In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
df=pd.read_csv("C:/Users/chalanagowda/Downloads/climate_change_impact_on_agricultur
print(df)
```

```
      Year    Country              Region  Crop_Type  Average_Temperature_C  \
0     2001      India         West Bengal       Corn                   1.55   
1     2024      China               North       Corn                   3.23   
2     2001     France       Ile-de-France      Wheat                  21.11   
3     2001     Canada            Prairies     Coffee                  27.85   
4     1998      India          Tamil Nadu  Sugarcane                   2.19   
...    ...        ...                 ...        ...                    ...   
9995  2022     France  Nouvelle-Aquitaine     Cotton                  30.48   
9996  1999  Australia          Queensland   Soybeans                   9.53   
9997  2000  Argentina           Patagonia     Coffee                  31.92   
9998  1996     Brazil           Southeast   Soybeans                  13.95   
9999  2015      China               South       Corn                  11.78   

      Total_Precipitation_mm  CO2_Emissions_MT  Crop_Yield_MT_per_HA  \
0                     447.06             15.22                 1.737   
1                    2913.57             29.82                 1.737   
2                    1301.74             25.75                 1.719   
3                    1154.36             13.91                 3.890   
4                    1627.48             11.81                 1.080   
...                      ...               ...                   ...   
9995                  685.93             17.64                 3.033   
9996                 2560.38             10.68                 2.560   
9997                  357.76             26.01                 1.161   
9998                 1549.52             17.31                 3.348   
9999                 1676.25              5.34                 3.710   

      Extreme_Weather_Events  Irrigation_Access_%  Pesticide_Use_KG_per_HA  \
0                          8                14.54                    10.08   
1                          8                11.05                    33.06   
2                          5                84.42                    27.41   
3                          5                94.06                    14.38   
4                          9                95.75                    44.35   
...                      ...                  ...                      ...   
9995                       9                27.56                    41.96   
9996                       4                77.02                     5.45   
9997                      10                78.53                    11.94   
9998                       2                42.65                    44.71   
9999                       5                46.41                    48.28   

      Fertilizer_Use_KG_per_HA  Soil_Health_Index Adaptation_Strategies  \
0                        14.78              83.25      Water Management   
1                        23.25              54.02         Crop Rotation   
2                        65.53              67.78      Water Management   
3                        87.58              91.39         No Adaptation   
4                        88.08              49.61         Crop Rotation   
...                        ...                ...                   ...   
9995                     10.95              43.41         No Adaptation   
9996                     82.32              59.39         No Adaptation   
9997                     26.00              41.46      Water Management   
9998                     25.07              75.10         Crop Rotation   
9999                     98.27              59.38      Water Management   

      Economic_Impact_Million_USD  
0                          808.13  
1                          616.22  
2                          796.96  
```

```
3                          790.32
4                          401.72
...                           ...
9995                      1483.06
9996                       829.61
9997                       155.99
9998                      1613.90
9999                       453.14

[10000 rows x 15 columns]
```

In [ ]:

```

```

In [2]:

```
#Information about the dataset
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 15 columns):
 #   Column                       Non-Null Count  Dtype  
---  ------                       --------------  -----  
 0   Year                         10000 non-null  int64  
 1   Country                      10000 non-null  object 
 2   Region                       10000 non-null  object 
 3   Crop_Type                    10000 non-null  object 
 4   Average_Temperature_C        10000 non-null  float64
 5   Total_Precipitation_mm       10000 non-null  float64
 6   CO2_Emissions_MT             10000 non-null  float64
 7   Crop_Yield_MT_per_HA         10000 non-null  float64
 8   Extreme_Weather_Events       10000 non-null  int64  
 9   Irrigation_Access_%          10000 non-null  float64
 10  Pesticide_Use_KG_per_HA      10000 non-null  float64
 11  Fertilizer_Use_KG_per_HA     10000 non-null  float64
 12  Soil_Health_Index            10000 non-null  float64
 13  Adaptation_Strategies        10000 non-null  object 
 14  Economic_Impact_Million_USD  10000 non-null  float64
dtypes: float64(9), int64(2), object(4)
memory usage: 1.1+ MB
```

In [3]:

```
df.duplicated()
```

Out[3]:

```
0       False
1       False
2       False
3       False
4       False
        ...  
9995    False
9996    False
9997    False
9998    False
9999    False
Length: 10000, dtype: bool
```

In [6]:

```
df.duplicated().sum()
```

Out[6]:
```
0
```

In [8]:
```
#Display first 5 rows
df.head()
```

Out[8]:

	Year	Country	Region	Crop_Type	Average_Temperature_C	Total_Precipitation_mm	CO
0	2001	India	West Bengal	Corn	1.55	447.06	
1	2024	China	North	Corn	3.23	2913.57	
2	2001	France	Ile-de-France	Wheat	21.11	1301.74	
3	2001	Canada	Prairies	Coffee	27.85	1154.36	
4	1998	India	Tamil Nadu	Sugarcane	2.19	1627.48	

In [10]:
```
#Display last 5 rows
df.tail()
```

Out[10]:

	Year	Country	Region	Crop_Type	Average_Temperature_C	Total_Precipitation_
9995	2022	France	Nouvelle-Aquitaine	Cotton	30.48	68
9996	1999	Australia	Queensland	Soybeans	9.53	256
9997	2000	Argentina	Patagonia	Coffee	31.92	35
9998	1996	Brazil	Southeast	Soybeans	13.95	154
9999	2015	China	South	Corn	11.78	167

In [11]:
```
#The number of rows and columns
df.shape
```

Out[11]:
```
(10000, 15)
```

In [12]:
```
#checking for NULL values (Boolean values)
df.isnull()
```

Out[12]:

	Year	Country	Region	Crop_Type	Average_Temperature_C	Total_Precipitation_mm
0	False	False	False	False	False	False
1	False	False	False	False	False	False
2	False	False	False	False	False	False
3	False	False	False	False	False	False
4	False	False	False	False	False	False
...	...	...	...	...	...	...
9995	False	False	False	False	False	False
9996	False	False	False	False	False	False
9997	False	False	False	False	False	False
9998	False	False	False	False	False	False
9999	False	False	False	False	False	False

10000 rows × 15 columns

In [5]:
```
df.isnull().sum()
```

Out[5]:
```
Year                            0
Country                         0
Region                          0
Crop_Type                       0
Average_Temperature_C           0
Total_Precipitation_mm          0
CO2_Emissions_MT                0
Crop_Yield_MT_per_HA            0
Extreme_Weather_Events          0
Irrigation_Access_%             0
Pesticide_Use_KG_per_HA         0
Fertilizer_Use_KG_per_HA        0
Soil_Health_Index               0
Adaptation_Strategies           0
Economic_Impact_Million_USD     0
dtype: int64
```

In [9]:
```
#data cleaning
#handling missing values
df.fillna(df.select_dtypes(include=[np.number]).mean(),inplace=True)
```

In [10]:
```
print(df.describe())
```

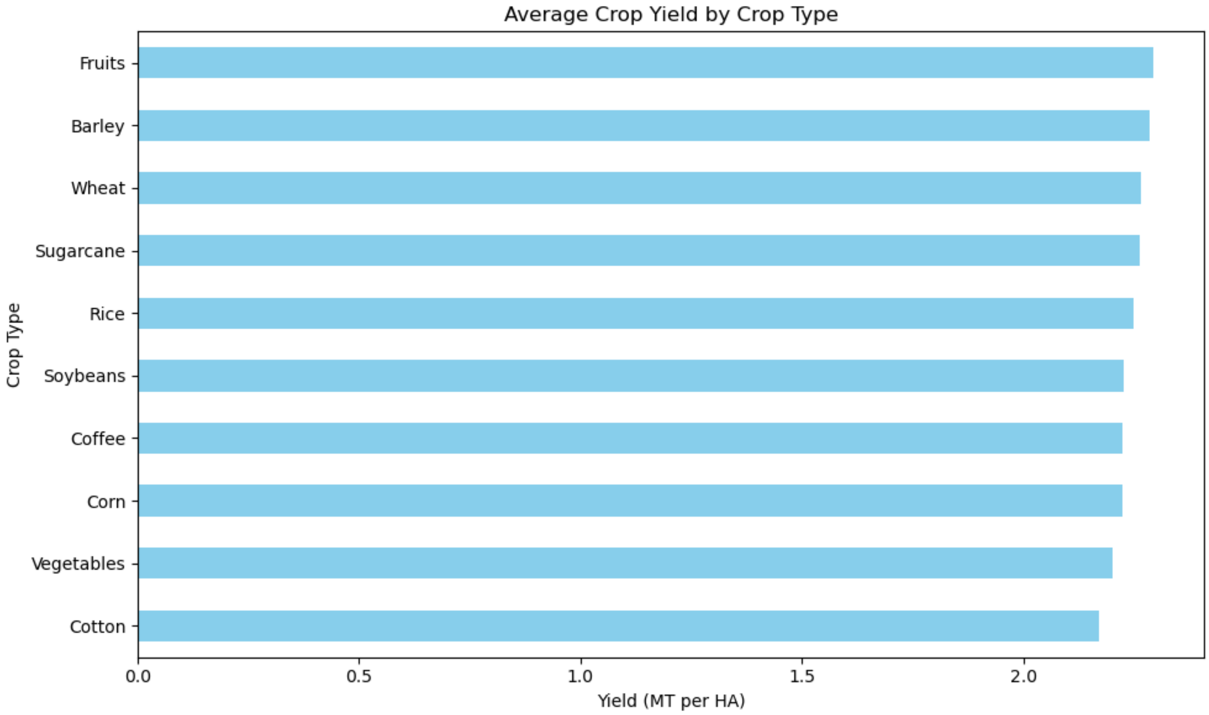
```
               Year  Average_Temperature_C  Total_Precipitation_mm  \
count  10000.000000           10000.000000            10000.000000   
mean    2007.088700              15.241299             1611.663834   
std       10.084245              11.466955              805.016815   
min     1990.000000              -4.990000              200.150000   
25%     1999.000000               5.430000              925.697500   
50%     2007.000000              15.175000             1611.160000   
75%     2016.000000              25.340000             2306.997500   
max     2024.000000              35.000000             2999.670000   

       CO2_Emissions_MT  Crop_Yield_MT_per_HA  Extreme_Weather_Events  \
count      10000.000000          10000.000000            10000.000000   
mean          15.246608              2.240017                4.980900   
std            8.589423              0.998342                3.165808   
min            0.500000              0.450000                0.000000   
25%            7.760000              1.449000                2.000000   
50%           15.200000              2.170000                5.000000   
75%           22.820000              2.930000                8.000000   
max           30.000000              5.000000               10.000000   

       Irrigation_Access_%  Pesticide_Use_KG_per_HA  Fertilizer_Use_KG_per_HA  \
count         10000.000000             10000.000000              10000.000000   
mean             55.248332                24.955735                 49.973708   
std              25.988305                14.490962                 28.711027   
min              10.010000                 0.000000                  0.010000   
25%              32.677500                12.527500                 25.390000   
50%              55.175000                24.930000                 49.635000   
75%              77.582500                37.470000                 74.825000   
max              99.990000                49.990000                 99.990000   

       Soil_Health_Index  Economic_Impact_Million_USD  
count       10000.000000                 10000.000000  
mean           64.901278                   674.269658  
std            20.195882                   414.591431  
min            30.000000                    47.840000  
25%            47.235000                   350.545000  
50%            64.650000                   583.920000  
75%            82.472500                   917.505000  
max           100.000000                  2346.470000  
```

In [11]:

```
#removing duplicates
df.drop_duplicates(inplace=True)
```

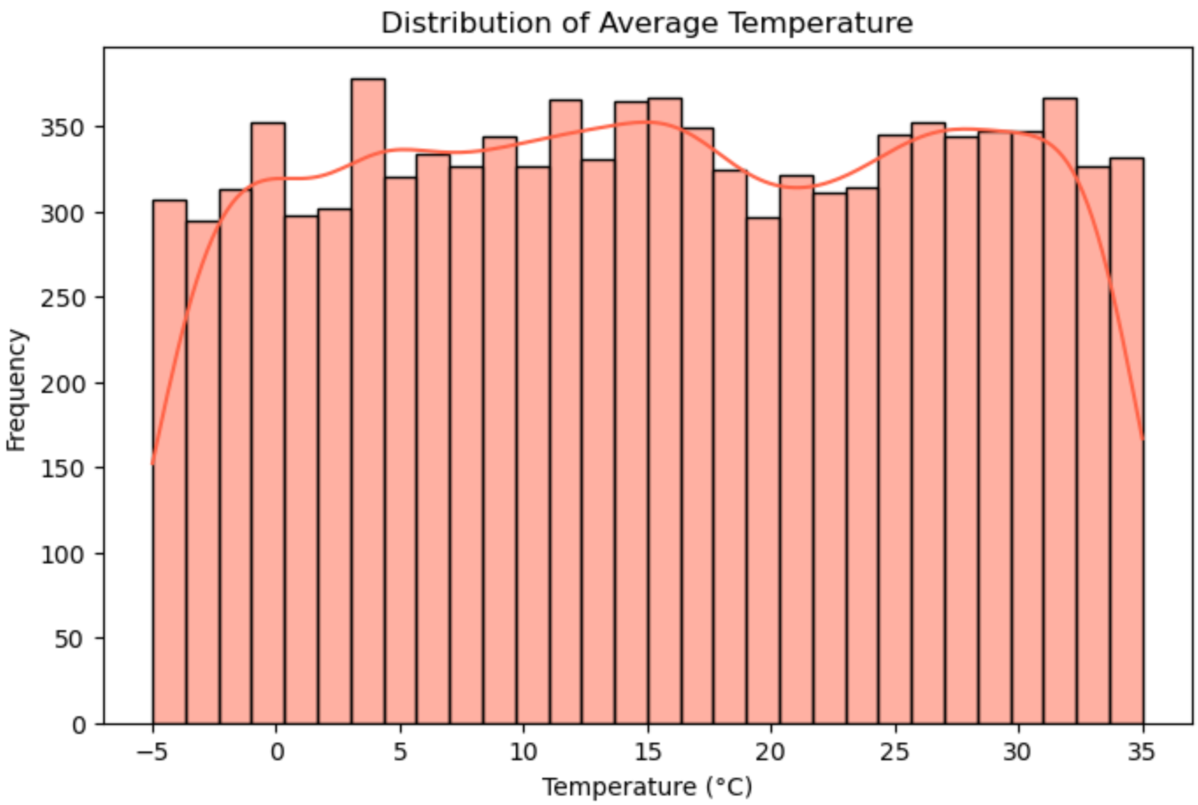
In [12]:

```
#Bar Plot: Average Yield by Crop Type
avg_yield_crop = df.groupby('Crop_Type')['Crop_Yield_MT_per_HA'].mean().sort_values

plt.figure(figsize=(10, 6))
avg_yield_crop.plot(kind='barh', color='skyblue')
plt.title('Average Crop Yield by Crop Type')
plt.xlabel('Yield (MT per HA)')
plt.ylabel('Crop Type')
plt.tight_layout()
plt.show()
```

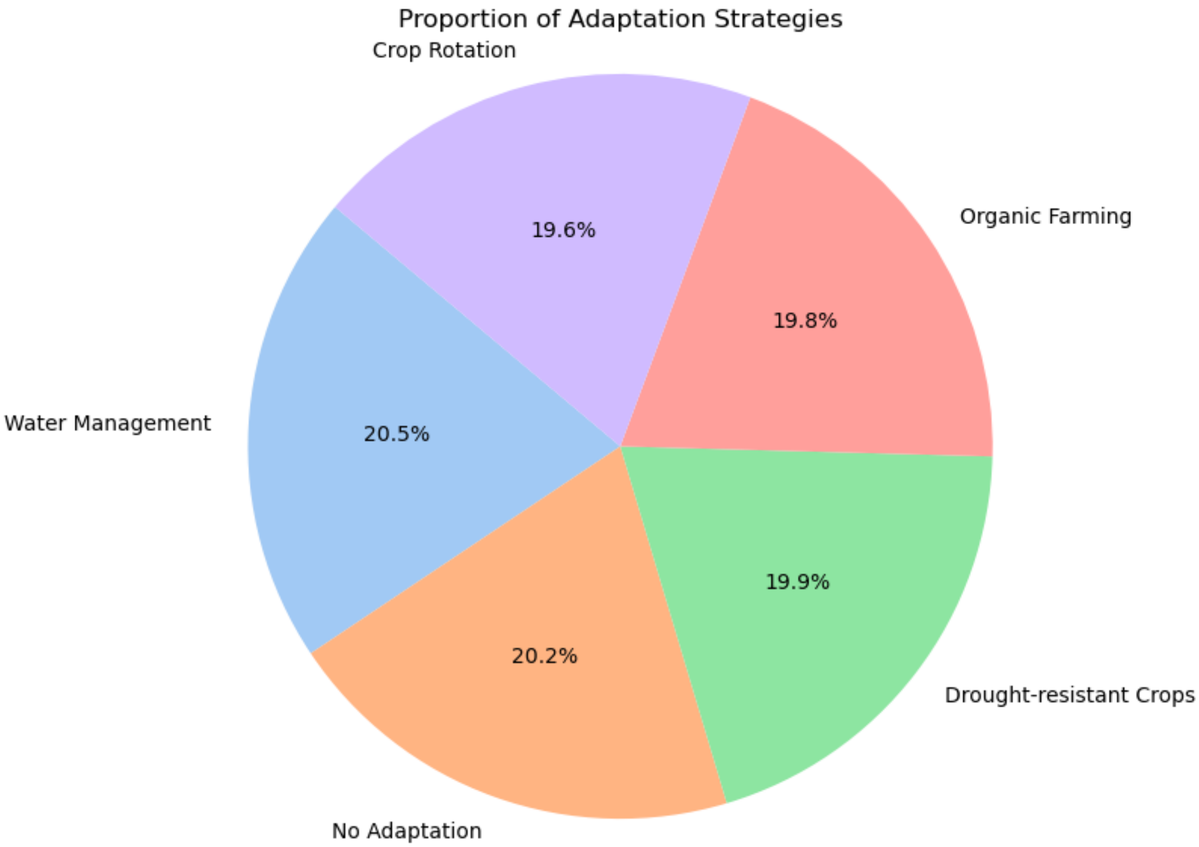


```
In [21]: #Histogram: Distribution of Average Temperature
         plt.figure(figsize=(8, 5))
         sns.histplot(df['Average_Temperature_C'], bins=30, kde=True, color='tomato')
         plt.title('Distribution of Average Temperature')
         plt.xlabel('Temperature (°C)')
         plt.ylabel('Frequency')
         plt.show()
```

```
C:\Users\chalanagowda\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119: FutureWa
rning: use_inf_as_na option is deprecated and will be removed in a future version. C
onvert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
```

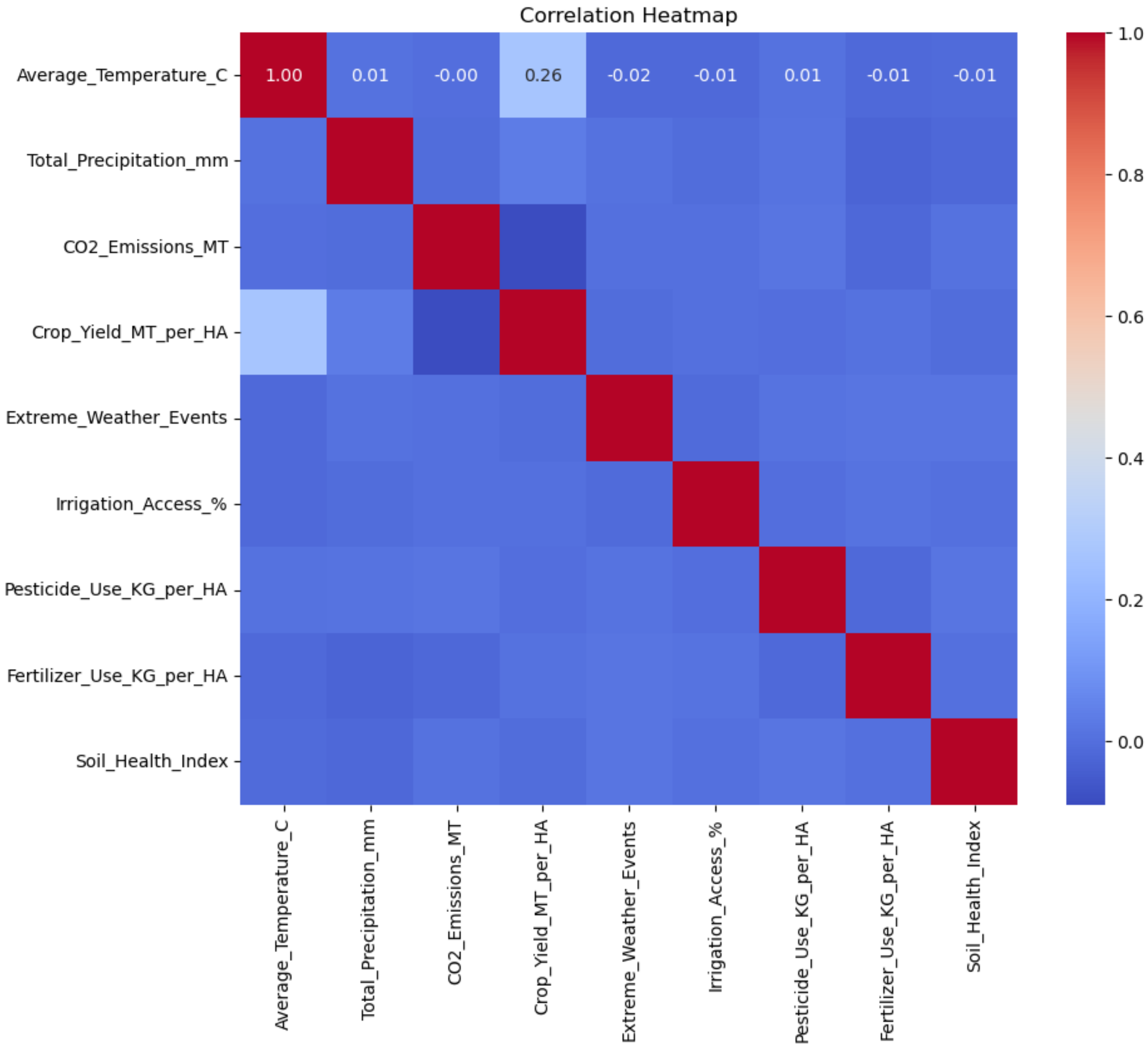


In [14]:
```
#Pie Chart: Adaptation Strategies Proportion
strategy_counts = df['Adaptation_Strategies'].value_counts()

plt.figure(figsize=(7, 7))
plt.pie(strategy_counts, labels=strategy_counts.index, autopct='%1.1f%%', startangl
plt.title('Proportion of Adaptation Strategies')
plt.axis('equal')
plt.show()
```



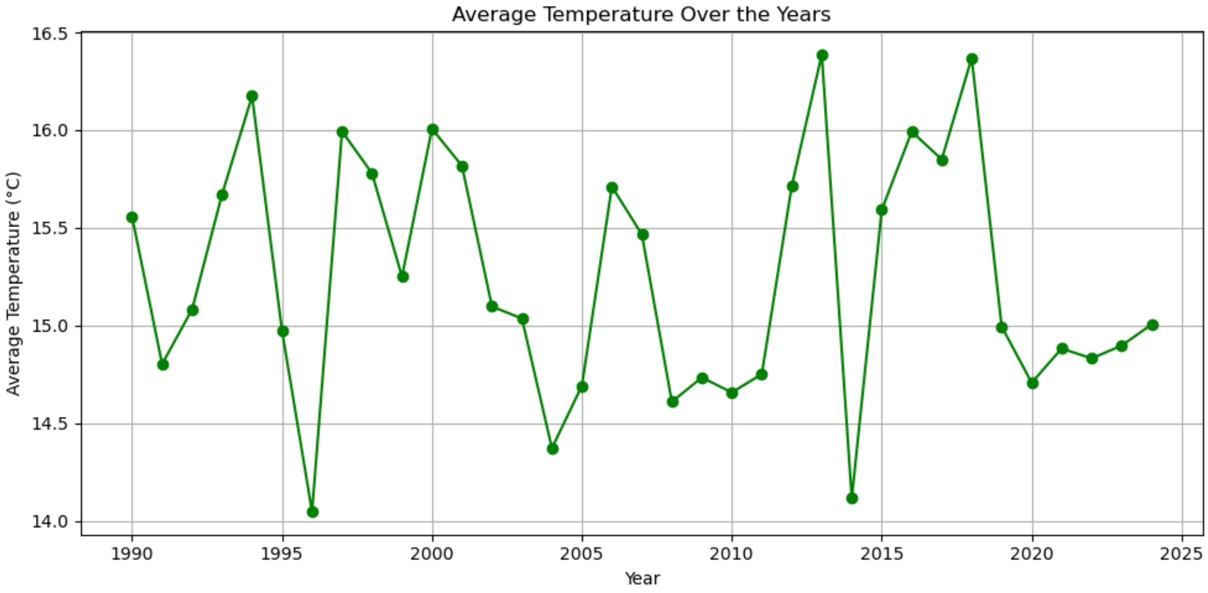
In [15]:

```
#Correlation Heatmap (Climate vs Agriculture)
# Select numeric columns for correlation
corr_columns = ['Average_Temperature_C', 'Total_Precipitation_mm', 'CO2_Emissions_M
                'Crop_Yield_MT_per_HA', 'Extreme_Weather_Events', 'Irrigation_Acces
                'Pesticide_Use_KG_per_HA', 'Fertilizer_Use_KG_per_HA', 'Soil_Health

plt.figure(figsize=(10, 8))
sns.heatmap(df[corr_columns].corr(), annot=True, cmap='coolwarm', fmt=".2f")
plt.title('Correlation Heatmap')
plt.show()
```

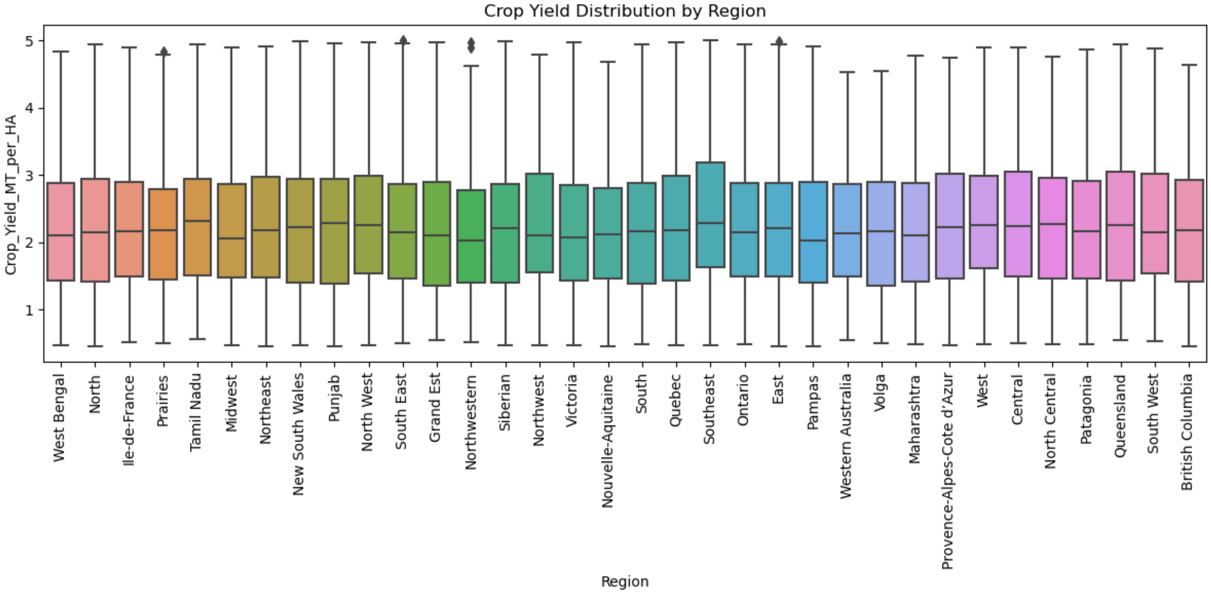


In [16]:

```
#Time Series Plot: Average Temperature over Years
avg_temp_by_year = df.groupby('Year')['Average_Temperature_C'].mean()

plt.figure(figsize=(10, 5))
avg_temp_by_year.plot(marker='o', linestyle='-', color='green')
plt.title('Average Temperature Over the Years')
plt.xlabel('Year')
plt.ylabel('Average Temperature (°C)')
plt.grid(True)
plt.tight_layout()
plt.show()
```



```
In [22]: #Boxplot: Yield Distribution by Region
         plt.figure(figsize=(12, 6))
         sns.boxplot(data=df, x='Region', y='Crop_Yield_MT_per_HA')
         plt.title('Crop Yield Distribution by Region')
         plt.xticks(rotation=90)
         plt.tight_layout()
         plt.show()
```



```
In [ ]:
```