat rising temperatures and irregular precipitation patterns.



Recommendations

The Federal Government and other relevant agencies should Support Agricultural Innovations such as:

- The research and development of climate-resilient crops
- Precision Agriculture – Utilizing satellite imaging, sensors, and AI tools to optimize resource usage and predict environmental impacts on yields.
- Integrated Farming Systems- combining crop, livestock, and fisheries farming to diversify and stabilize production outputs.



Recommendations

**The Legislative arm of the Government
should bring out Land Use Policies that:**

- Protect agricultural land and prevent urban sprawl and over-extraction of resources from farmlands.
- Rehabilitate degraded lands to improve their agricultural viability and ecosystem services
- Implement policies to stabilize prices of agricultural inputs and outputs, ensuring affordability and profitability for farmers.



Conclusions

- Climatic variables such as temperature, precipitation, and humidity have shown significant fluctuations over the years, with recent declining trends for precipitation and agricultural land use.
- Agricultural production indices (crop, livestock, and fisheries) have shown overall increases despite fluctuations, while GDP has consistently grown. Inflation rates have fluctuated, showing an upward trend since 2010.
- Climatic variables positively influence agricultural production (e.g., higher temperatures lead to increased crop and livestock production). However, negative impacts such as decreased fisheries production and agricultural land due to precipitation trends were observed.



Conclusions

- The Decision Tree Regressor Model accurately predicts crop production indices ($R^2 = 96\%$), showing its reliability in analyzing and forecasting agricultural outcomes.
- Scenarios demonstrate that climatic and land-use changes significantly affect production outcomes.

Code snippet

[https://colab.research.google.com/drive/1oo3K7iOqt6ZIRp3jnyXEjGOErTOCLmMi
?usp=sharing](https://colab.research.google.com/drive/1oo3K7iOqt6ZIRp3jnyXEjGOErTOCLmMi?usp=sharing)



Thanks