Climate Impact On World's Agriculture

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```
library(dplyr)
library(ggplot2)
library(tidyverse)

Climate_Data <- read.csv("C:/Users/HP/R Programming/Climate_Impact.csv")


# Arranging the given data in Ascendiing order on the basis of Year
Climate_Data <- Climate_Data %>% arrange(Year)
head(Climate_Data, n=5)
```

```
##   Year   Country     Region  Crop_Type Average_Temperature_C Total_Precipitation_mm CO2_Emissions_MT
## 1 1990    France  Grand Est   Soybeans                15.23                1468.76             5.41
## 2 1990    Canada     Quebec       Corn                15.30                 739.72             5.03
## 3 1990   Nigeria North West Vegetables                 4.03                 338.35             6.57
## 4 1990 Argentina     Pampas      Wheat                14.98                1175.60            25.88
## 5 1990     China       East      Wheat                15.42                 269.76            29.93
##   Crop_Yield_MT_per_HA Extreme_Weather_Events Irrigation_Access_. Pesticide_Use_KG_per_HA
## 1                3.120                      5              62.01                   2.49
## 2                3.270                      8              13.92                   5.80
## 3                1.116                      0              47.31                  22.19
## 4                4.383                      8              57.06                  20.34
## 5                2.007                      5              70.80                  49.57
##   Fertilizer_Use_KG_per_HA Soil_Health_Index   Adaptation_Strategies Economic_Impact_Million_USD
## 1                    27.56            76.44 Drought-resistant Crops                    1524.34
## 2                     9.44            44.82           Crop Rotation                    1159.41
## 3                     1.34            74.72           No Adaptation                     165.05
## 4                    60.94            65.92           No Adaptation                    1177.04
## 5                    22.82            67.66           Crop Rotation                     795.47
```

```
tail(Climate_Data, n=5)
```

```
##       Year Country        Region Crop_Type Average_Temperature_C Total_Precipitation_mm
## 9996  2024     USA       Midwest    Coffee                20.71                1713.58
## 9997  2024 Nigeria North Central      Rice                12.82                 940.32
## 9998  2024  France Ile-de-France    Coffee                10.67                2225.76
## 9999  2024   China         North    Fruits                34.64                2647.19
## 10000 2024  France Ile-de-France    Barley                33.29                1351.64
##       CO2_Emissions_MT Crop_Yield_MT_per_HA Extreme_Weather_Events Irrigation_Access_.
## 9996             24.46                2.817                      3               60.58
## 9997             24.64                2.547                      3               54.49
```

```
## 9998             19.12               2.142                      8              37.26
## 9999              4.52               2.790                      7              47.16
## 10000             6.53               0.840                      5              72.70
##       Pesticide_Use_KG_per_HA Fertilizer_Use_KG_per_HA Soil_Health_Index   Adaptation_Strategies
## 9996                    42.46                   33.26            70.20         Organic Farming
## 9997                    20.61                    8.02            65.65 Drought-resistant Crops
## 9998                    31.45                   28.92            33.64         Organic Farming
## 9999                    47.34                    8.13            73.53         Organic Farming
## 10000                   45.90                    7.15            58.95 Drought-resistant Crops
##       Economic_Impact_Million_USD
## 9996                      1338.58
## 9997                       508.45
## 9998                       662.01
## 9999                       993.43
## 10000                      312.47
```

```
## We can see that the dataset contains the information of (1990-2024)

# Finding out the names of each column
colnames(Climate_Data)
```

```
##  [1] "Year"                      "Country"                   "Region"
##  [4] "Crop_Type"                 "Average_Temperature_C"     "Total_Precipitation_mm"
##  [7] "CO2_Emissions_MT"          "Crop_Yield_MT_per_HA"      "Extreme_Weather_Events"
## [10] "Irrigation_Access_."       "Pesticide_Use_KG_per_HA"   "Fertilizer_Use_KG_per_HA"
## [13] "Soil_Health_Index"         "Adaptation_Strategies"     "Economic_Impact_Million_USD"
```

```
# Finding Out the Number of Countries in the Dataset
unique_countries <- Climate_Data %>%
  distinct(Country)
print(unique_countries)
```

```
##      Country
## 1     France
## 2     Canada
## 3    Nigeria
## 4  Argentina
## 5      China
## 6     Russia
## 7  Australia
## 8      India
## 9     Brazil
## 10       USA
```

```
## Creating Function to find out the unique regions of Each Country
get_unique_regions <- function(data, country_name) {
  unique_regions <- data %>%
    filter(Country == country_name) %>%
    distinct(Region)

  return(unique_regions)
}
```

```r
# Finding out the Regions of Each Country

## Australia
unique_regions_australia <- get_unique_regions(Climate_Data,"Australia")
print(unique_regions_australia)
```

```
##              Region
## 1   New South Wales
## 2 Western Australia
## 3          Victoria
## 4        Queensland
```

```r
## France
unique_regions_france <- get_unique_regions(Climate_Data,"France")
print(unique_regions_france)
```

```
##                       Region
## 1                  Grand Est
## 2 Provence-Alpes-Cote d'Azur
## 3         Nouvelle-Aquitaine
## 4               Ile-de-France
```

```r
## Canada
unique_regions_canada <- get_unique_regions(Climate_Data,"Canada")
print(unique_regions_canada)
```

```
##             Region
## 1           Quebec
## 2 British Columbia
## 3         Prairies
## 4          Ontario
```

```r
## Nigeria
unique_regions_nigeria <- get_unique_regions(Climate_Data,"Nigeria")
print(unique_regions_nigeria)
```

```
##          Region
## 1    North West
## 2    South West
## 3    South East
## 4 North Central
```

```r
## Argentina
unique_regions_argentina <- get_unique_regions(Climate_Data,"Argentina")
print(unique_regions_argentina)
```

```
##      Region
## 1    Pampas
## 2 Northeast
## 3 Patagonia
## 4 Northwest
```

```r
## China
unique_regions_china <- get_unique_regions(Climate_Data,"China")
print(unique_regions_china)
```

```
##    Region
## 1    East
## 2   South
## 3   North
## 4 Central
```

```r
## Russia
unique_regions_russia <- get_unique_regions(Climate_Data,"Russia")
print(unique_regions_russia)
```

```
##         Region
## 1     Siberian
## 2 Northwestern
## 3        Volga
## 4      Central
```

```r
## India
unique_regions_india <- get_unique_regions(Climate_Data,"India")
print(unique_regions_india)
```

```
##        Region
## 1 West Bengal
## 2      Punjab
## 3  Tamil Nadu
## 4 Maharashtra
```

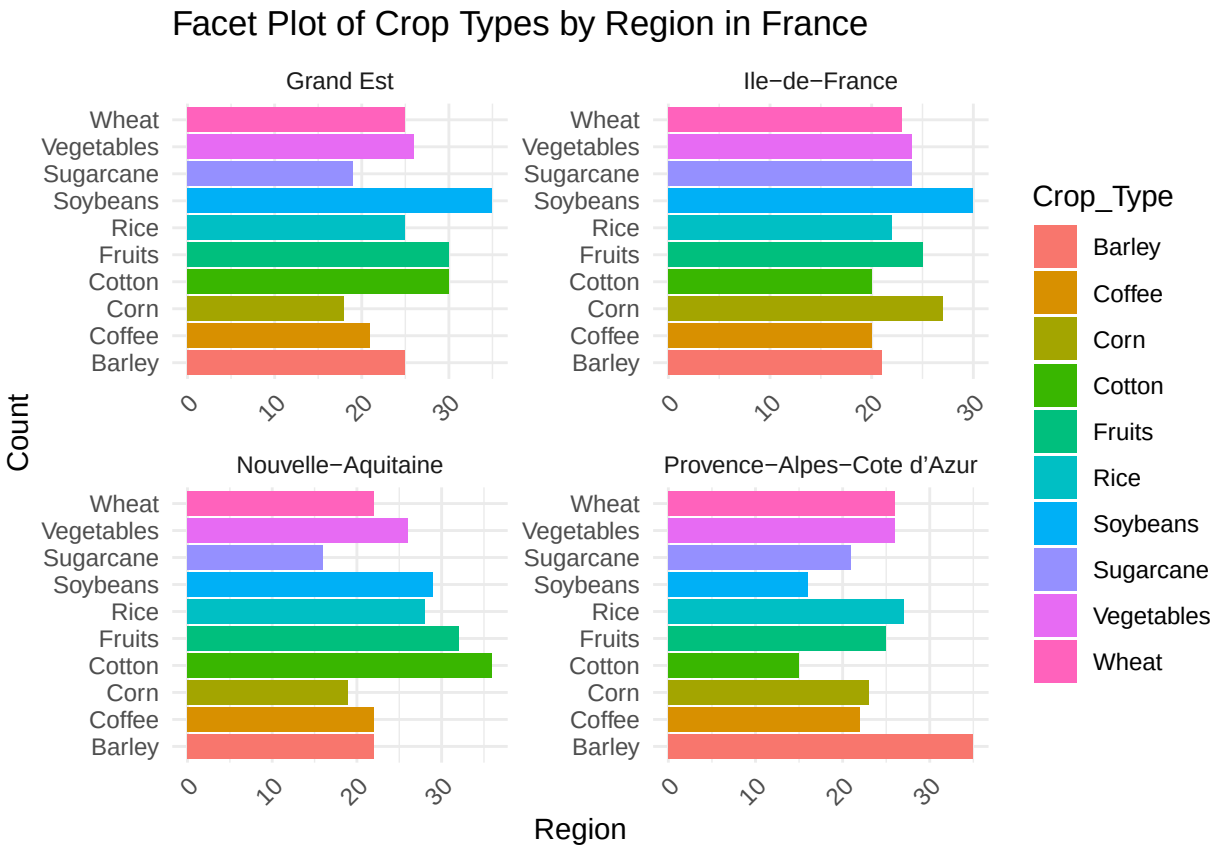
```r
## Brasil
unique_regions_brazil <- get_unique_regions(Climate_Data,"Brazil")
print(unique_regions_brazil)
```

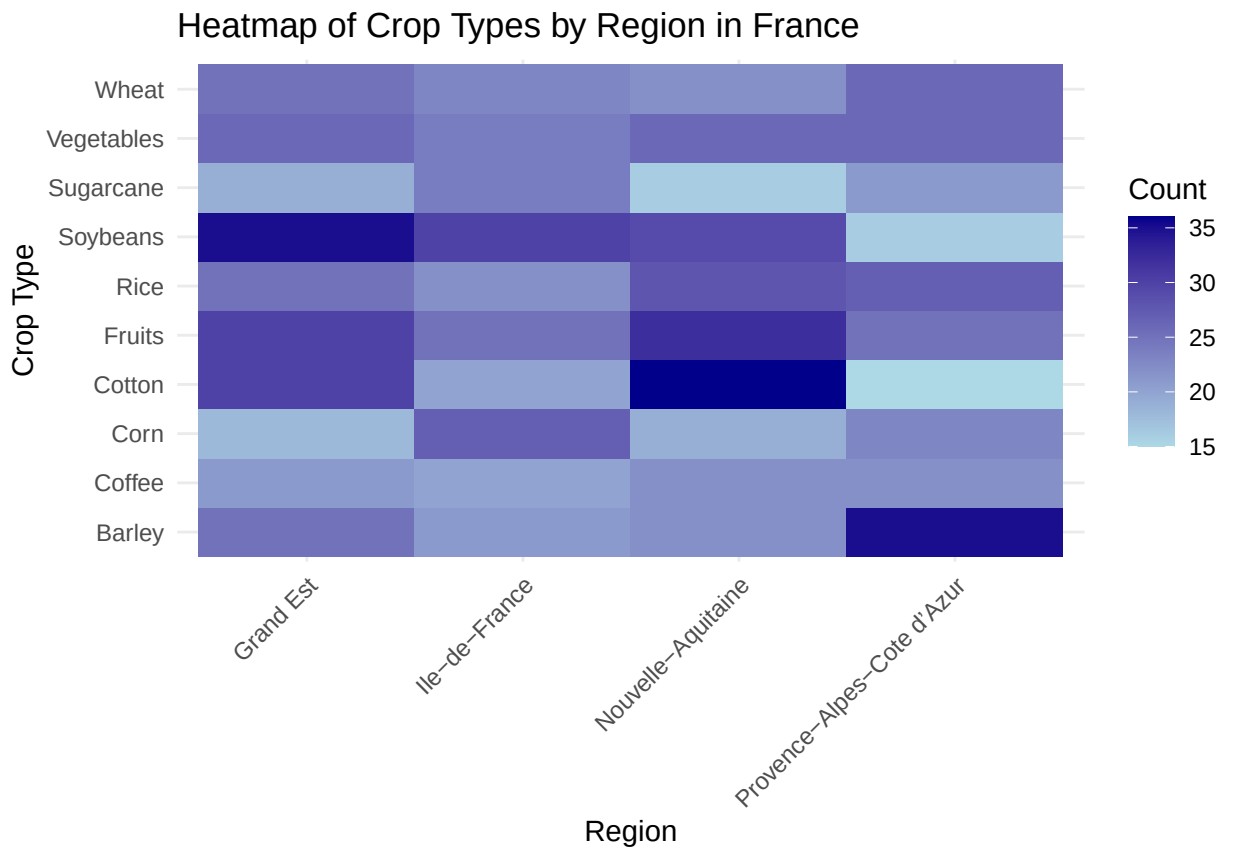
```
##      Region
## 1 Northeast
## 2     North
## 3     South
## 4 Southeast
```

```r
## USA
unique_regions_usa <- get_unique_regions(Climate_Data,"USA")
print(unique_regions_usa)
```

```
##      Region
## 1     South
## 2   Midwest
## 3      West
## 4 Northeast
```

```r
## Crop Data of the Every Regions of Each Country

# Creating a Function to summarize and visualize crop types by region for a given country using a heatm
summarize_and_visualize_crops_by_country <- function(data, country) {
  country_data <- data %>%
    filter(Country == country)


  crop_summary <- country_data %>%
    group_by(Region, Crop_Type) %>%
    summarise(Count = n(), .groups = 'drop')


  # Facet Plot
  facet_plot <- ggplot(crop_summary, aes(x = Count, y = Crop_Type, fill = Crop_Type)) +
    geom_bar(stat = "identity") +
    facet_wrap(~Region, scales = "free") +
    labs(title = paste("Facet Plot of Crop Types by Region in", country),
         x = "Region",
         y = "Count") +
    theme_minimal() +
    theme(axis.text.x = element_text(angle = 45, hjust = 1))

  print(facet_plot)


  # Heat Map
  heatmap_plot <- ggplot(crop_summary, aes(x = Region, y = Crop_Type, fill = Count)) +
    scale_fill_gradient(low = "lightblue", high = "darkblue") +
    geom_tile() +
    labs(title = paste("Heatmap of Crop Types by Region in", country),
         x = "Region",
         y = "Crop Type",
         fill = "Count") +
    theme_minimal() +
    theme(axis.text.x = element_text(angle = 45, hjust = 1))

  print(heatmap_plot)


  return(crop_summary)
}


# France
france_crops <- summarize_and_visualize_crops_by_country(Climate_Data, "France")
```

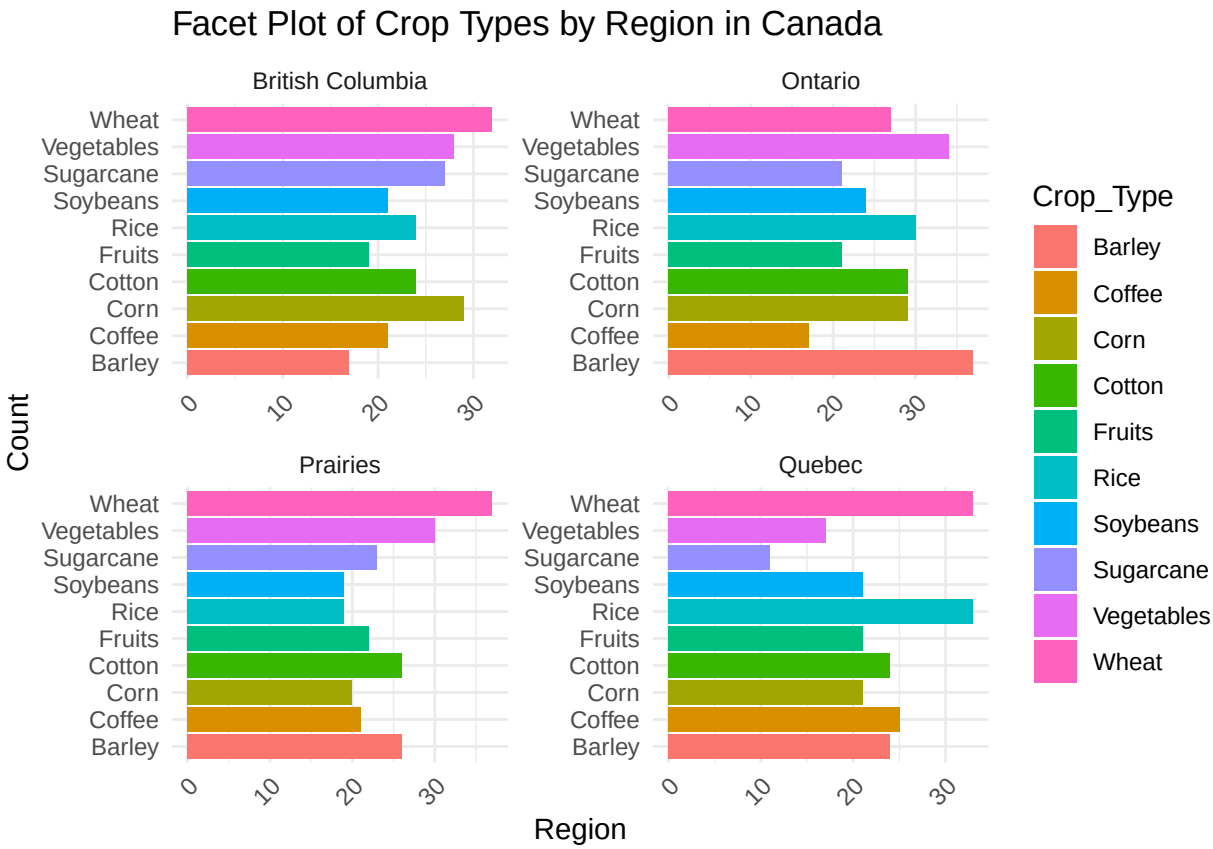

Facet Plot of Crop Types by Region in France
Grand Est
Ile−de−France
Nouvelle−Aquitaine
Provence−Alpes−Cote d'Azur
Wheat
Vegetables
Sugarcane
Soybeans
Rice
Fruits
Cotton
Corn
Coffee
Barley
0
10
20
30
Count
Region
Crop_Type
Barley
Coffee
Corn
Cotton
Fruits
Rice
Soybeans
Sugarcane
Vegetables
Wheat

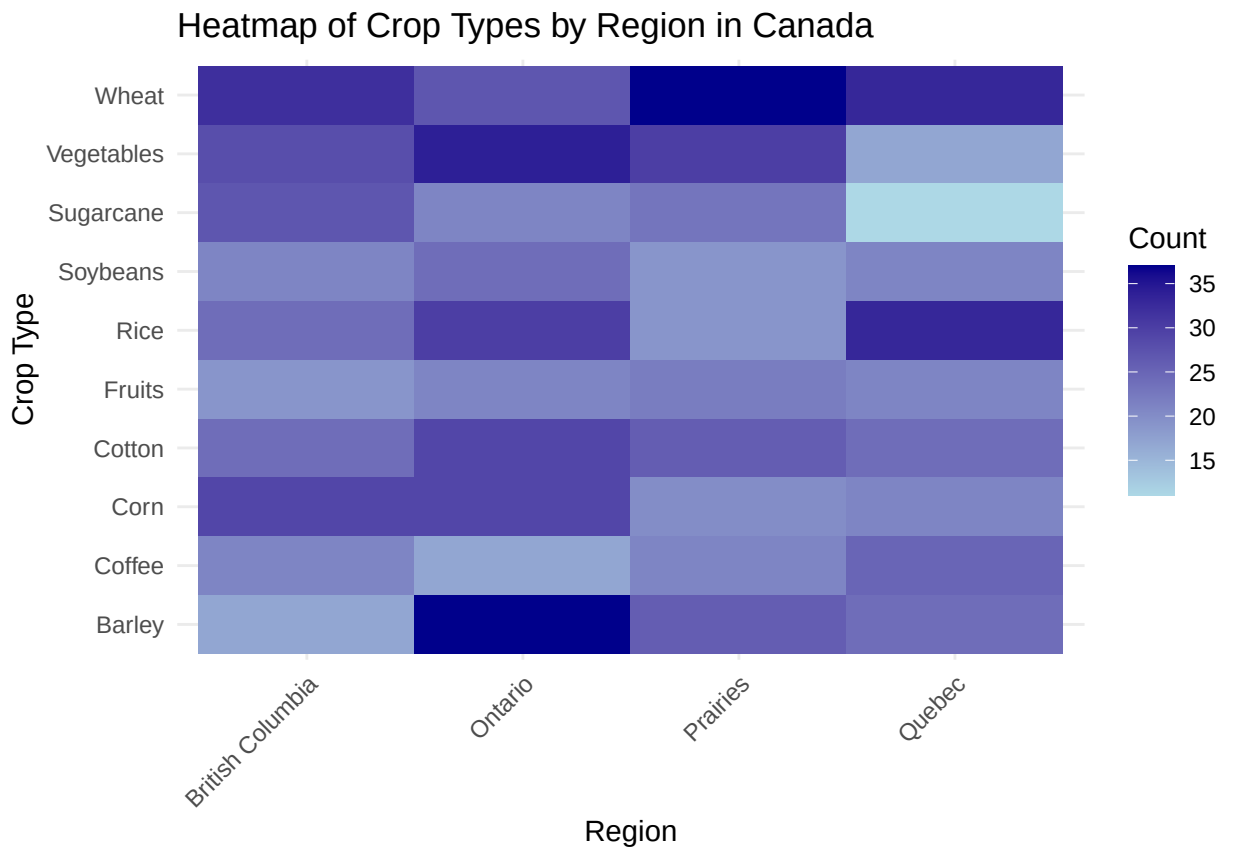



```
print(france_crops)
```

```
## # A tibble: 40 x 3
##    Region    Crop_Type  Count
##    <chr>     <chr>      <int>
##  1 Grand Est Barley        25
##  2 Grand Est Coffee        21
##  3 Grand Est Corn          18
##  4 Grand Est Cotton        30
##  5 Grand Est Fruits        30
##  6 Grand Est Rice          25
##  7 Grand Est Soybeans      35
##  8 Grand Est Sugarcane     19
##  9 Grand Est Vegetables    26
## 10 Grand Est Wheat         25
## # i 30 more rows
```

```
# Canada
canada_crops <- summarize_and_visualize_crops_by_country(Climate_Data, "Canada")
```

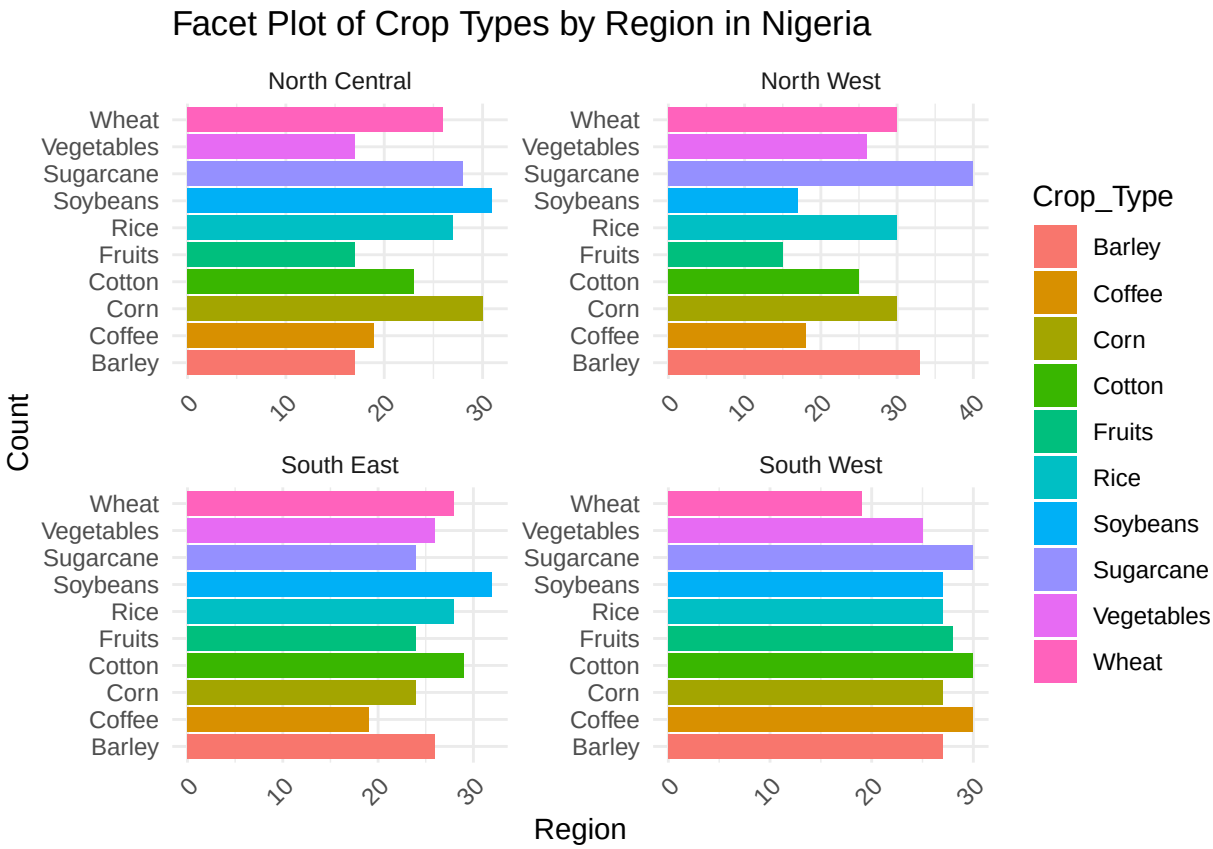

Facet Plot of Crop Types by Region in Canada
British Columbia
Ontario
Prairies
Quebec
Wheat
Vegetables
Sugarcane
Soybeans
Rice
Fruits
Cotton
Corn
Coffee
Barley
0
10
20
30
Count
Region
Crop_Type
Barley
Coffee
Corn
Cotton
Fruits
Rice
Soybeans
Sugarcane
Vegetables
Wheat

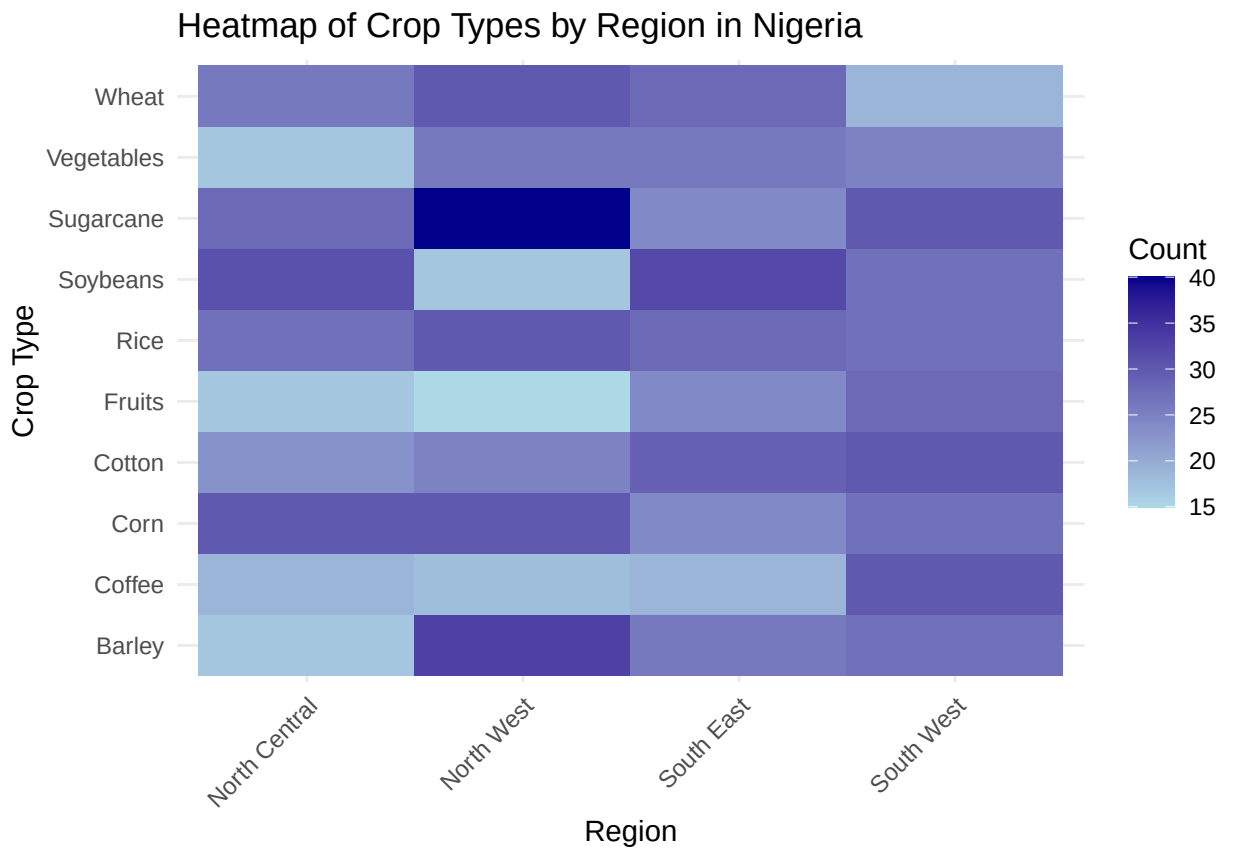



```
print(canada_crops)
```

```
## # A tibble: 40 x 3
##    Region           Crop_Type  Count
##    <chr>            <chr>      <int>
##  1 British Columbia Barley        17
##  2 British Columbia Coffee        21
##  3 British Columbia Corn          29
##  4 British Columbia Cotton        24
##  5 British Columbia Fruits        19
##  6 British Columbia Rice          24
##  7 British Columbia Soybeans      21
##  8 British Columbia Sugarcane     27
##  9 British Columbia Vegetables    28
## 10 British Columbia Wheat         32
## # i 30 more rows
```

```
# Nigeria
nigeria_crops <- summarize_and_visualize_crops_by_country(Climate_Data, "Nigeria")
```

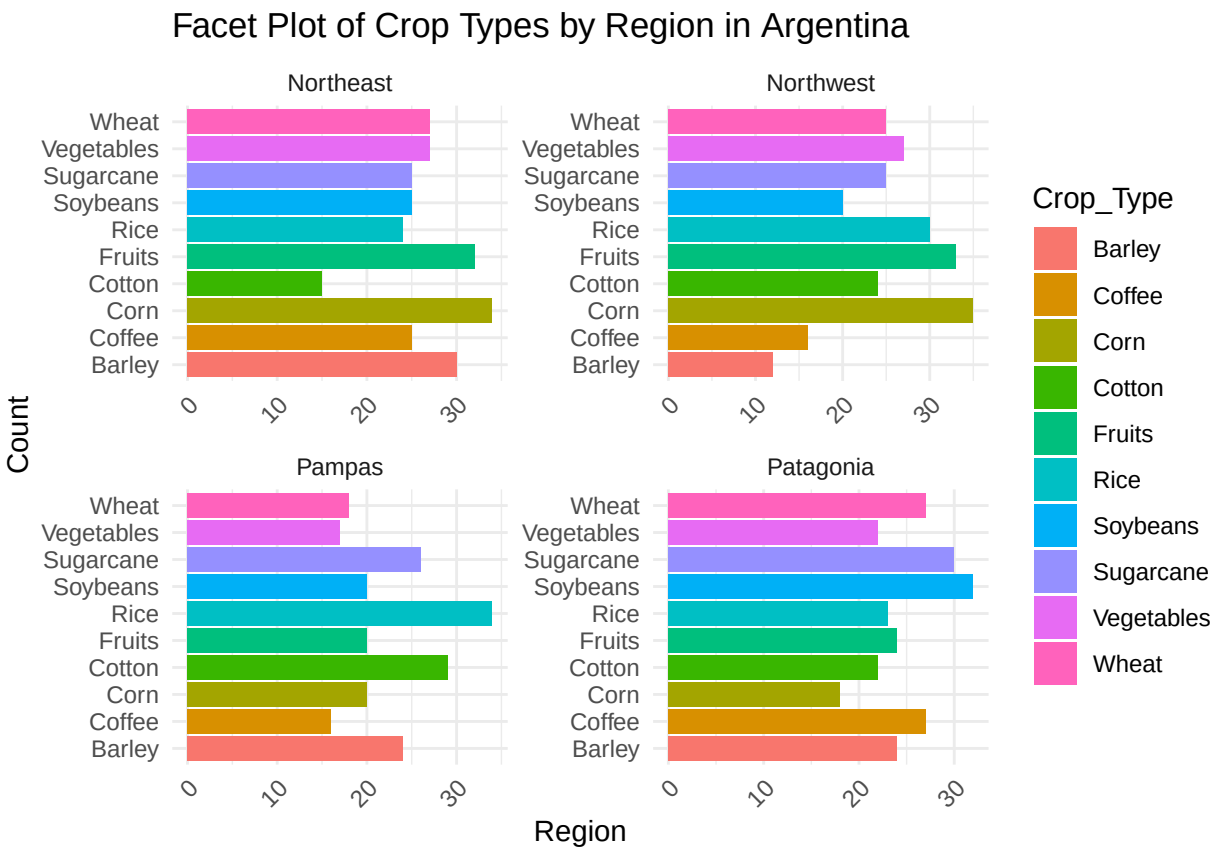

Facet Plot of Crop Types by Region in Nigeria
North Central
North West
South East
South West
Wheat
Vegetables
Sugarcane
Soybeans
Rice
Fruits
Cotton
Corn
Coffee
Barley
0
10
20
30
40
Count
Region
Crop_Type
Barley
Coffee
Corn
Cotton
Fruits
Rice
Soybeans
Sugarcane
Vegetables
Wheat

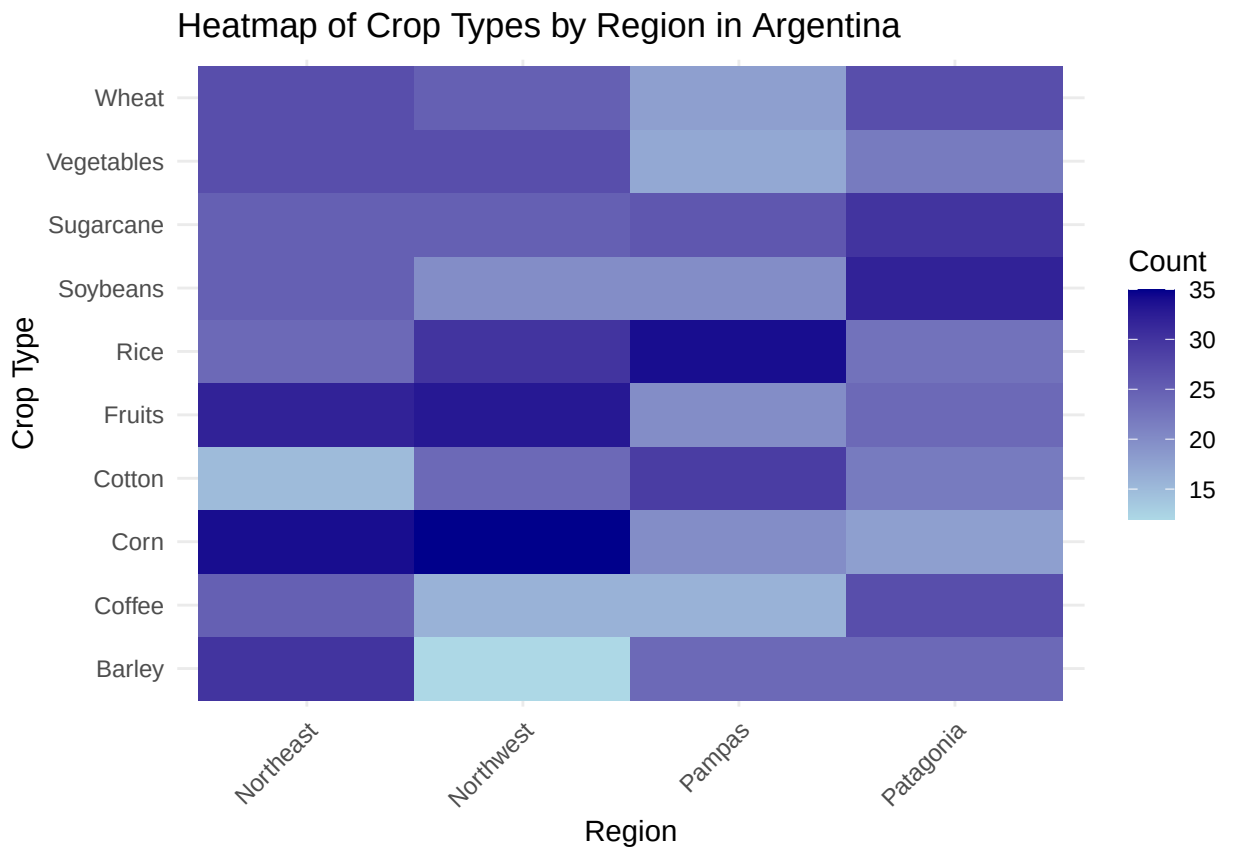



```
print(nigeria_crops)
```

```
## # A tibble: 40 x 3
##    Region        Crop_Type  Count
##    <chr>         <chr>      <int>
##  1 North Central Barley        17
##  2 North Central Coffee        19
##  3 North Central Corn          30
##  4 North Central Cotton        23
##  5 North Central Fruits        17
##  6 North Central Rice          27
##  7 North Central Soybeans      31
##  8 North Central Sugarcane     28
##  9 North Central Vegetables    17
## 10 North Central Wheat         26
## # i 30 more rows
```

```
# Argentina
argentina_crops <- summarize_and_visualize_crops_by_country(Climate_Data, "Argentina")
```

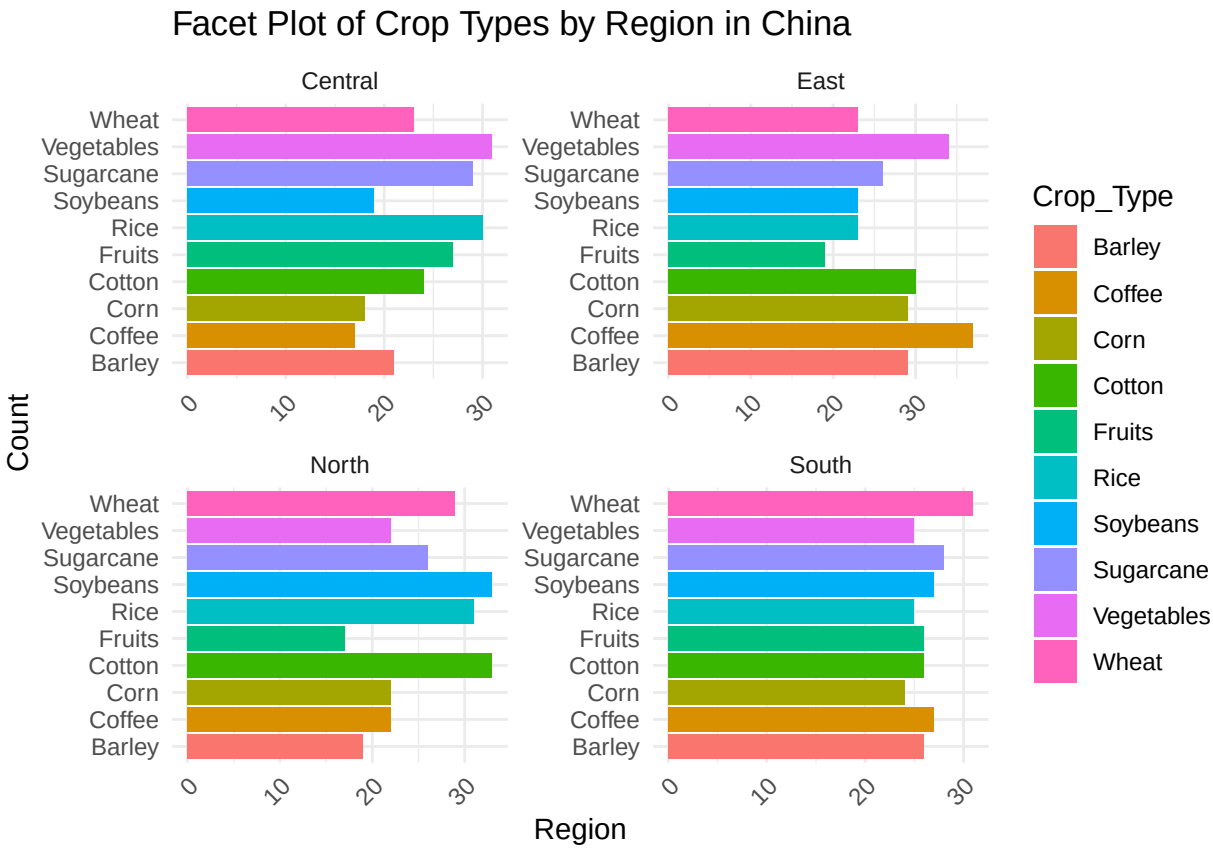

Facet Plot of Crop Types by Region in Argentina
Northeast
Northwest
Pampas
Patagonia
Wheat
Vegetables
Sugarcane
Soybeans
Rice
Fruits
Cotton
Corn
Coffee
Barley
0
10
20
30
Count
Region
Crop_Type
Barley
Coffee
Corn
Cotton
Fruits
Rice
Soybeans
Sugarcane
Vegetables
Wheat

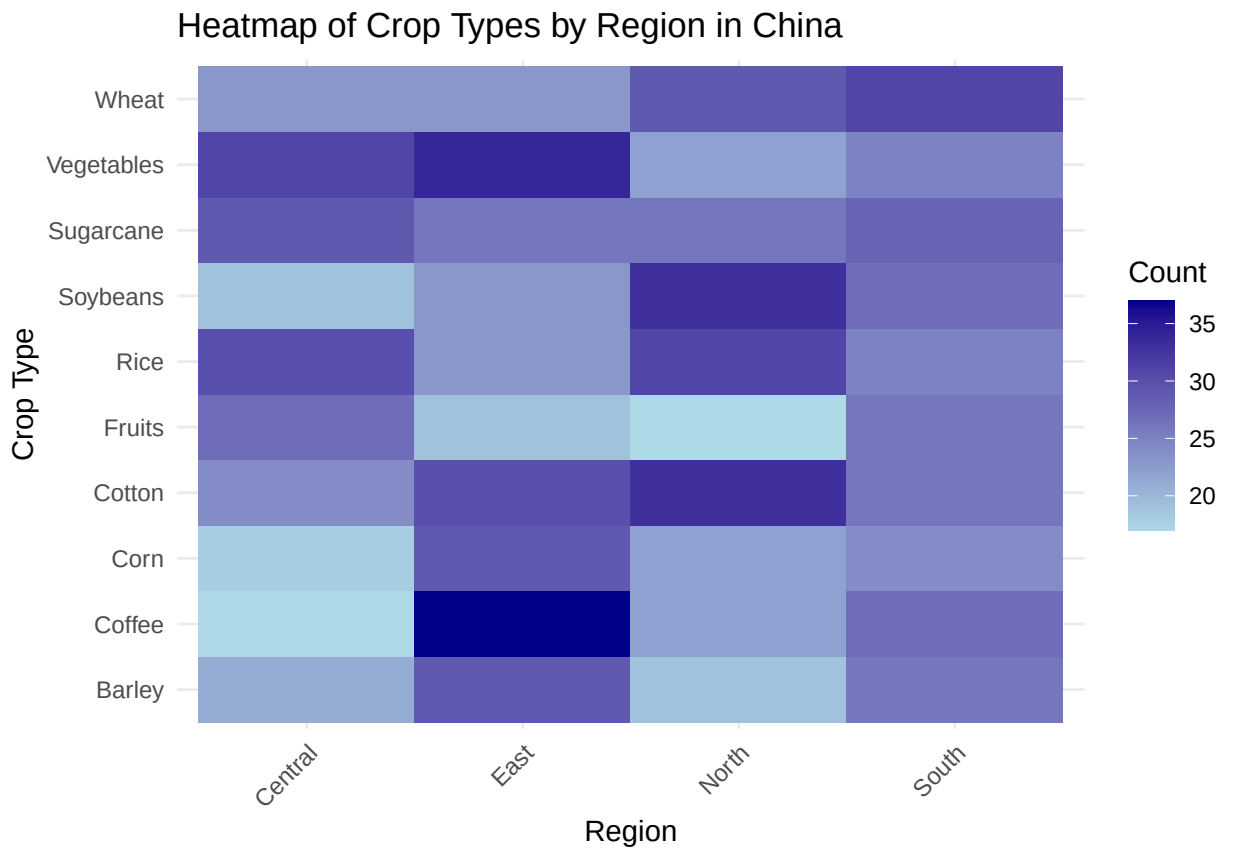



```
print(argentina_crops)
```

```
## # A tibble: 40 x 3
##    Region    Crop_Type  Count
##    <chr>     <chr>      <int>
##  1 Northeast Barley        30
##  2 Northeast Coffee        25
##  3 Northeast Corn          34
##  4 Northeast Cotton        15
##  5 Northeast Fruits        32
##  6 Northeast Rice          24
##  7 Northeast Soybeans      25
##  8 Northeast Sugarcane     25
##  9 Northeast Vegetables    27
## 10 Northeast Wheat         27
## # i 30 more rows
```

```
# China
china_crops <- summarize_and_visualize_crops_by_country(Climate_Data, "China")
```

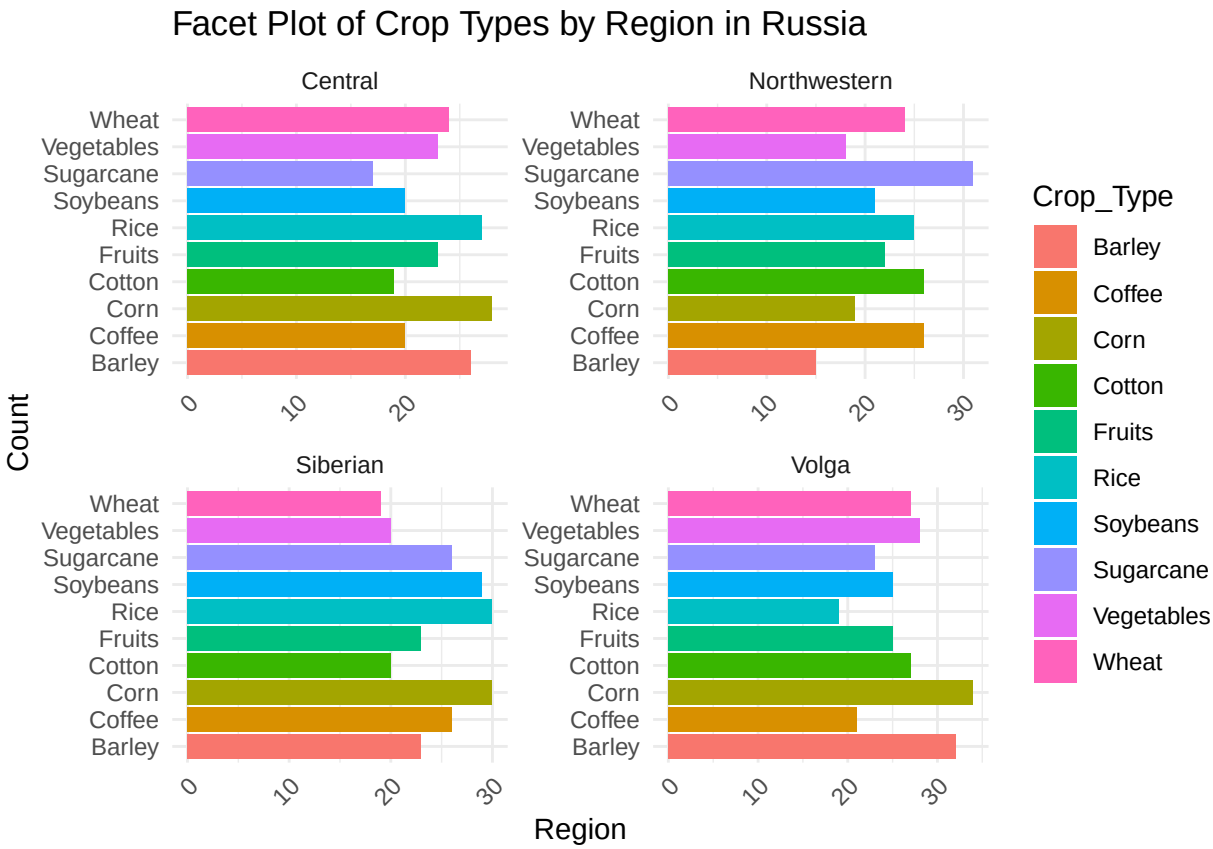

Facet Plot of Crop Types by Region in China
Central
East
North
South
Wheat
Vegetables
Sugarcane
Soybeans
Rice
Fruits
Cotton
Corn
Coffee
Barley
0
10
20
30
Count
Region
Crop_Type
Barley
Coffee
Corn
Cotton
Fruits
Rice
Soybeans
Sugarcane
Vegetables
Wheat

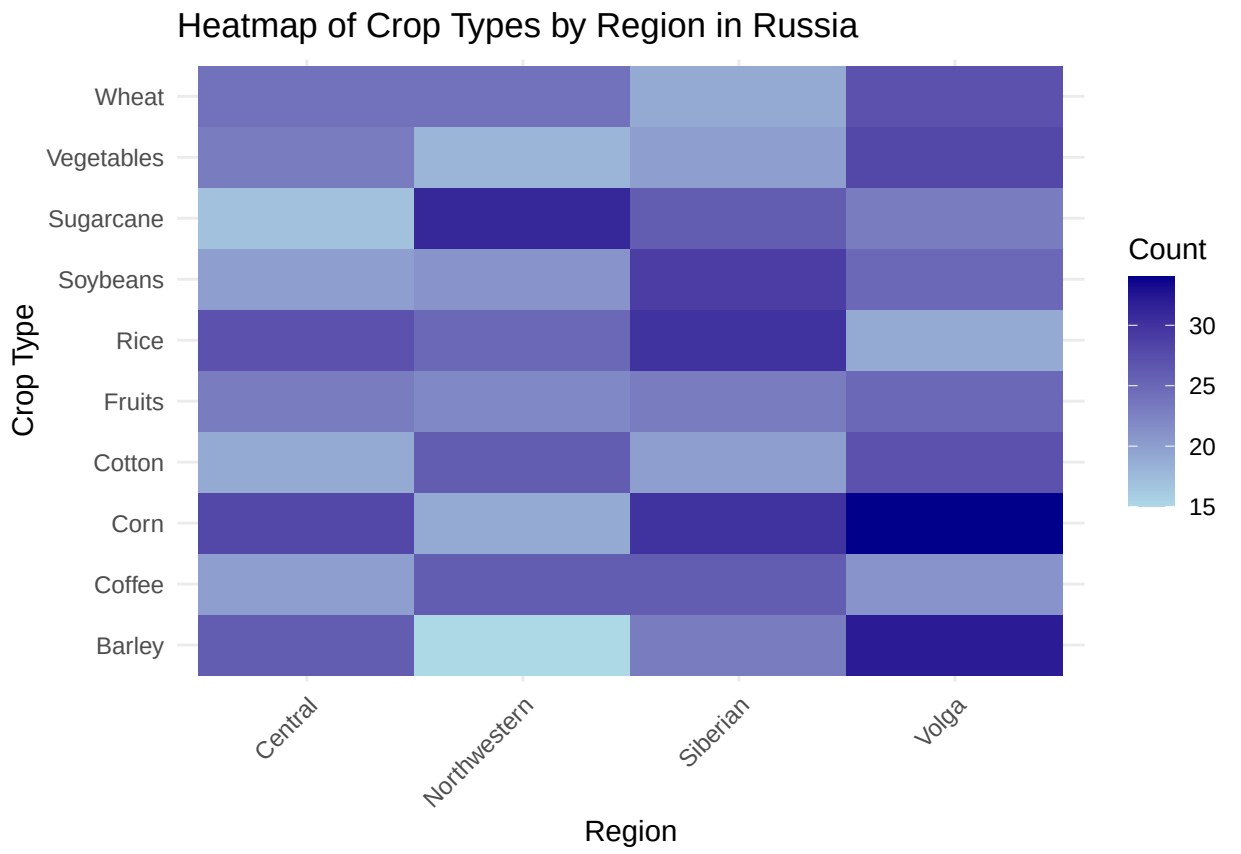



```
print(china_crops)
```

```
## # A tibble: 40 x 3
##    Region  Crop_Type  Count
##    <chr>   <chr>      <int>
##  1 Central Barley        21
##  2 Central Coffee        17
##  3 Central Corn          18
##  4 Central Cotton        24
##  5 Central Fruits        27
##  6 Central Rice          30
##  7 Central Soybeans      19
##  8 Central Sugarcane     29
##  9 Central Vegetables    31
## 10 Central Wheat         23
## # i 30 more rows
```

```
# Russia
russia_crops <- summarize_and_visualize_crops_by_country(Climate_Data, "Russia")
```

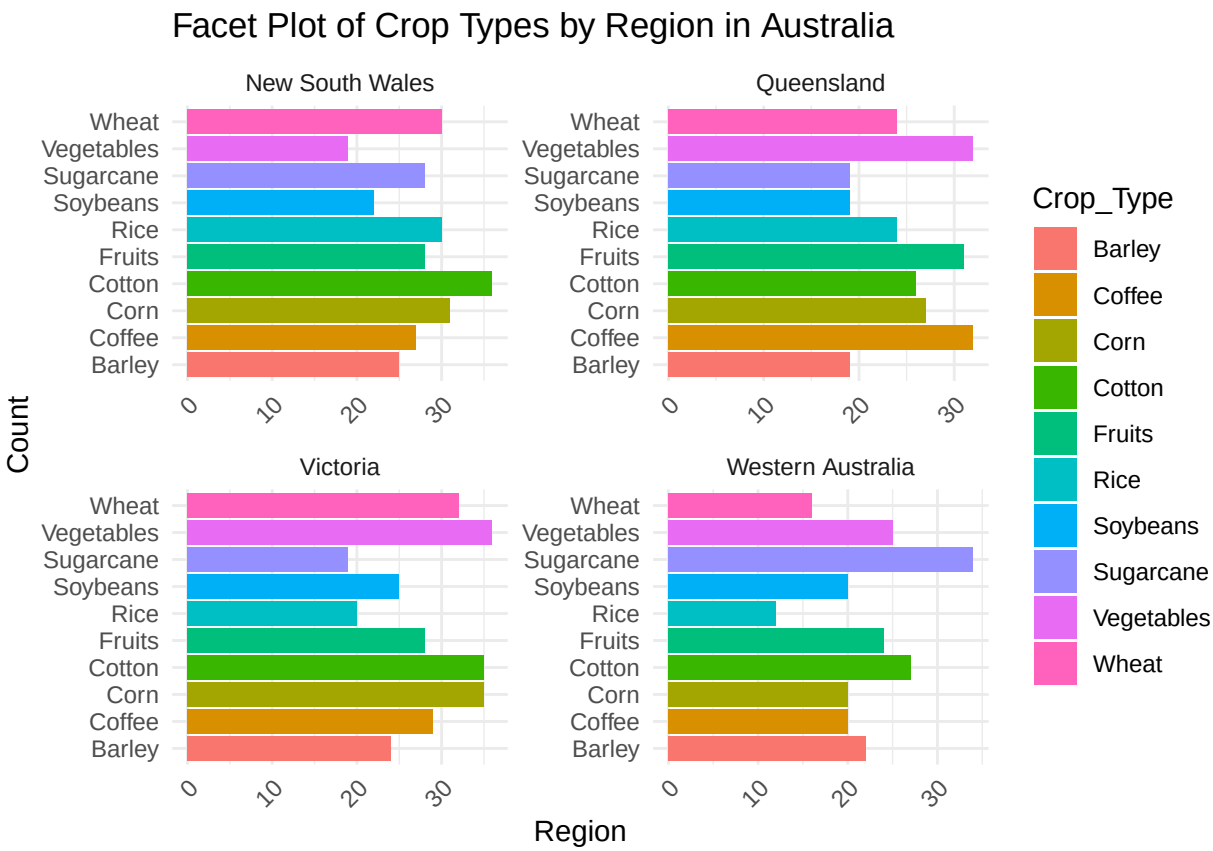

Facet Plot of Crop Types by Region in Russia
Central
Northwestern
Siberian
Volga
Wheat
Vegetables
Sugarcane
Soybeans
Rice
Fruits
Cotton
Corn
Coffee
Barley
0
10
20
30
Count
Region
Crop_Type
Barley
Coffee
Corn
Cotton
Fruits
Rice
Soybeans
Sugarcane
Vegetables
Wheat

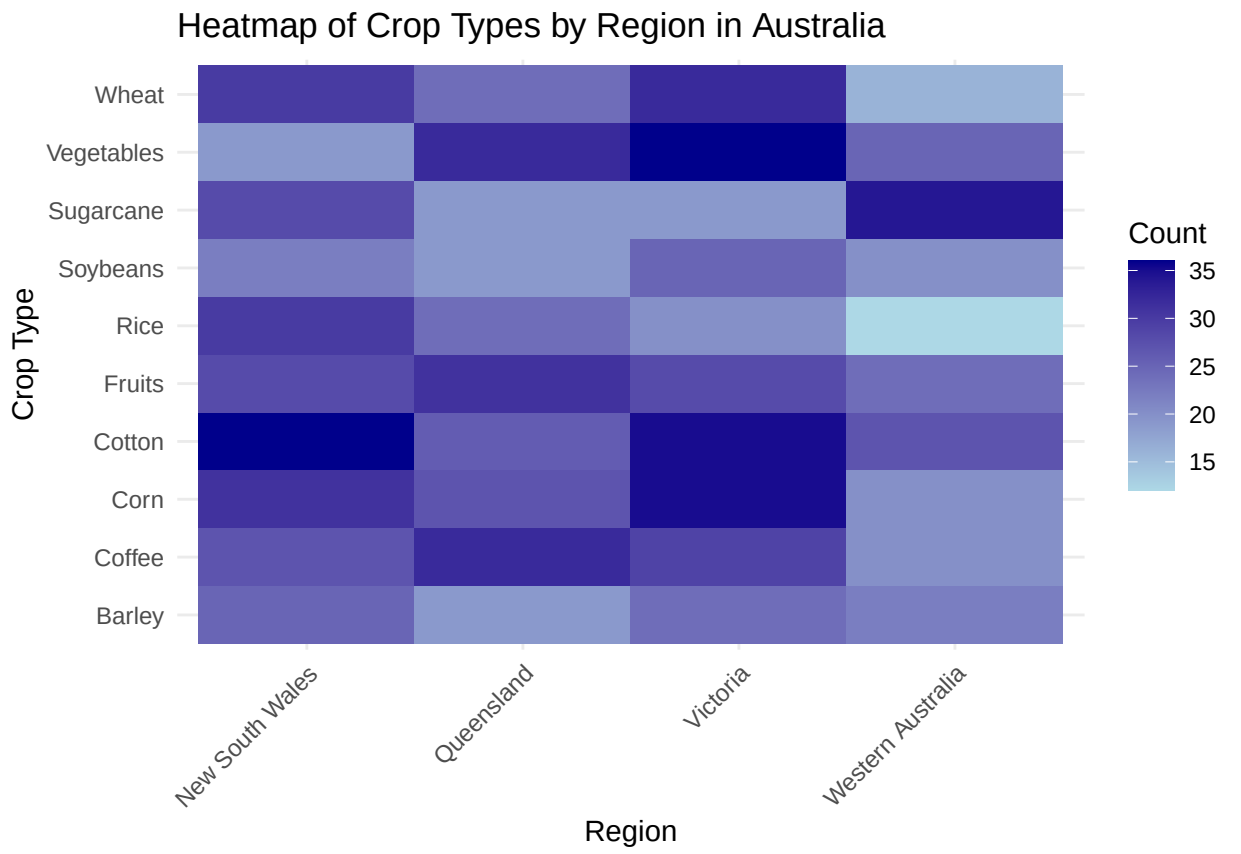



```
print(russia_crops)
```

```
## # A tibble: 40 x 3
##    Region  Crop_Type  Count
##    <chr>   <chr>      <int>
##  1 Central Barley        26
##  2 Central Coffee        20
##  3 Central Corn          28
##  4 Central Cotton        19
##  5 Central Fruits        23
##  6 Central Rice          27
##  7 Central Soybeans      20
##  8 Central Sugarcane     17
##  9 Central Vegetables    23
## 10 Central Wheat         24
## # i 30 more rows
```

```
# Australia
australia_crops <- summarize_and_visualize_crops_by_country(Climate_Data, "Australia")
```

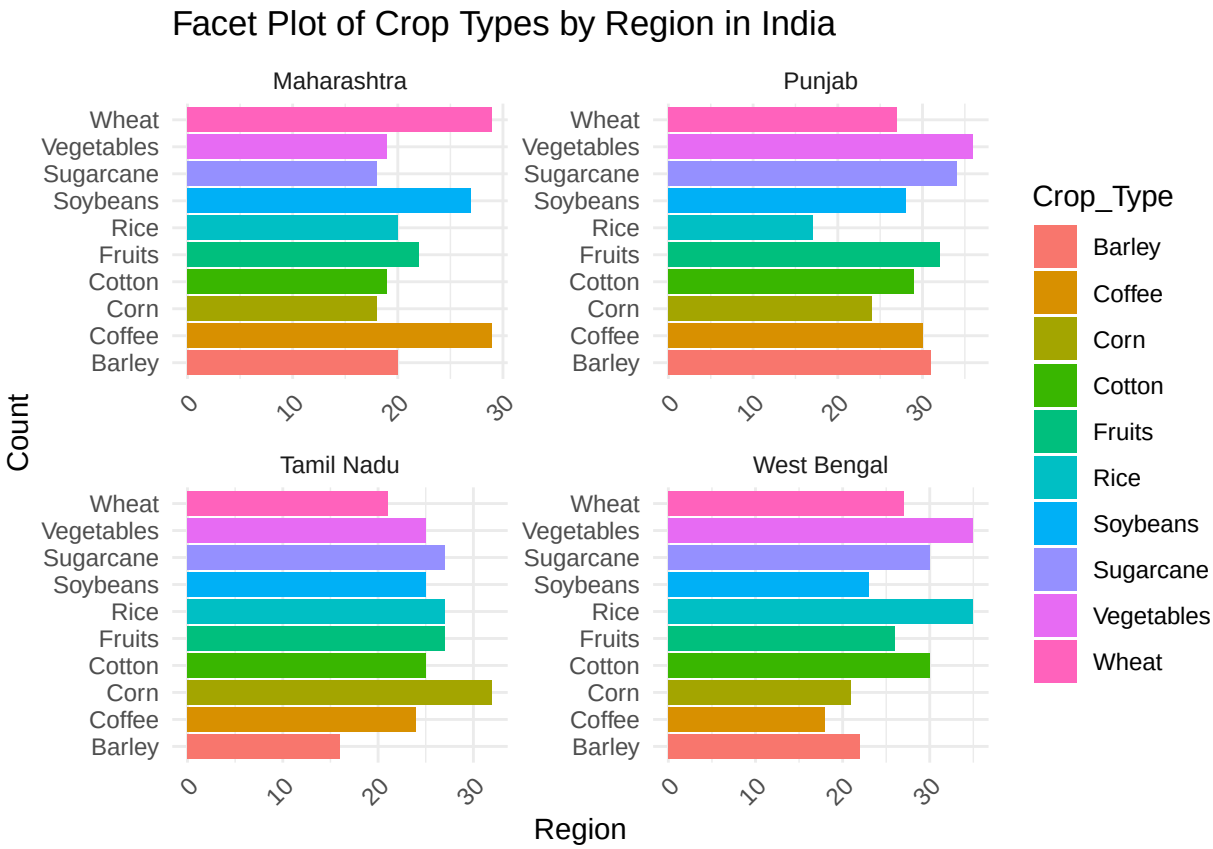

Facet Plot of Crop Types by Region in Australia
New South Wales
Queensland
Victoria
Western Australia
Wheat
Vegetables
Sugarcane
Soybeans
Rice
Fruits
Cotton
Corn
Coffee
Barley
0
10
20
30
Count
Region
Crop_Type
Barley
Coffee
Corn
Cotton
Fruits
Rice
Soybeans
Sugarcane
Vegetables
Wheat

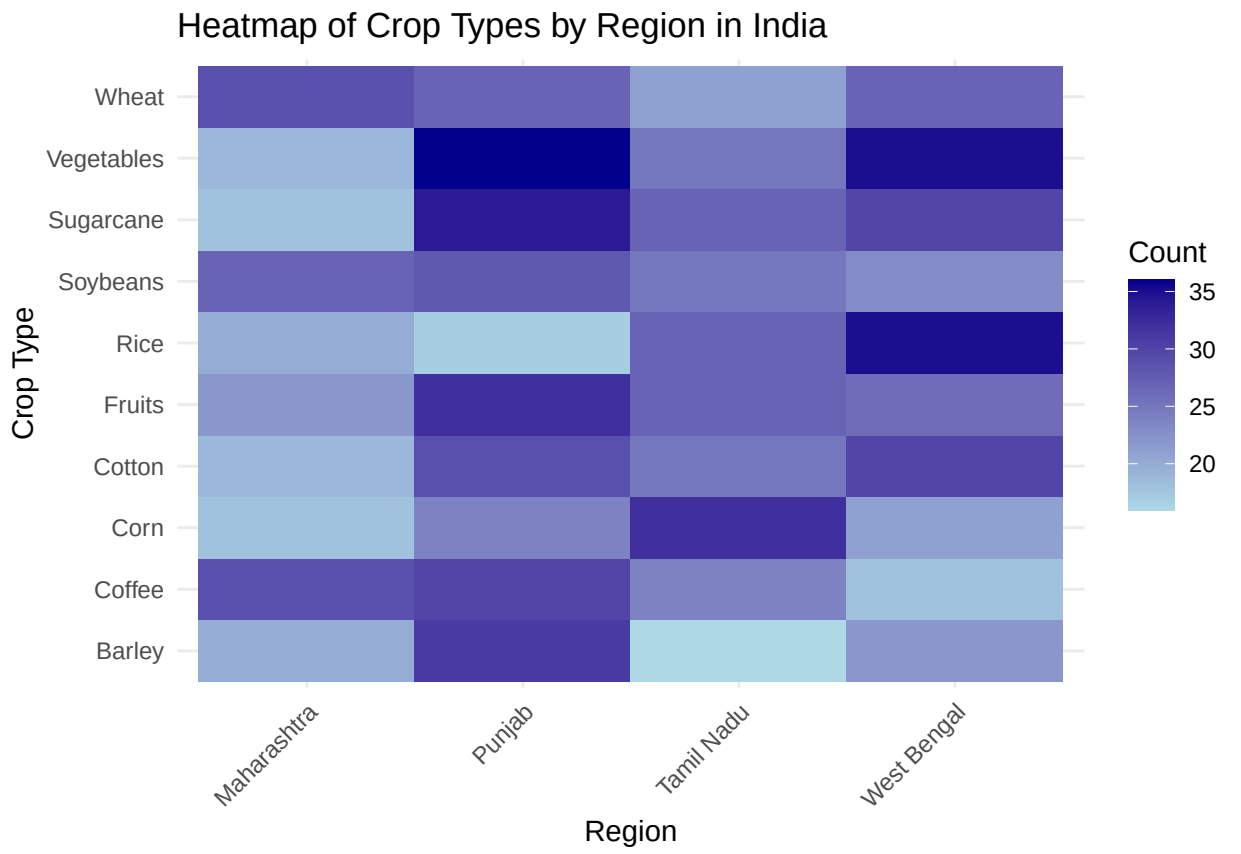



```
print(australia_crops)
```

```
## # A tibble: 40 x 3
##    Region          Crop_Type  Count
##    <chr>           <chr>      <int>
##  1 New South Wales Barley        25
##  2 New South Wales Coffee        27
##  3 New South Wales Corn          31
##  4 New South Wales Cotton        36
##  5 New South Wales Fruits        28
##  6 New South Wales Rice          30
##  7 New South Wales Soybeans      22
##  8 New South Wales Sugarcane     28
##  9 New South Wales Vegetables    19
## 10 New South Wales Wheat         30
## # i 30 more rows
```

```
# India
india_crops <- summarize_and_visualize_crops_by_country(Climate_Data, "India")
```

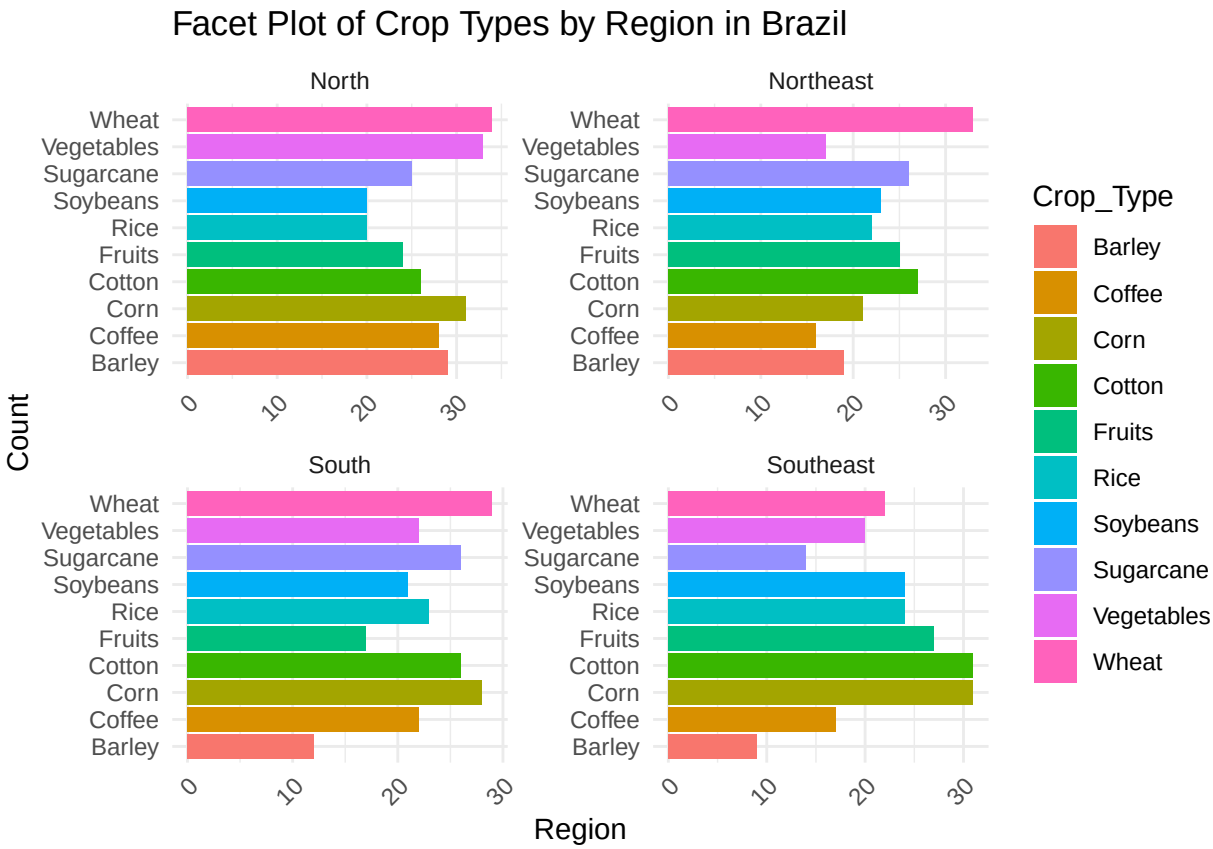

Facet Plot of Crop Types by Region in India
Maharashtra
Punjab
Tamil Nadu
West Bengal
Wheat
Vegetables
Sugarcane
Soybeans
Rice
Fruits
Cotton
Corn
Coffee
Barley
0
10
20
30
Count
Region
Crop_Type
Barley
Coffee
Corn
Cotton
Fruits
Rice
Soybeans
Sugarcane
Vegetables
Wheat

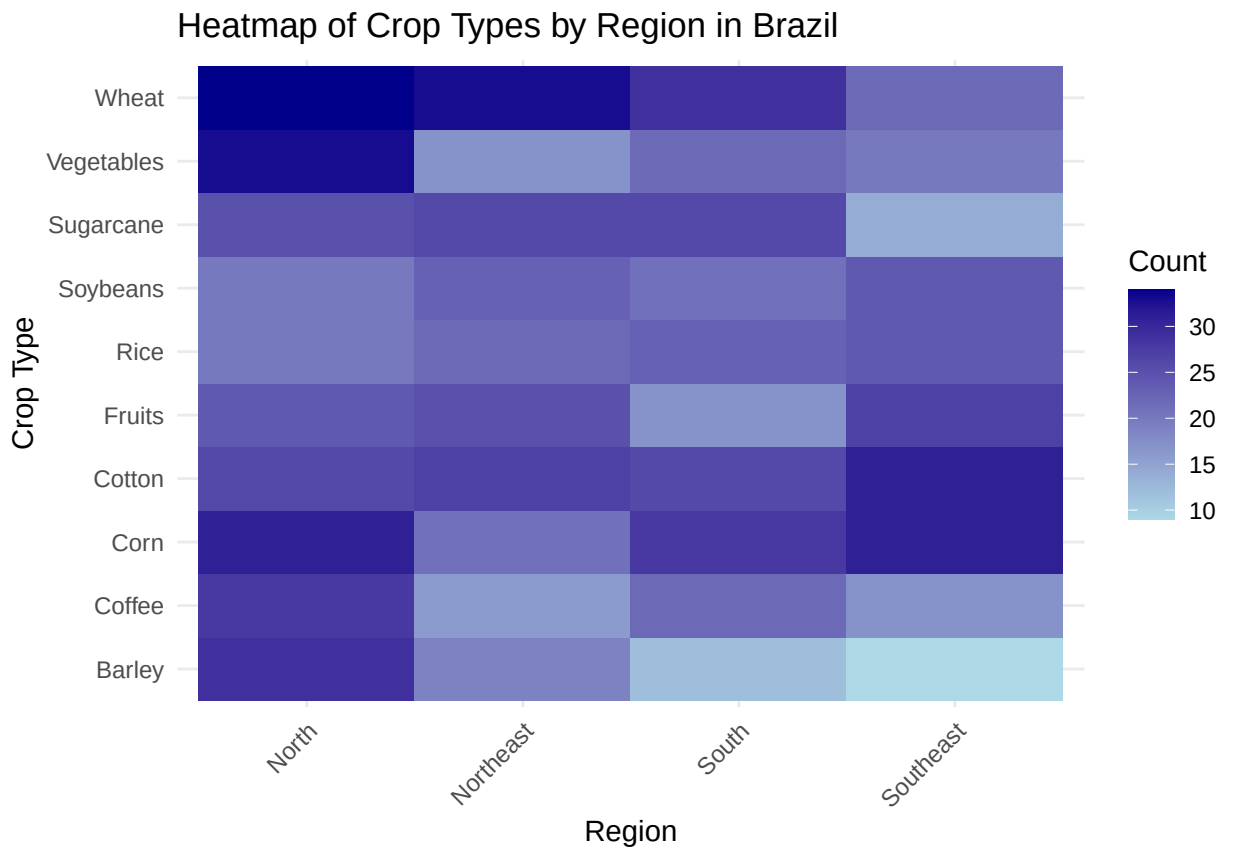



```
print(india_crops)
```

```
## # A tibble: 40 x 3
##    Region      Crop_Type  Count
##    <chr>       <chr>      <int>
##  1 Maharashtra Barley        20
##  2 Maharashtra Coffee        29
##  3 Maharashtra Corn          18
##  4 Maharashtra Cotton        19
##  5 Maharashtra Fruits        22
##  6 Maharashtra Rice          20
##  7 Maharashtra Soybeans      27
##  8 Maharashtra Sugarcane     18
##  9 Maharashtra Vegetables    19
## 10 Maharashtra Wheat         29
## # i 30 more rows
```

```
# Brzsil
brazil_crops <- summarize_and_visualize_crops_by_country(Climate_Data, "Brazil")
```

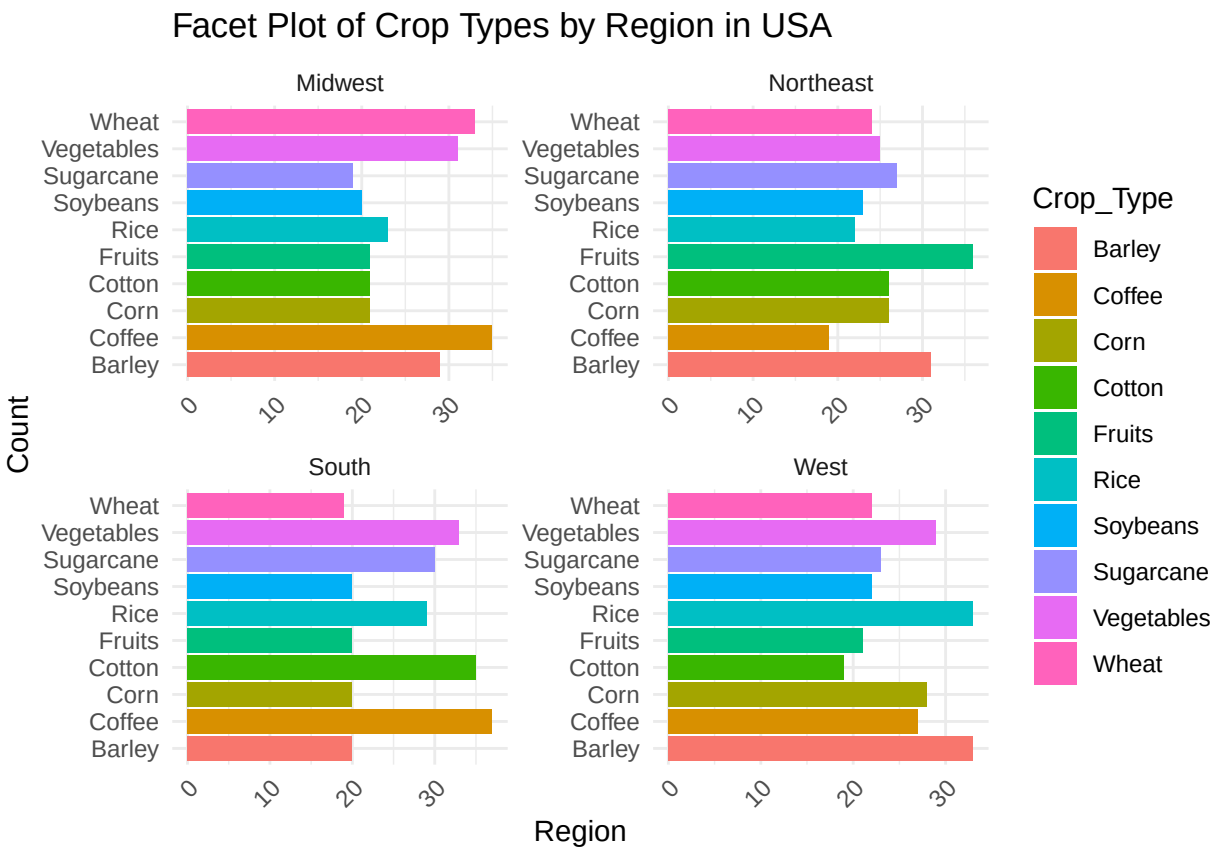

Facet Plot of Crop Types by Region in Brazil
North
Northeast
South
Southeast
Wheat
Vegetables
Sugarcane
Soybeans
Rice
Fruits
Cotton
Corn
Coffee
Barley
0
10
20
30
Count
Region
Crop_Type
Barley
Coffee
Corn
Cotton
Fruits
Rice
Soybeans
Sugarcane
Vegetables
Wheat

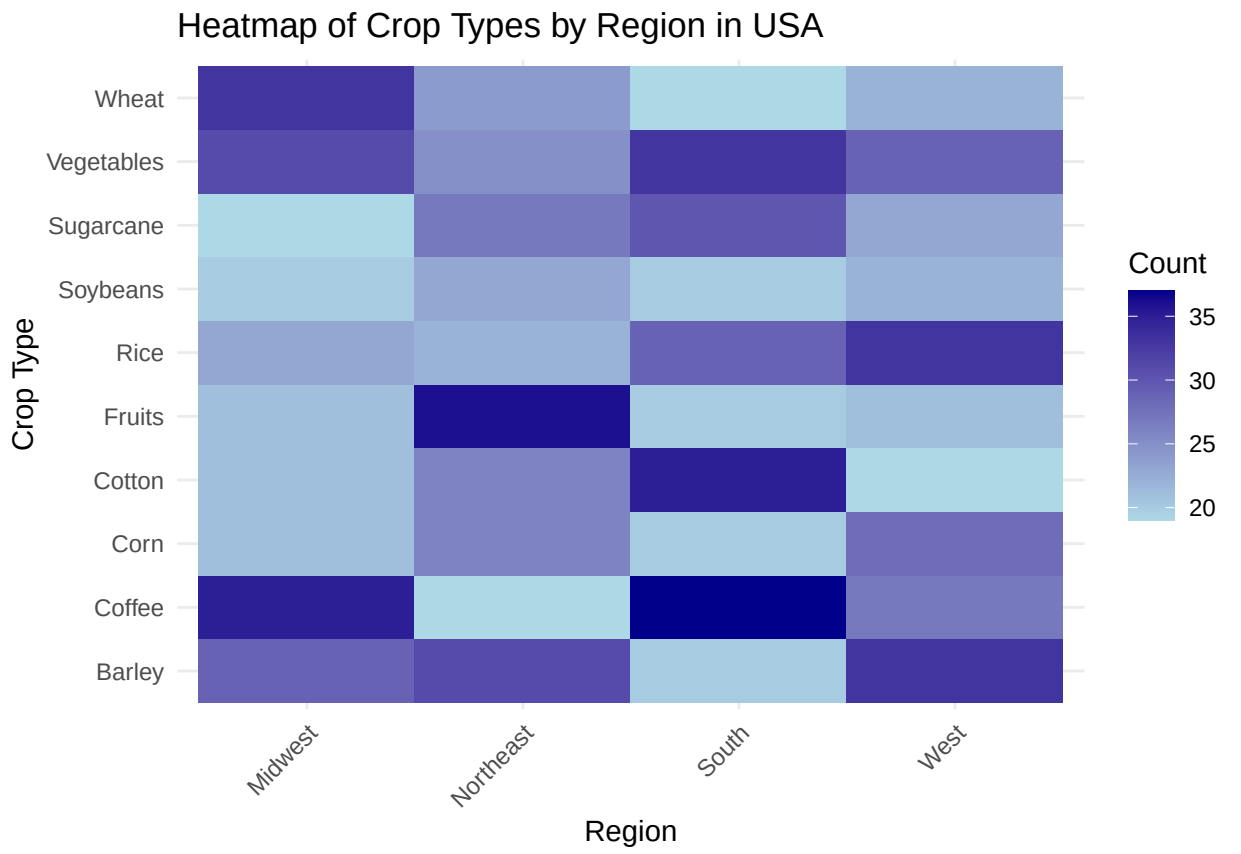



```
print(brazil_crops)
```

```
## # A tibble: 40 x 3
##    Region Crop_Type  Count
##    <chr>  <chr>      <int>
##  1 North  Barley        29
##  2 North  Coffee        28
##  3 North  Corn          31
##  4 North  Cotton        26
##  5 North  Fruits        24
##  6 North  Rice          20
##  7 North  Soybeans      20
##  8 North  Sugarcane     25
##  9 North  Vegetables    33
## 10 North  Wheat         34
## # i 30 more rows
```

```
# USA
usa_crops <- summarize_and_visualize_crops_by_country(Climate_Data, "USA")
```


Facet Plot of Crop Types by Region in USA
Midwest
Northeast
South
West
Wheat
Vegetables
Sugarcane
Soybeans
Rice
Fruits
Cotton
Corn
Coffee
Barley
0
10
20
30
Count
Region
Crop_Type
Barley
Coffee
Corn
Cotton
Fruits
Rice
Soybeans
Sugarcane
Vegetables
Wheat



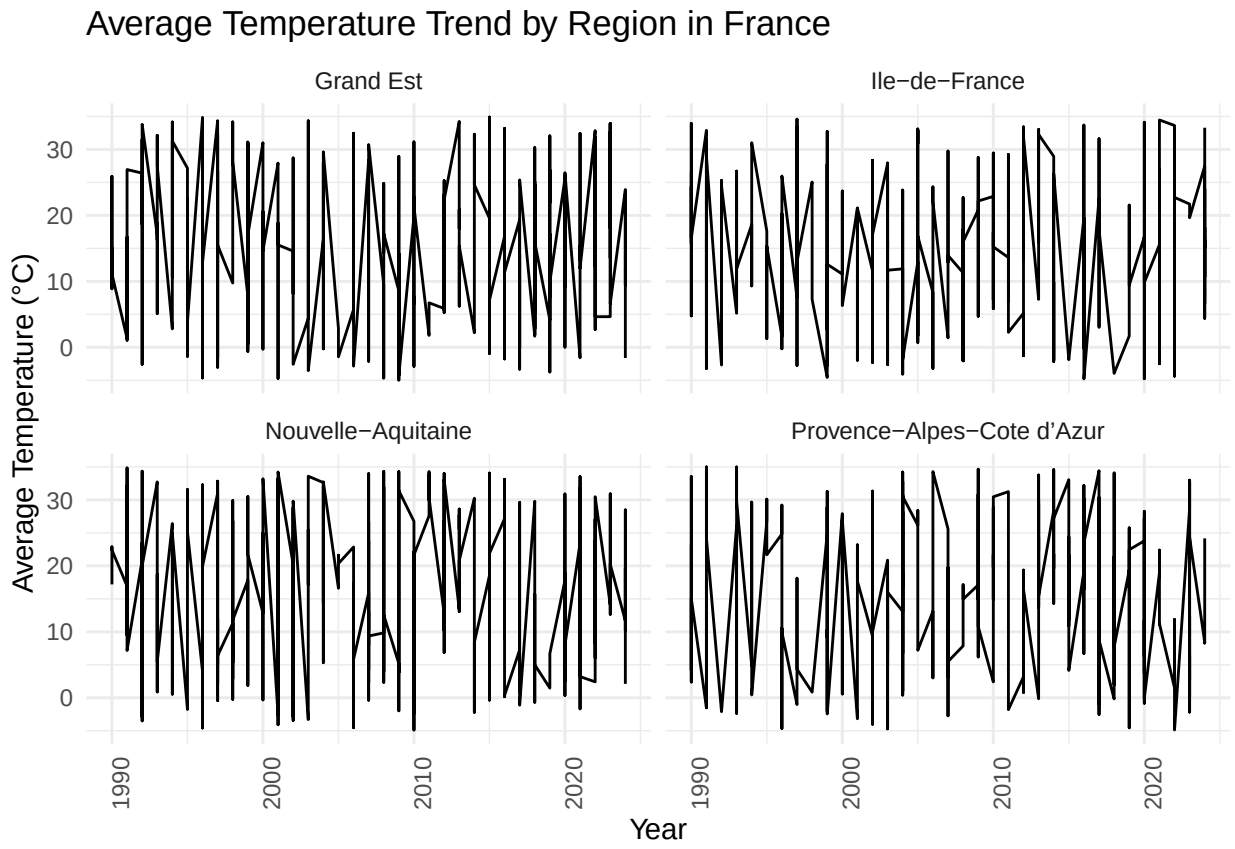

```
print(usa_crops)
```

```
## # A tibble: 40 x 3
##    Region  Crop_Type  Count
##    <chr>   <chr>      <int>
##  1 Midwest Barley        29
##  2 Midwest Coffee        35
##  3 Midwest Corn          21
##  4 Midwest Cotton        21
##  5 Midwest Fruits        21
##  6 Midwest Rice          23
##  7 Midwest Soybeans      20
##  8 Midwest Sugarcane     19
##  9 Midwest Vegetables    31
## 10 Midwest Wheat         33
## # i 30 more rows
```

```
## Creating Functions to Visualize the Average Temperature Trend of all Regions of Each Country

# Facet Line Plots

plot_temp_trend_country_facet <- function(data, country_name) {
  # Filter the data for the specified country
  filtered_data <- data %>%
    filter(Country == country_name)
```

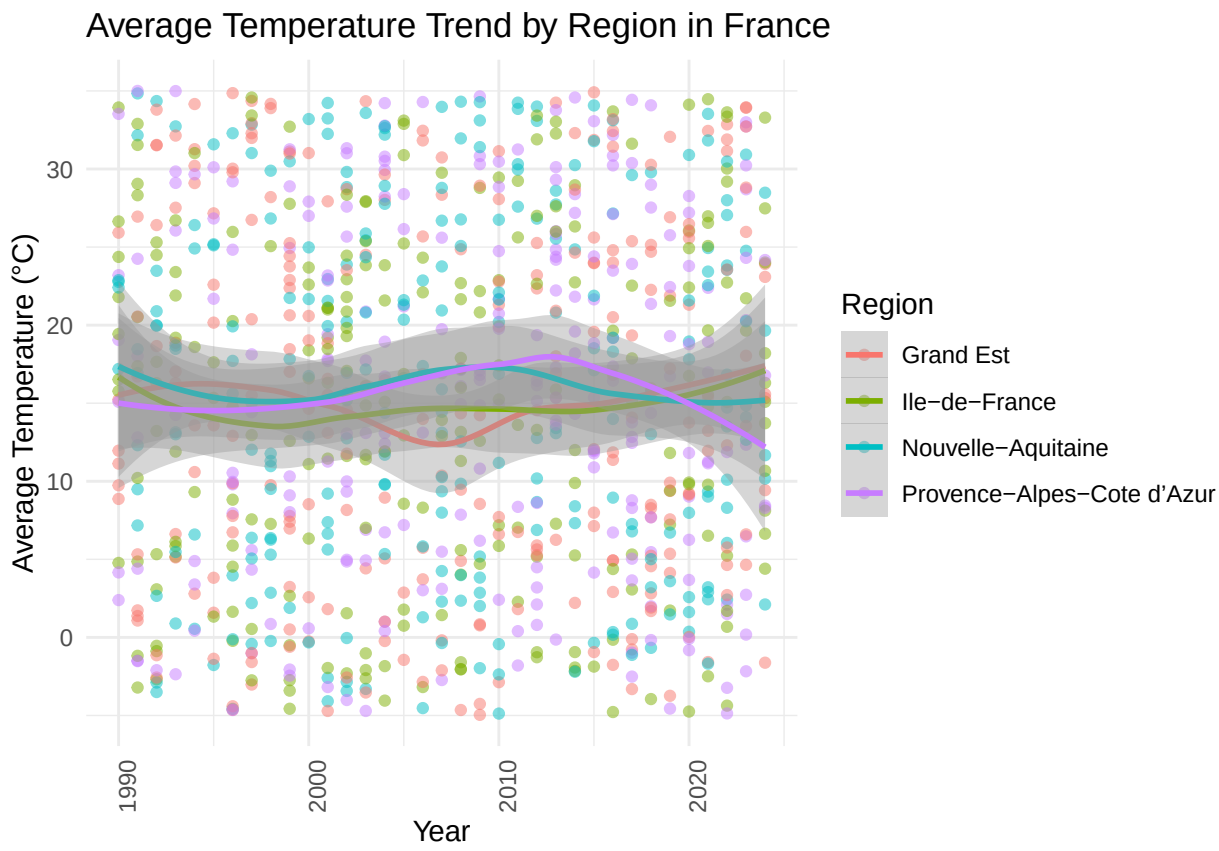
```r
  # Check if the country is in the dataset
  if (nrow(filtered_data) == 0) {
    stop("Country not found in the dataset.")
  }

  # Plot the average temperature trend using facets
  ggplot(filtered_data, aes(x = Year, y = Average_Temperature_C)) +
    geom_line() +
    facet_wrap(~ Region) +
    labs(title = paste("Average Temperature Trend by Region in", country_name),
         x = "Year",
         y = "Average Temperature (°C)") +
    theme_minimal() +
    theme(axis.text.x = element_text(angle = 90, hjust = 1))  # Rotate x-axis labels if needed
}


# Scatter Plot

plot_temp_smooth_country <- function(data, country_name) {
  # Filter the data for the specified country
  filtered_data <- data %>%
    filter(Country == country_name)

  # Check if the country is in the dataset
  if (nrow(filtered_data) == 0) {
    stop("Country not found in the dataset.")
  }

  # Plot scatter plots with smooth lines
  ggplot(filtered_data, aes(x = Year, y = Average_Temperature_C, color = Region)) +
    geom_point(alpha = 0.5) +
    geom_smooth(method = "loess") +
    labs(title = paste("Average Temperature Trend by Region in", country_name),
         x = "Year",
         y = "Average Temperature (°C)") +
    theme_minimal() +
    theme(axis.text.x = element_text(angle = 90, hjust = 1))  # Rotate x-axis labels if needed
}


# Box Plot

plot_temp_boxplot_country <- function(data, country_name) {
  # Filter the data for the specified country
  filtered_data <- data %>%
    filter(Country == country_name)

  # Check if the country is in the dataset
  if (nrow(filtered_data) == 0) {
    stop("Country not found in the dataset.")
  }
```

```
  # Plot a box plot of average temperatures by year and region
  ggplot(filtered_data, aes(x = factor(Year), y = Average_Temperature_C, fill = Region)) +
    geom_boxplot() +
    labs(title = paste("Average Temperature Boxplot by Region in", country_name),
         x = "Year",
         y = "Average Temperature (°C)") +
    theme_minimal() +
    theme(axis.text.x = element_text(angle = 90, hjust = 1))  # Rotate x-axis labels if needed
}


# France
plot_temp_trend_country_facet(Climate_Data, "France")
```

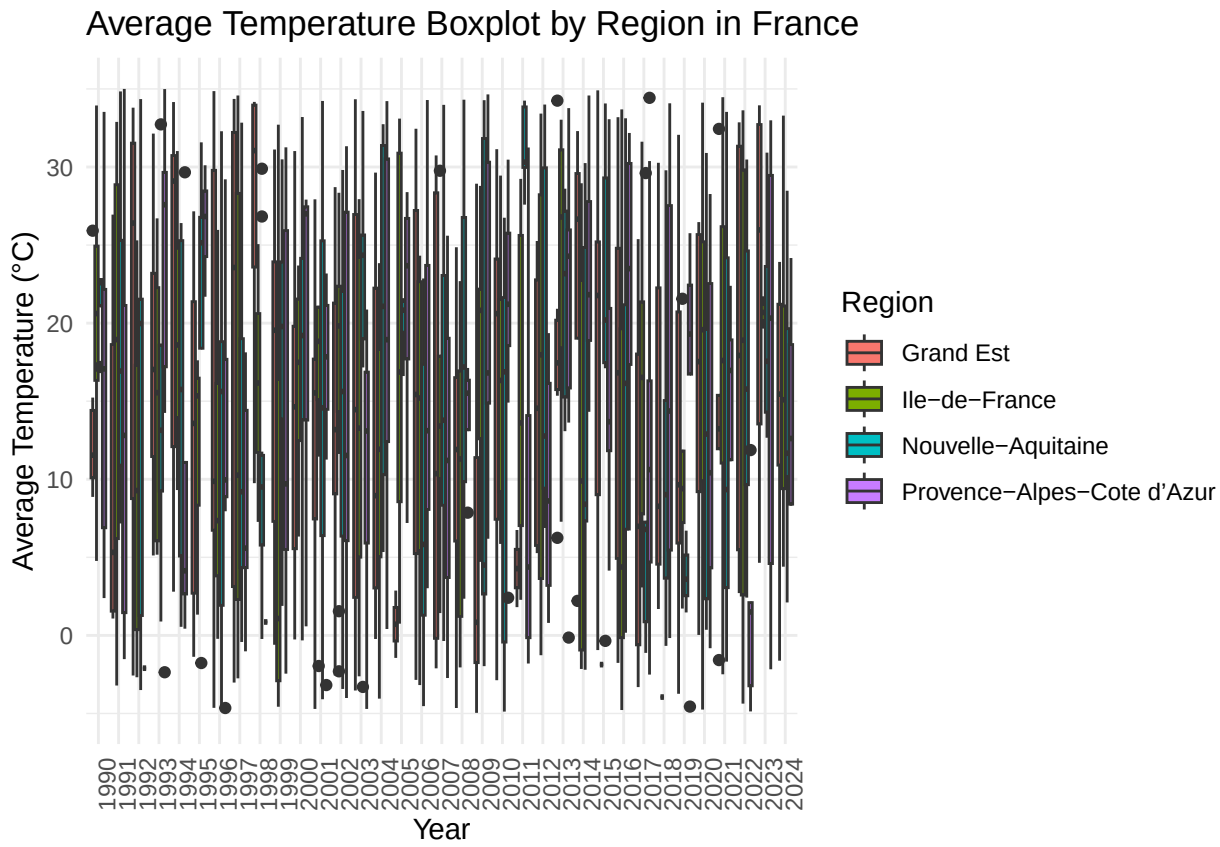



```
plot_temp_smooth_country(Climate_Data, "France")
```

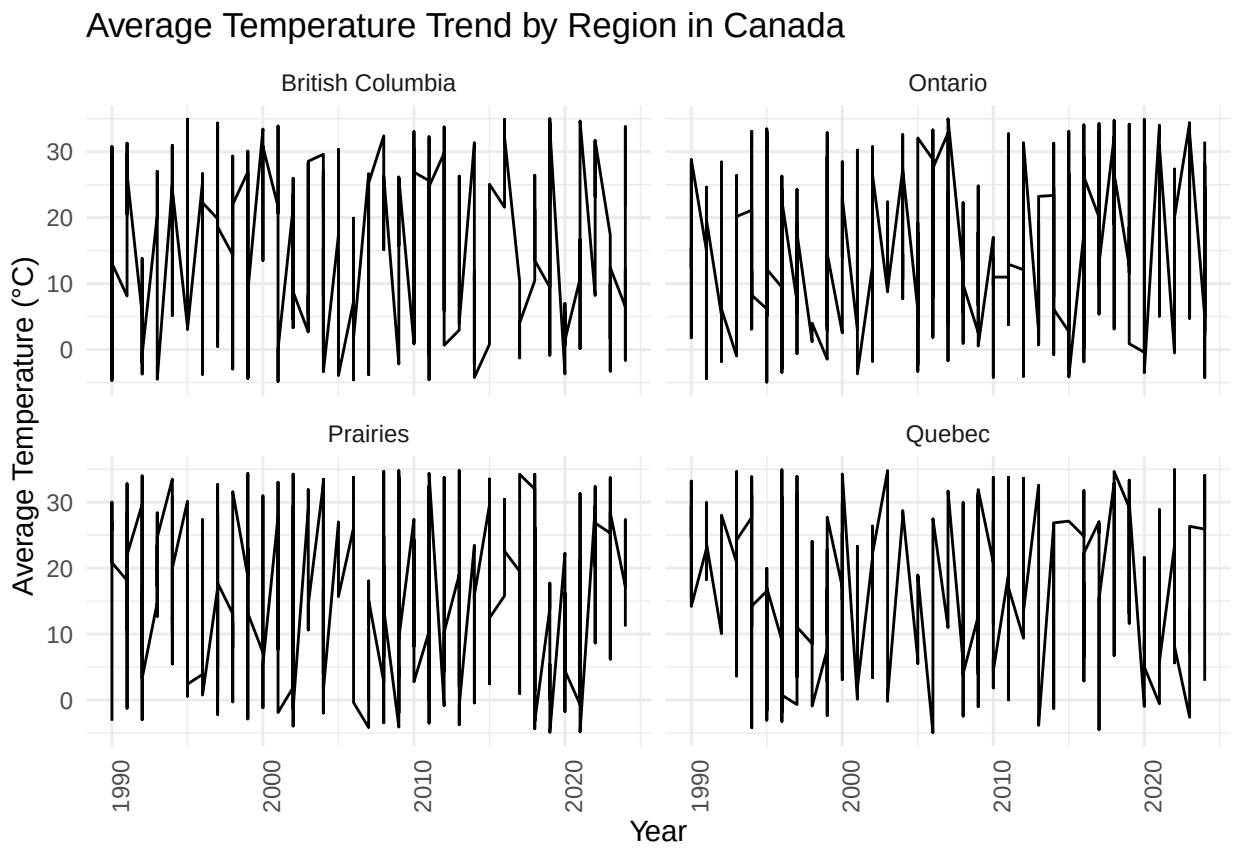
```
## `geom_smooth()` using formula = 'y ~ x'
```




```
plot_temp_boxplot_country(Climate_Data, "France")
```

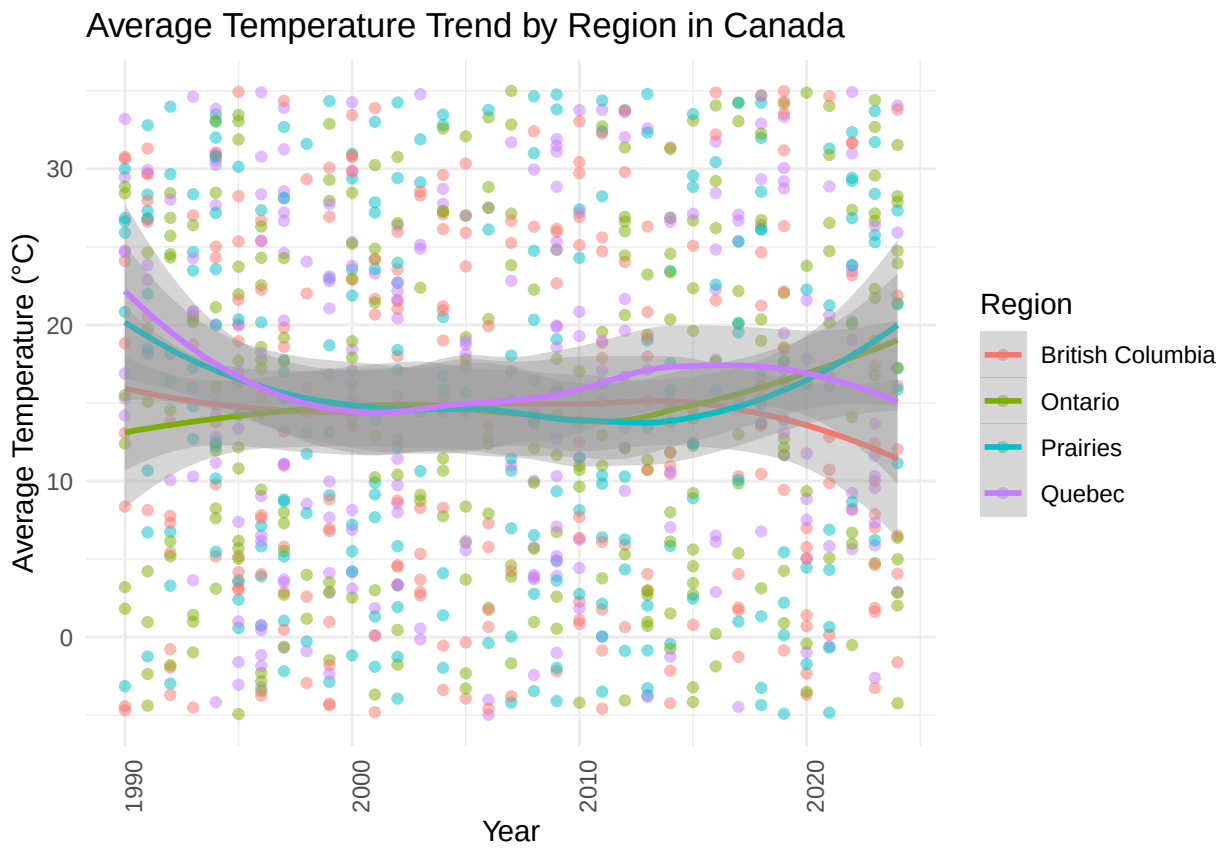



```
# Canada
plot_temp_trend_country_facet(Climate_Data, "Canada")
```

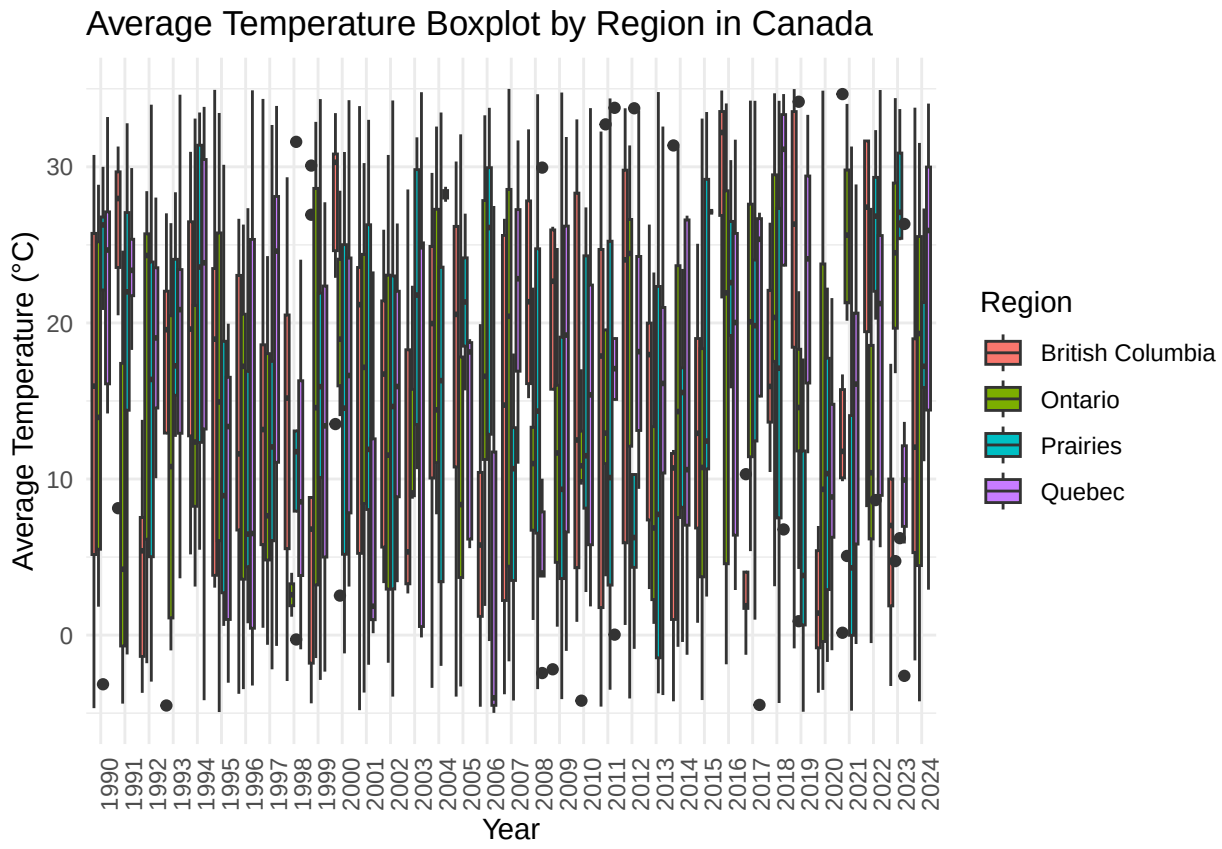



```
plot_temp_smooth_country(Climate_Data, "Canada")
```

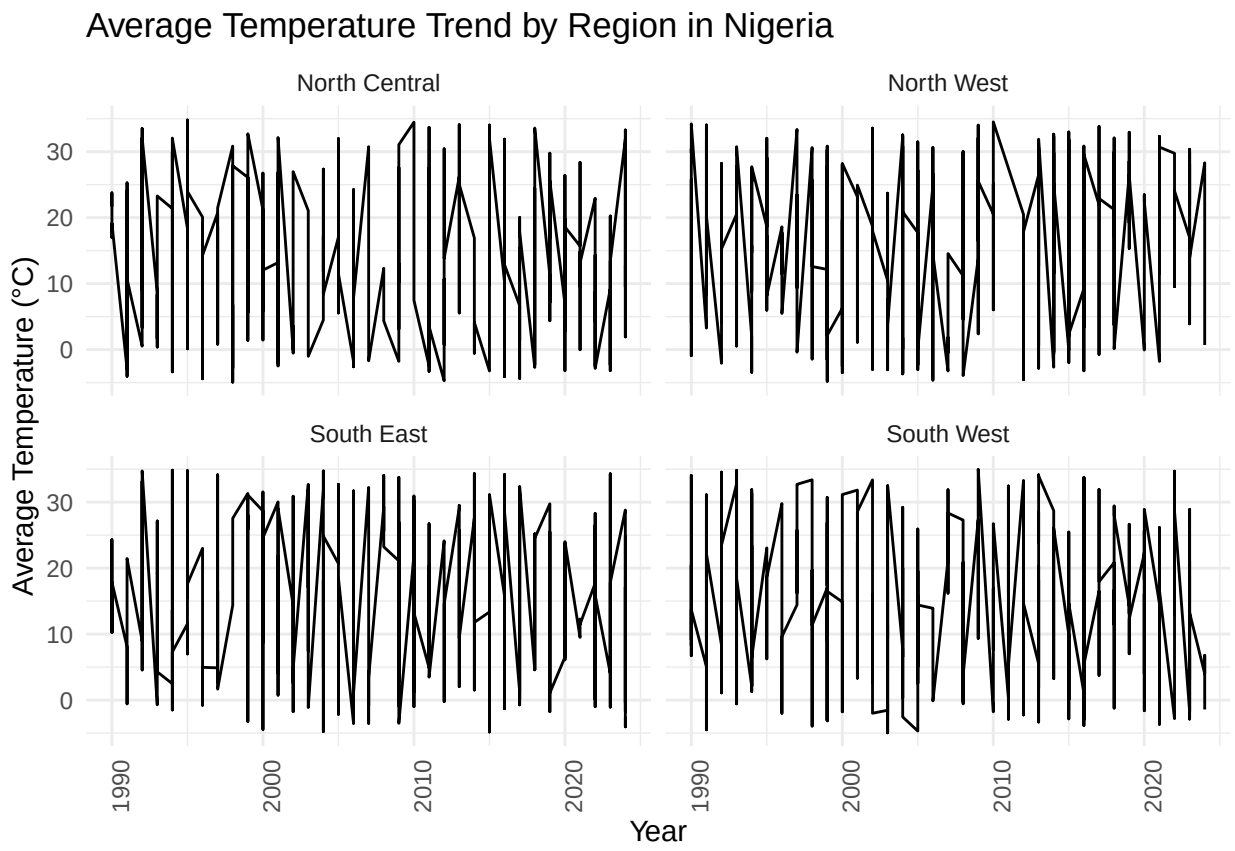
```
## `geom_smooth()` using formula = 'y ~ x'
```




```
plot_temp_boxplot_country(Climate_Data, "Canada")
```

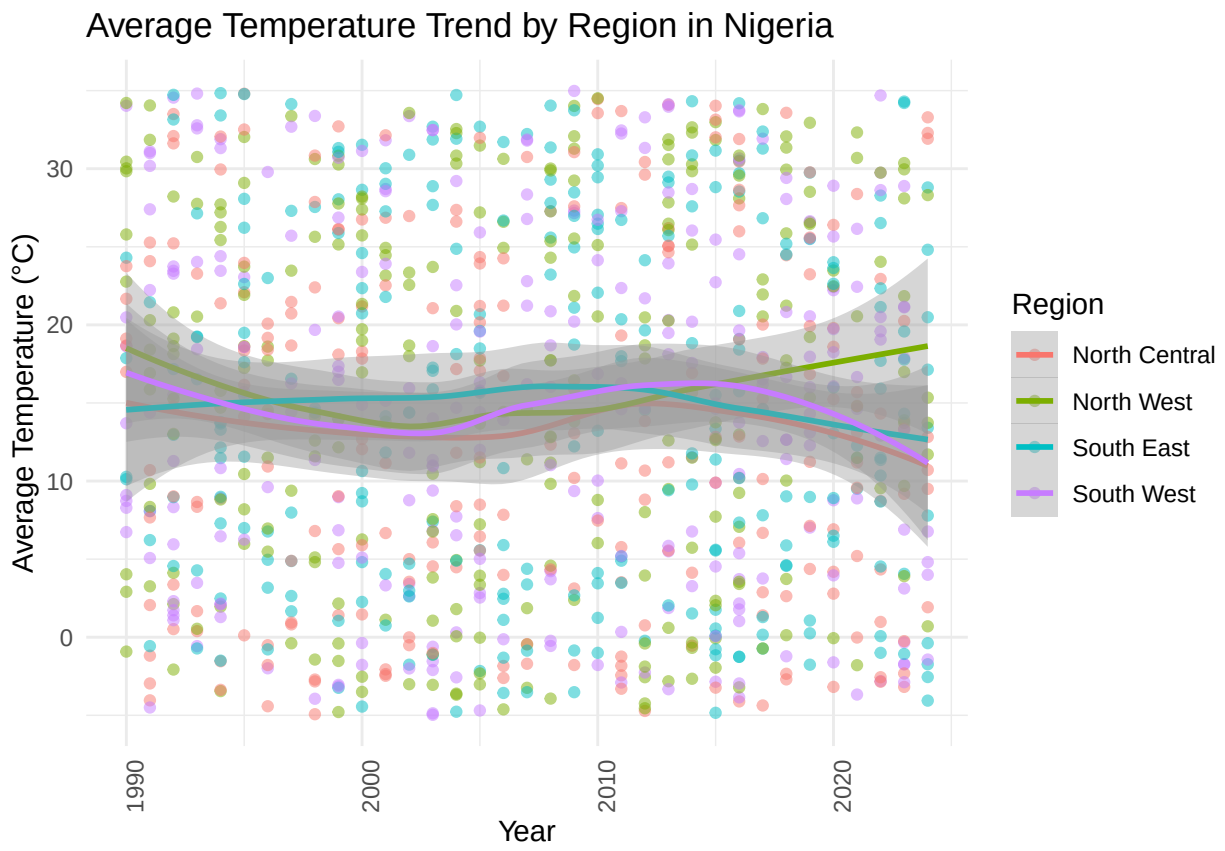



```
# Nigeria
plot_temp_trend_country_facet(Climate_Data, "Nigeria")
```

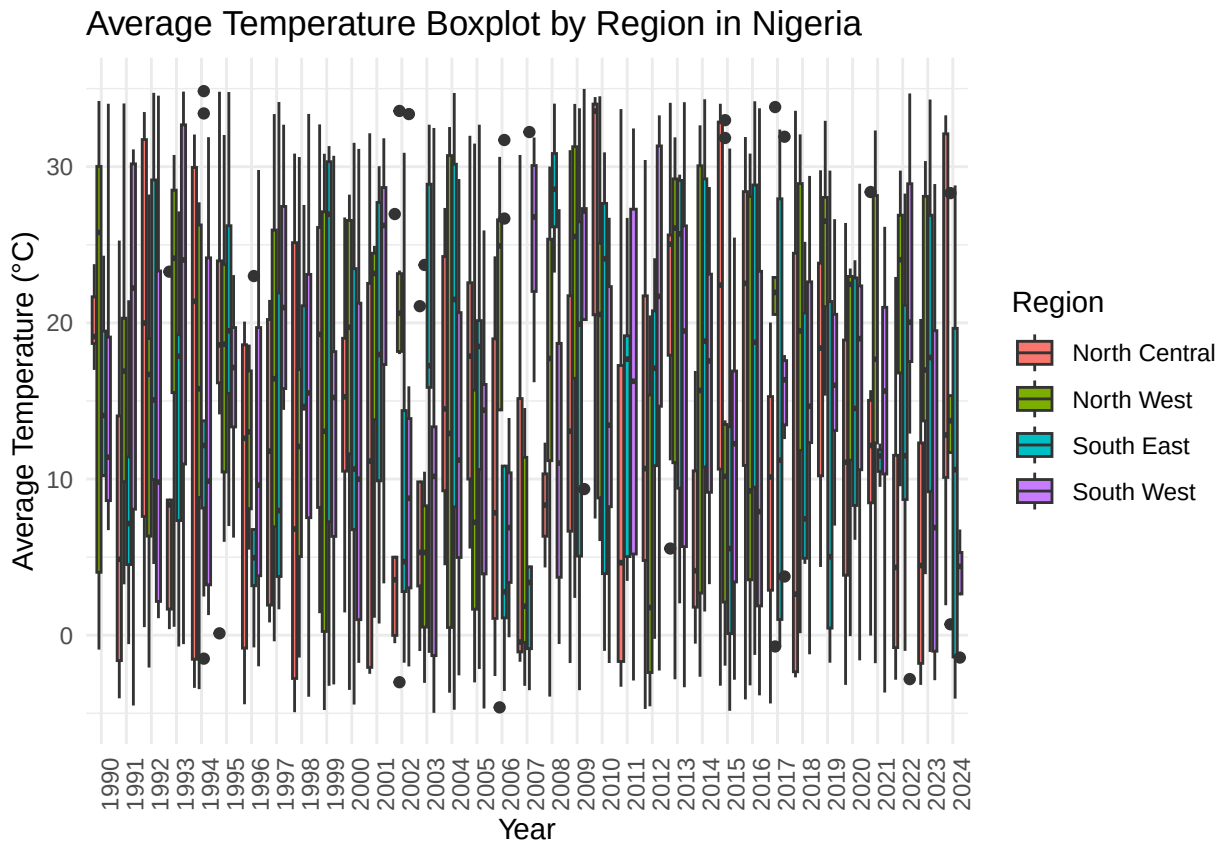



```
plot_temp_smooth_country(Climate_Data, "Nigeria")
```

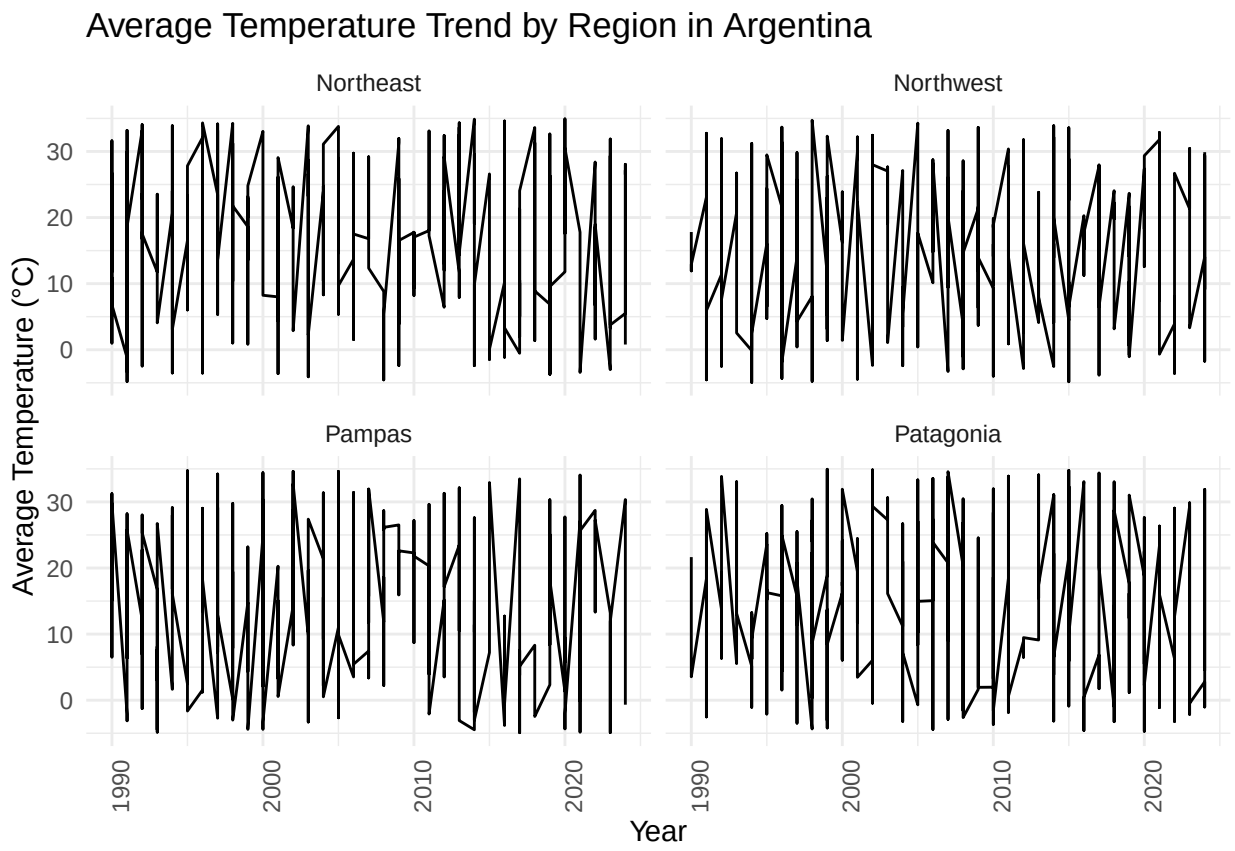
```
## `geom_smooth()` using formula = 'y ~ x'
```




```
plot_temp_boxplot_country(Climate_Data, "Nigeria")
```

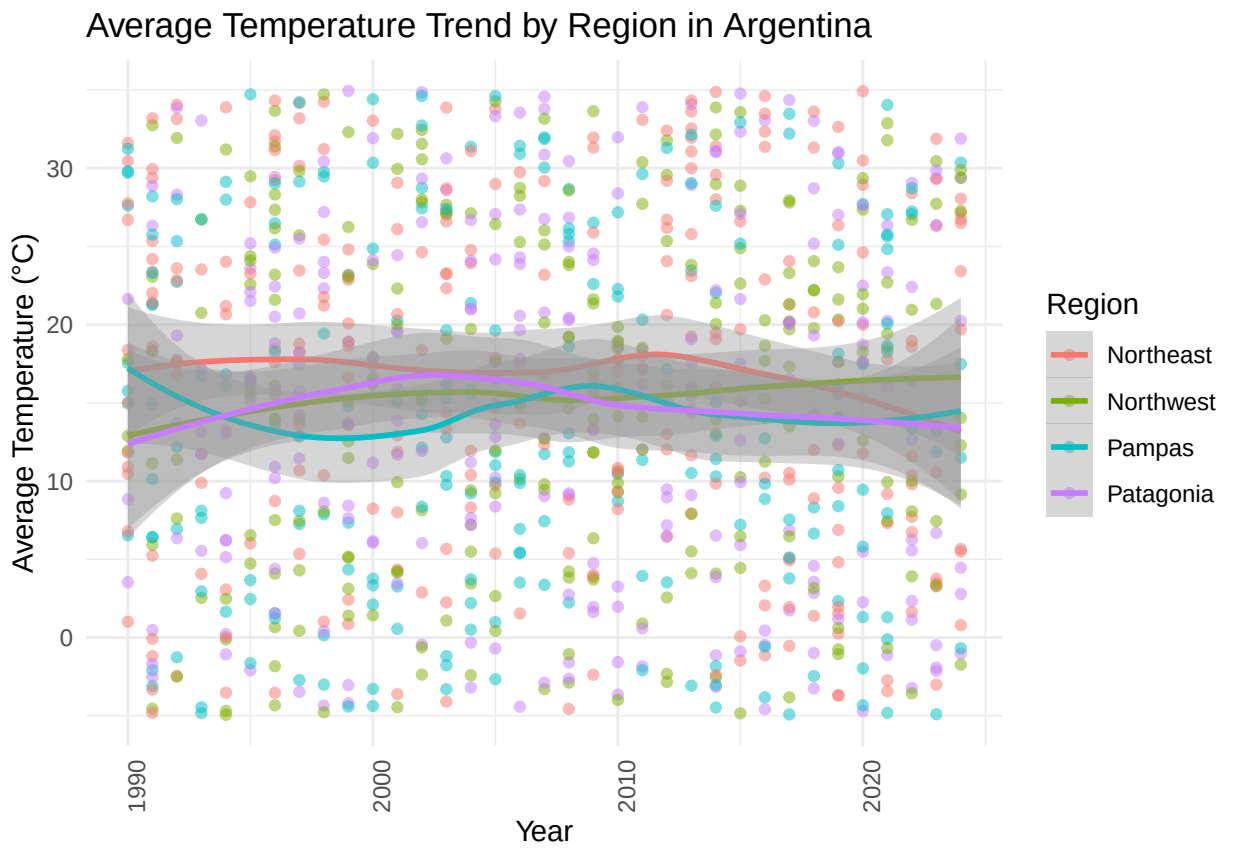



```
# Argentina
plot_temp_trend_country_facet(Climate_Data, "Argentina")
```

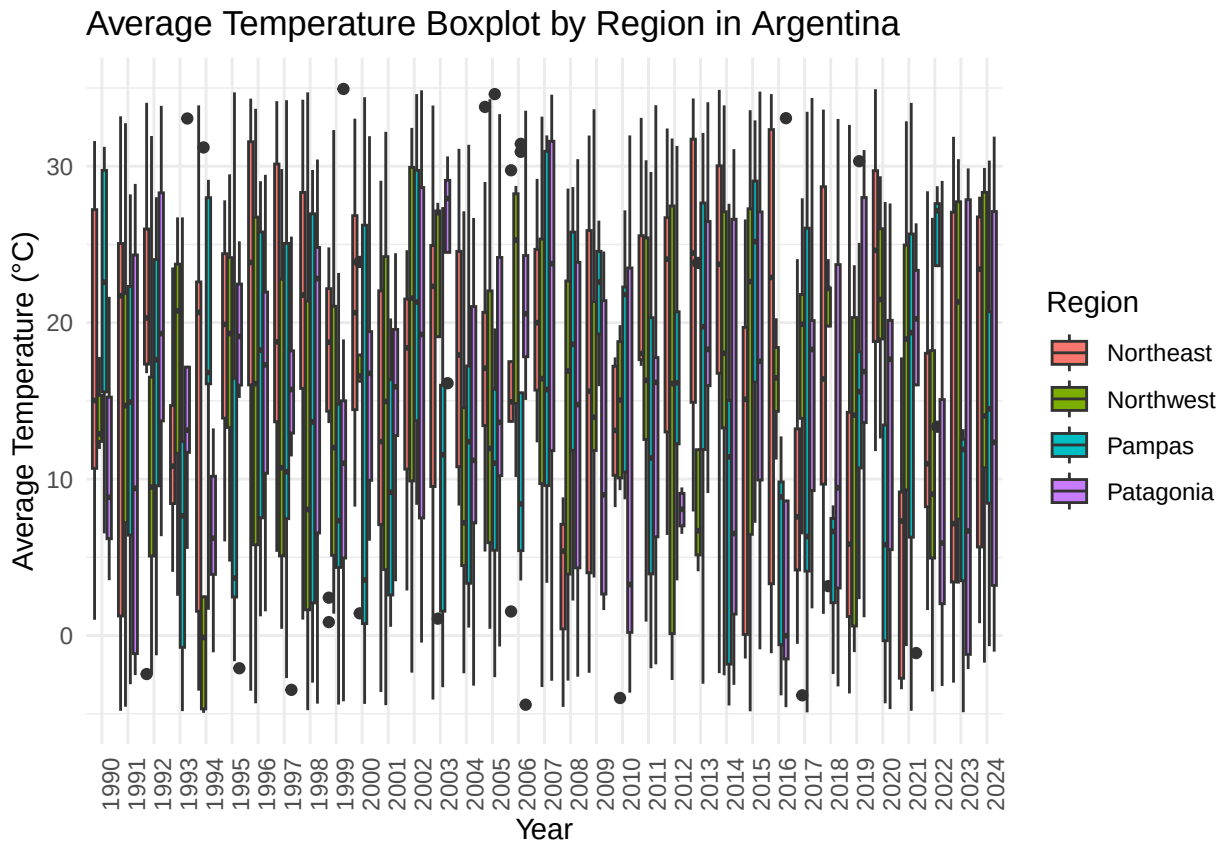



```
plot_temp_smooth_country(Climate_Data, "Argentina")
```

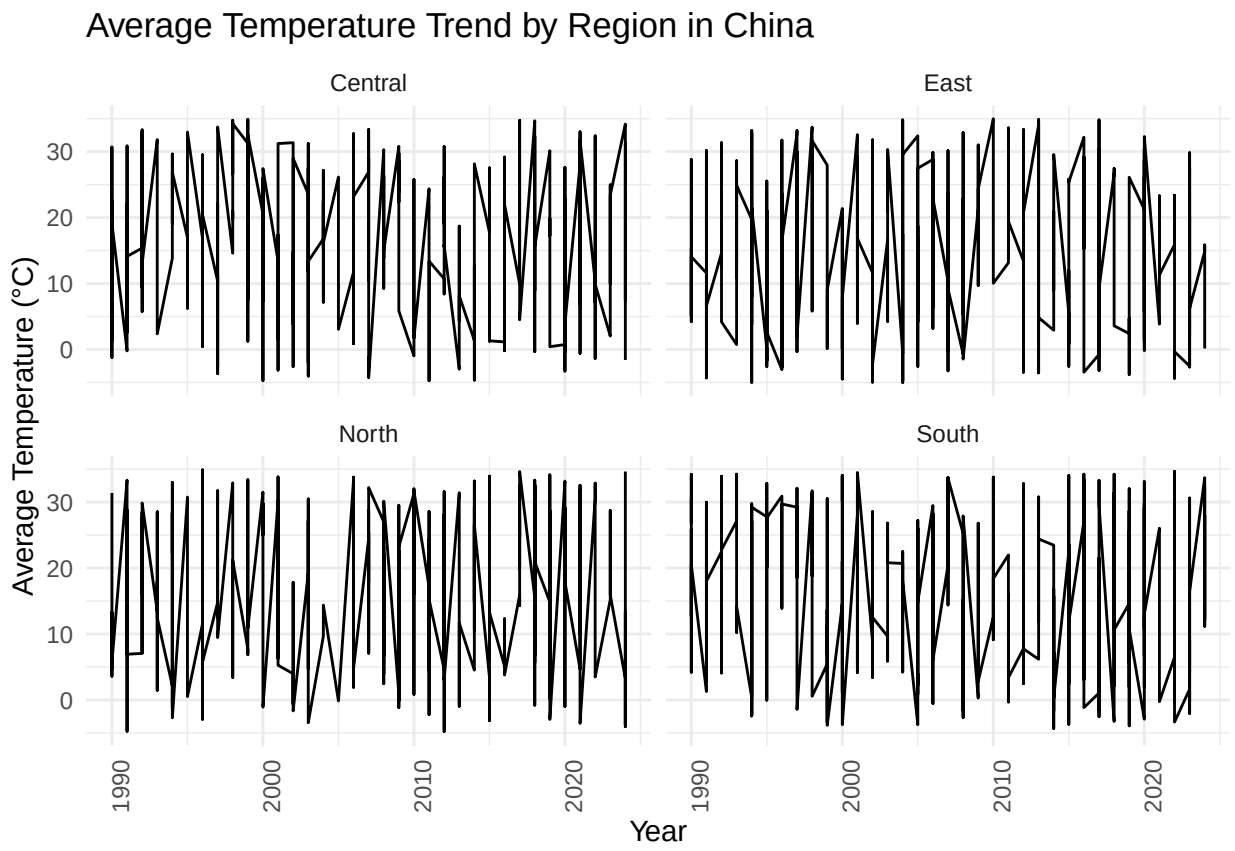
```
## `geom_smooth()` using formula = 'y ~ x'
```




```
plot_temp_boxplot_country(Climate_Data, "Argentina")
```

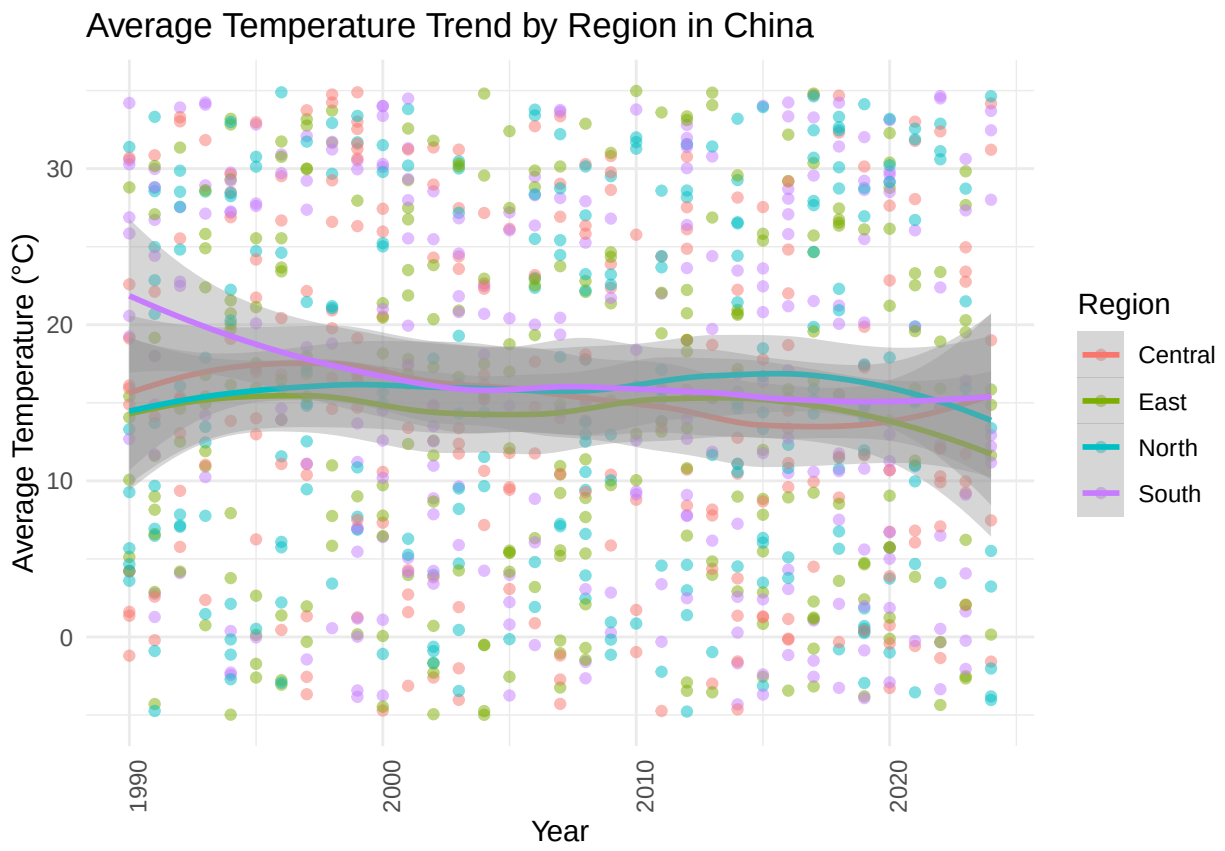



```
# China
plot_temp_trend_country_facet(Climate_Data, "China")
```

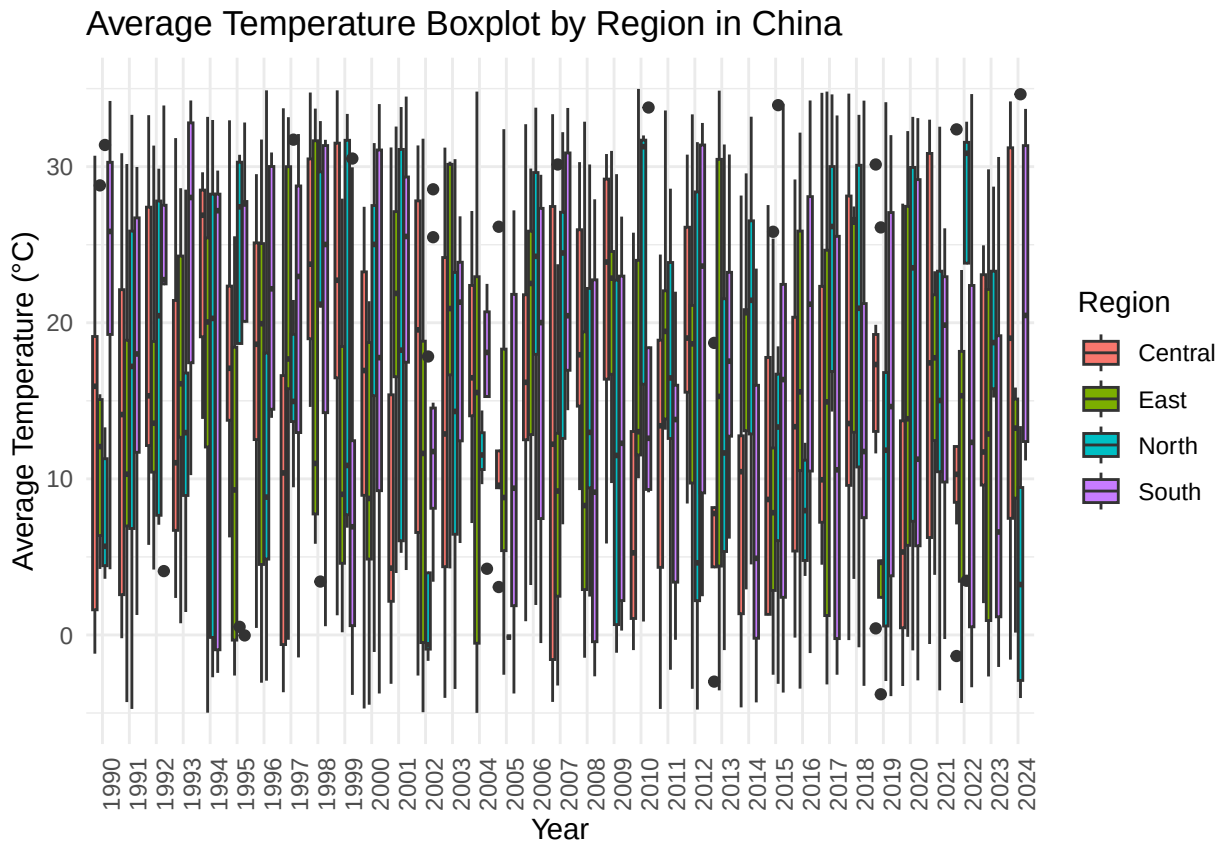



```
plot_temp_smooth_country(Climate_Data, "China")
```

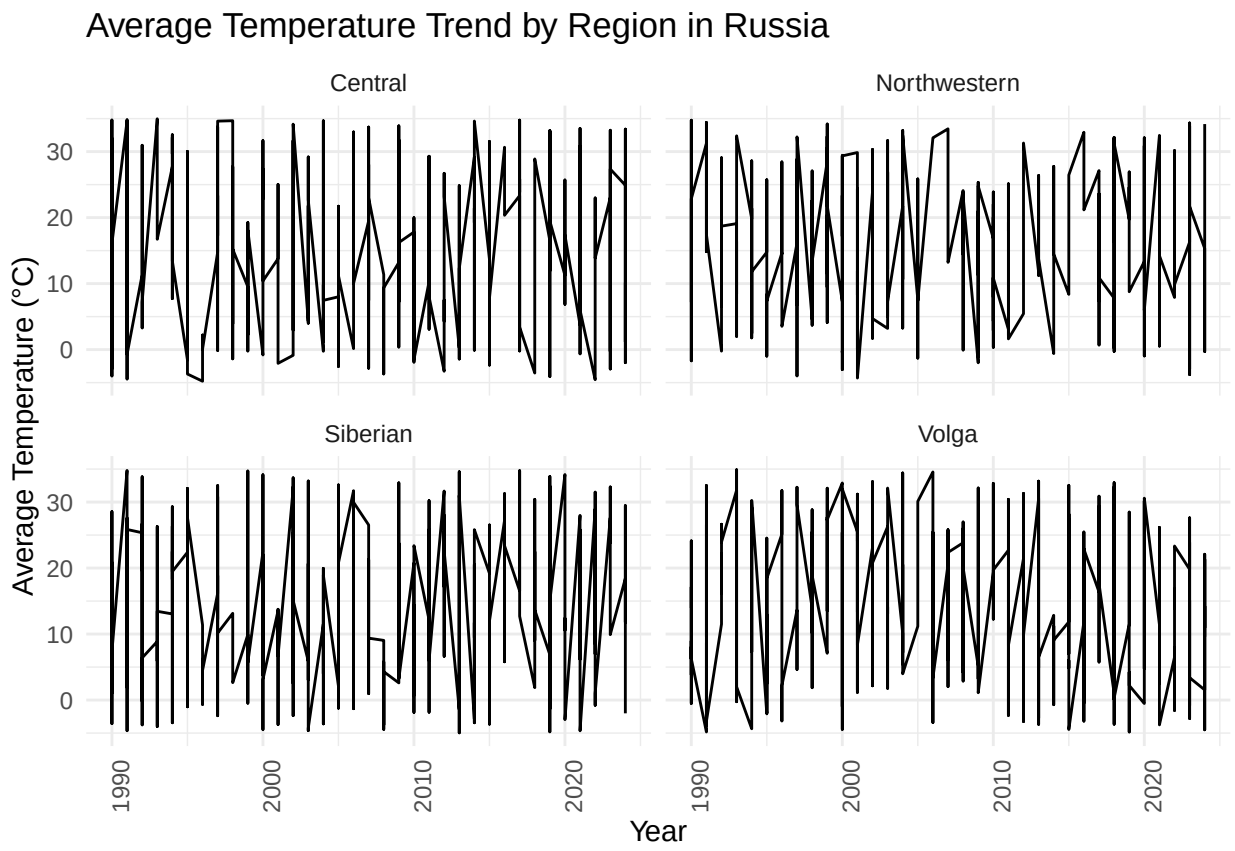
```
## `geom_smooth()` using formula = 'y ~ x'
```




```
plot_temp_boxplot_country(Climate_Data, "China")
```

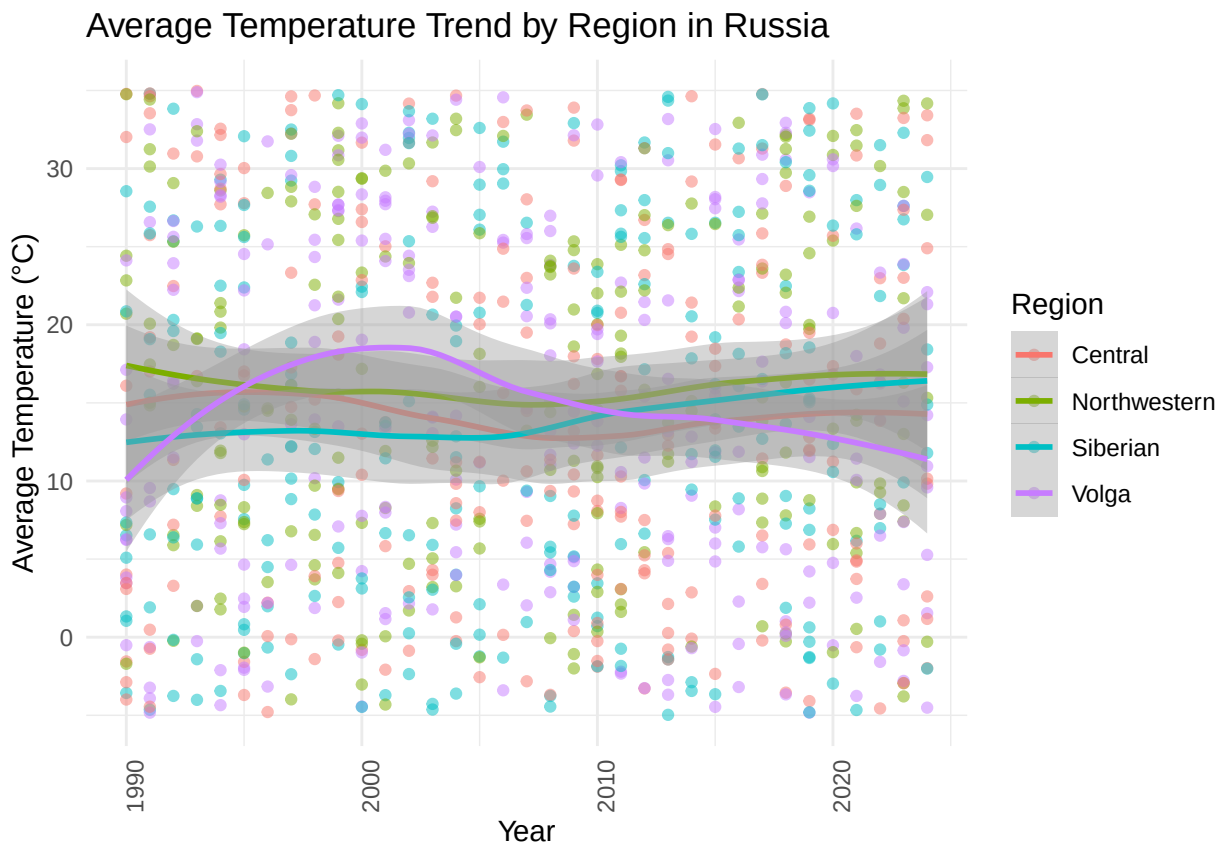



```
# Russia
plot_temp_trend_country_facet(Climate_Data, "Russia")
```

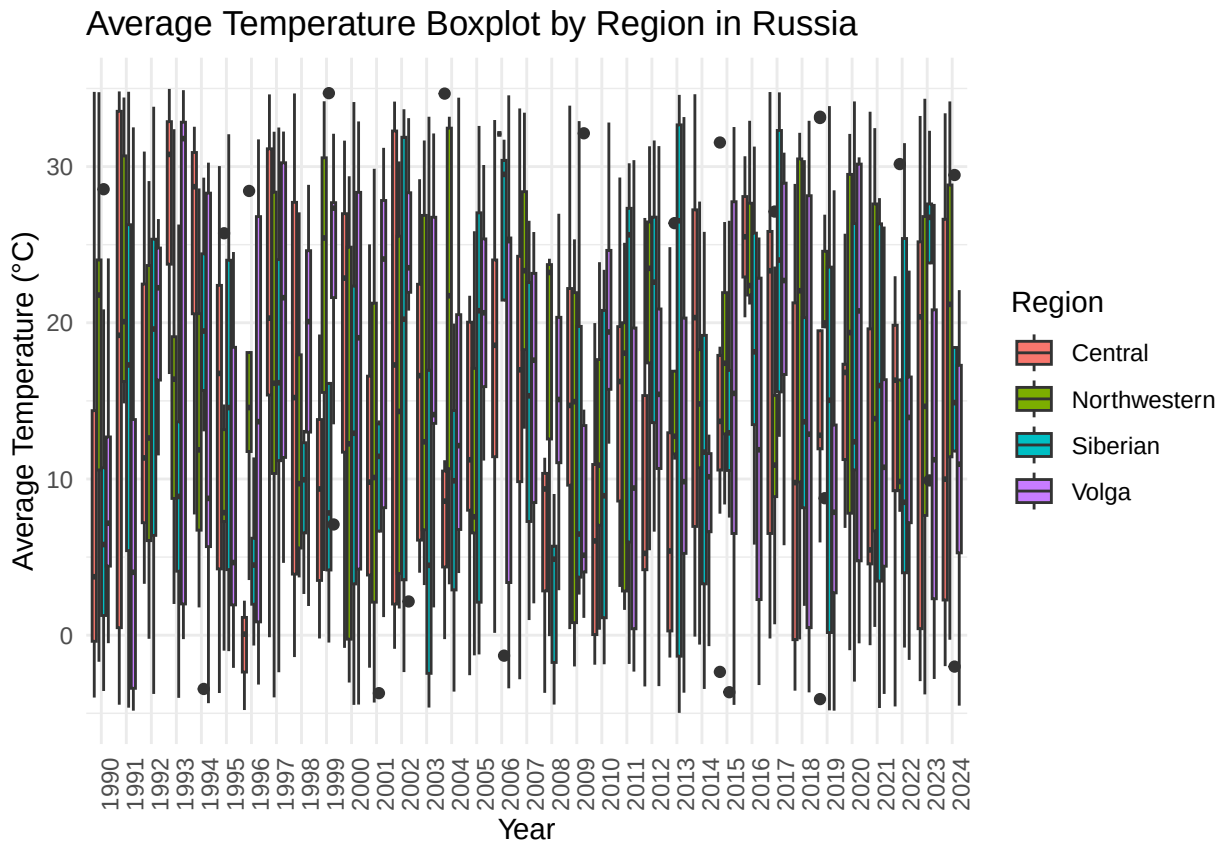



```
plot_temp_smooth_country(Climate_Data, "Russia")
```

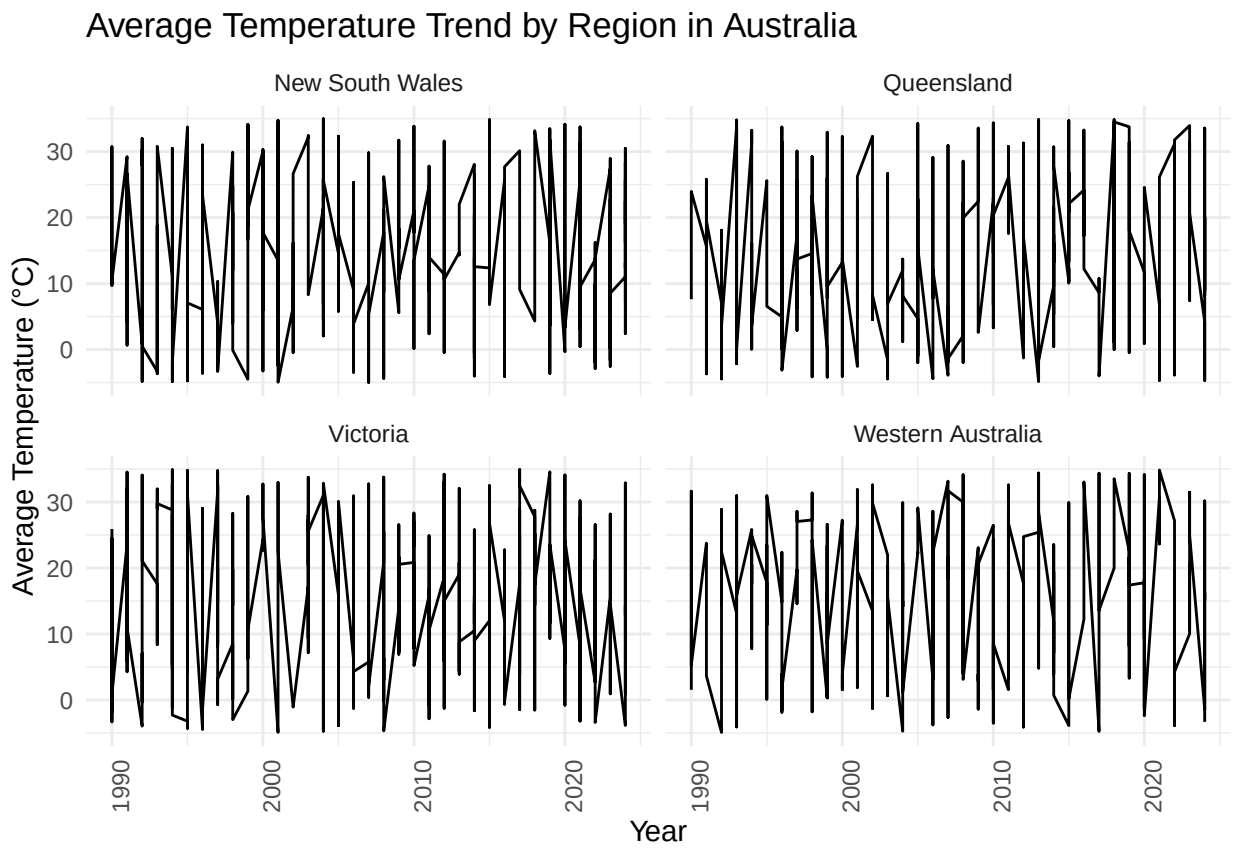
```
## `geom_smooth()` using formula = 'y ~ x'
```




```
plot_temp_boxplot_country(Climate_Data, "Russia")
```

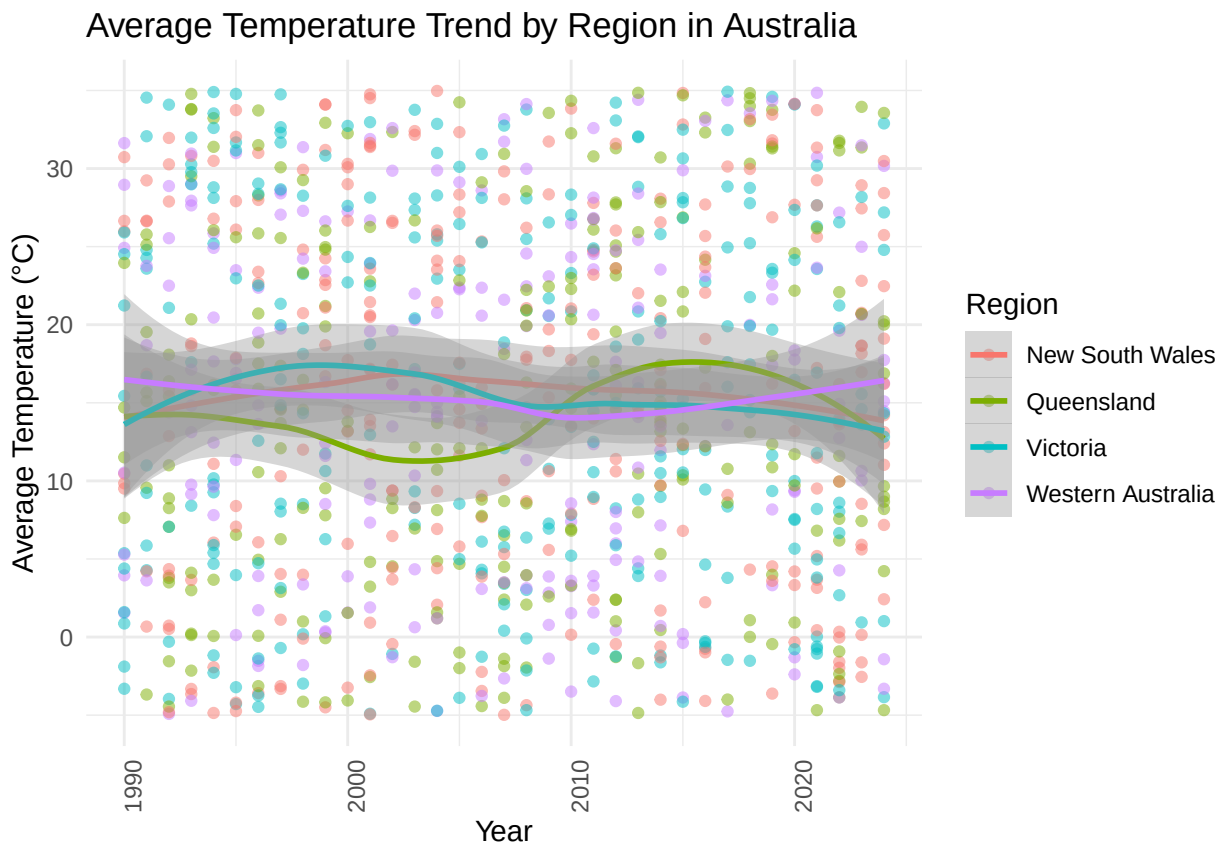



```
# Australia
plot_temp_trend_country_facet(Climate_Data, "Australia")
```

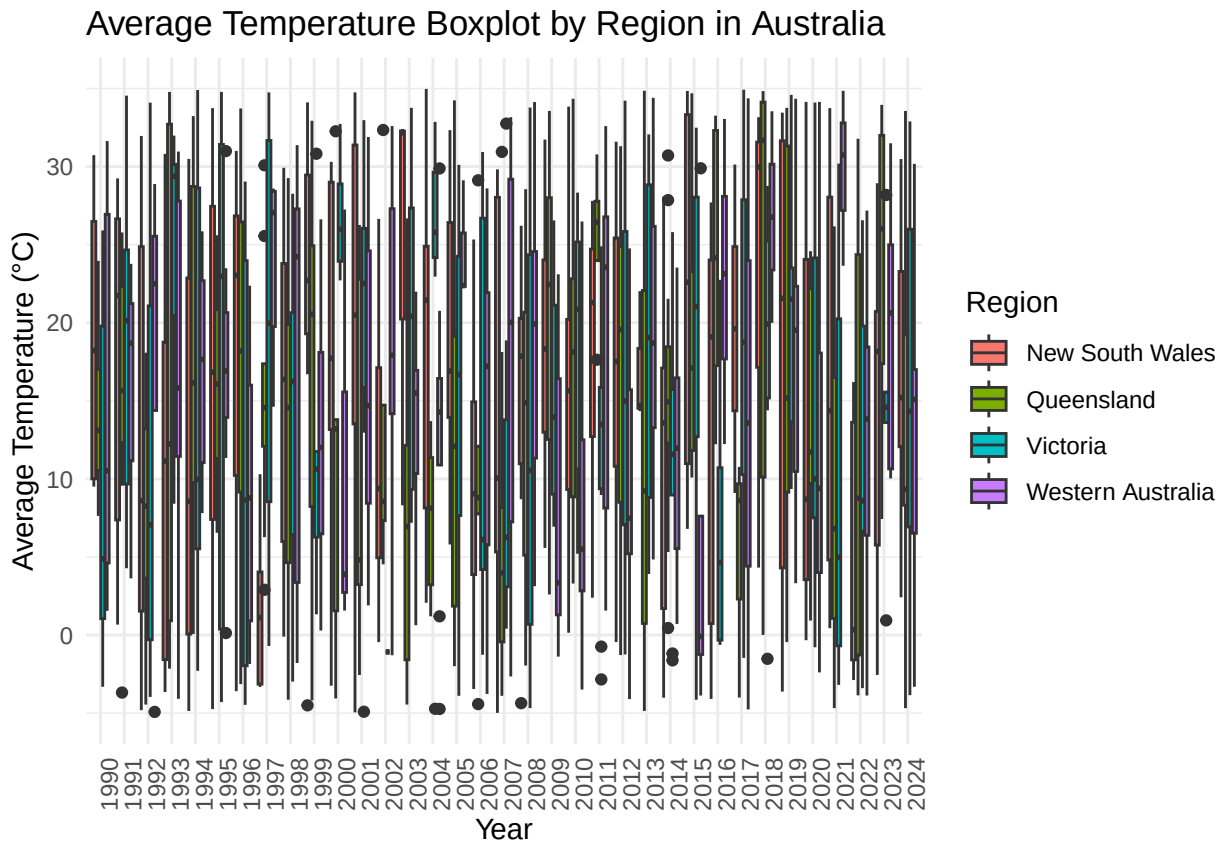



```
plot_temp_smooth_country(Climate_Data, "Australia")
```

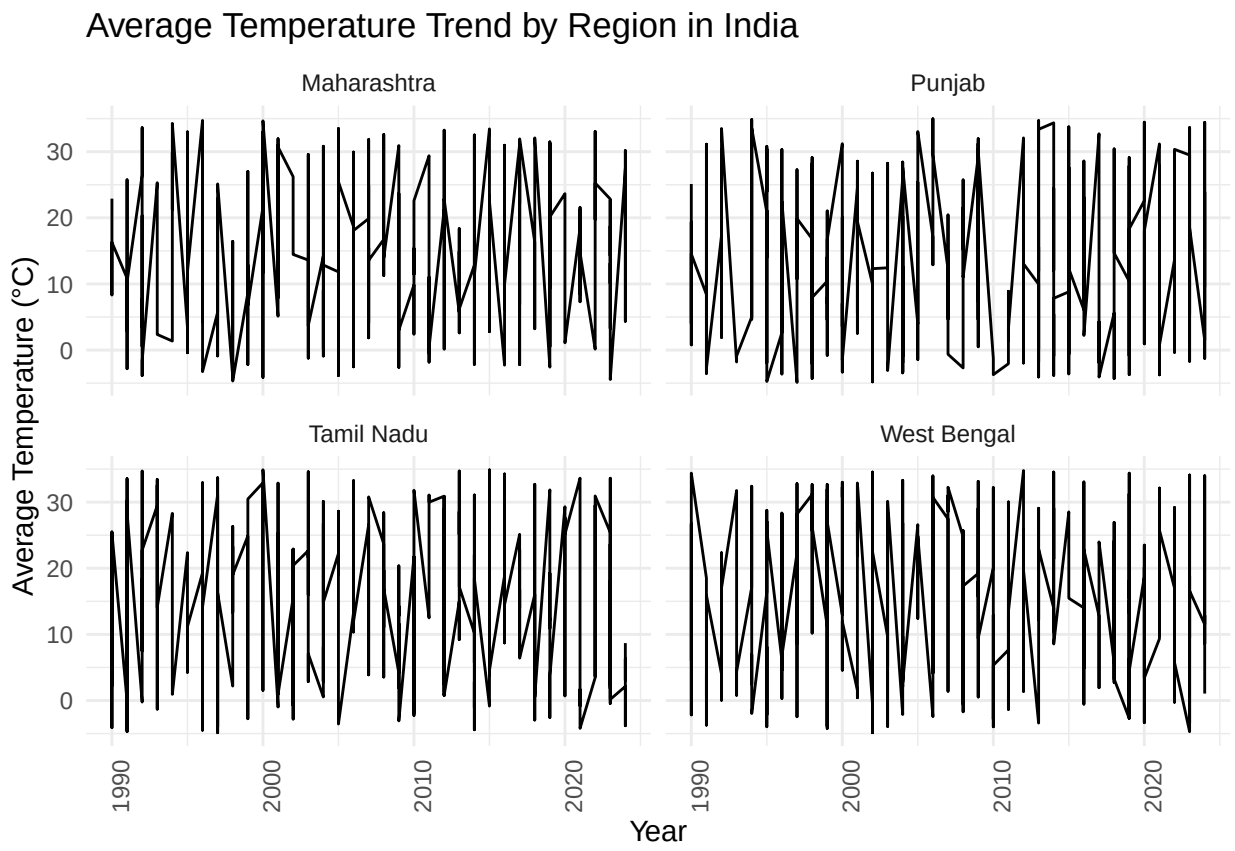
```
## `geom_smooth()` using formula = 'y ~ x'
```




```
plot_temp_boxplot_country(Climate_Data, "Australia")
```

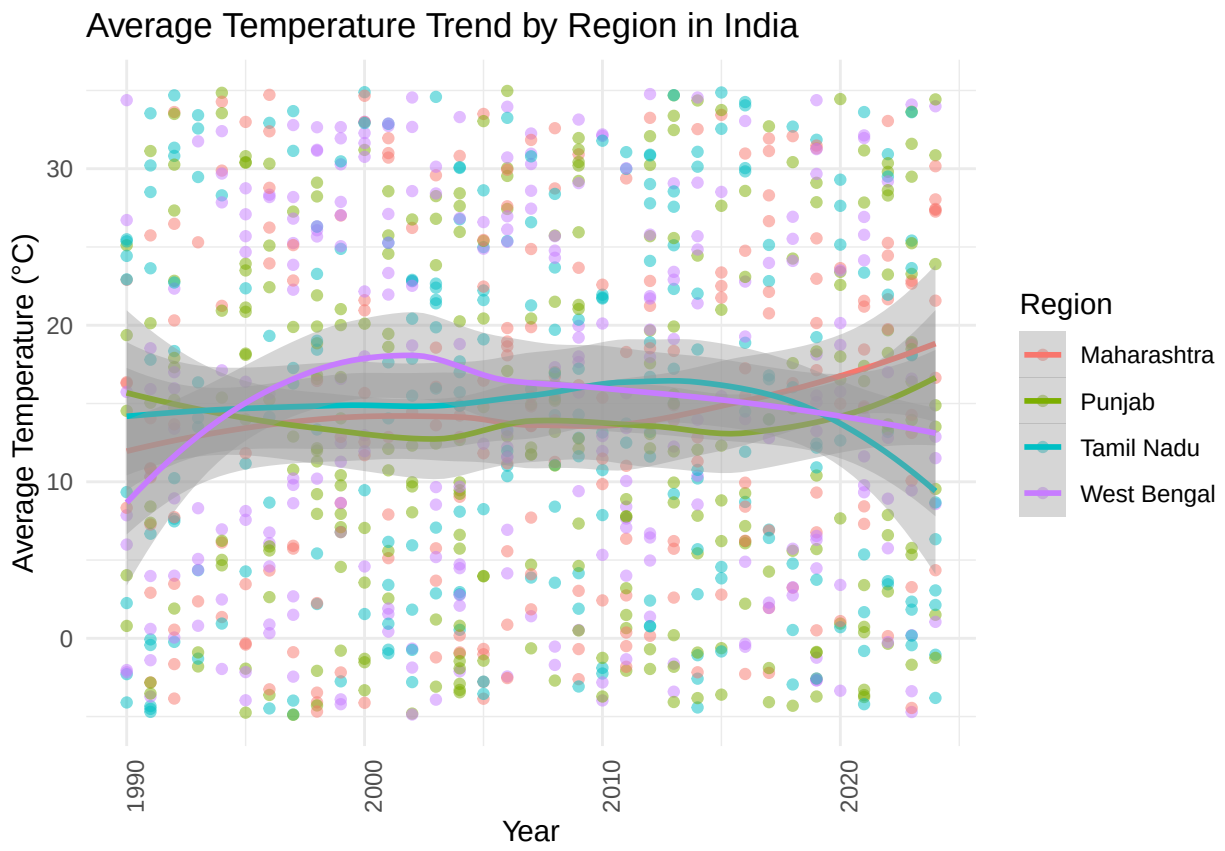



```
# India
plot_temp_trend_country_facet(Climate_Data, "India")
```

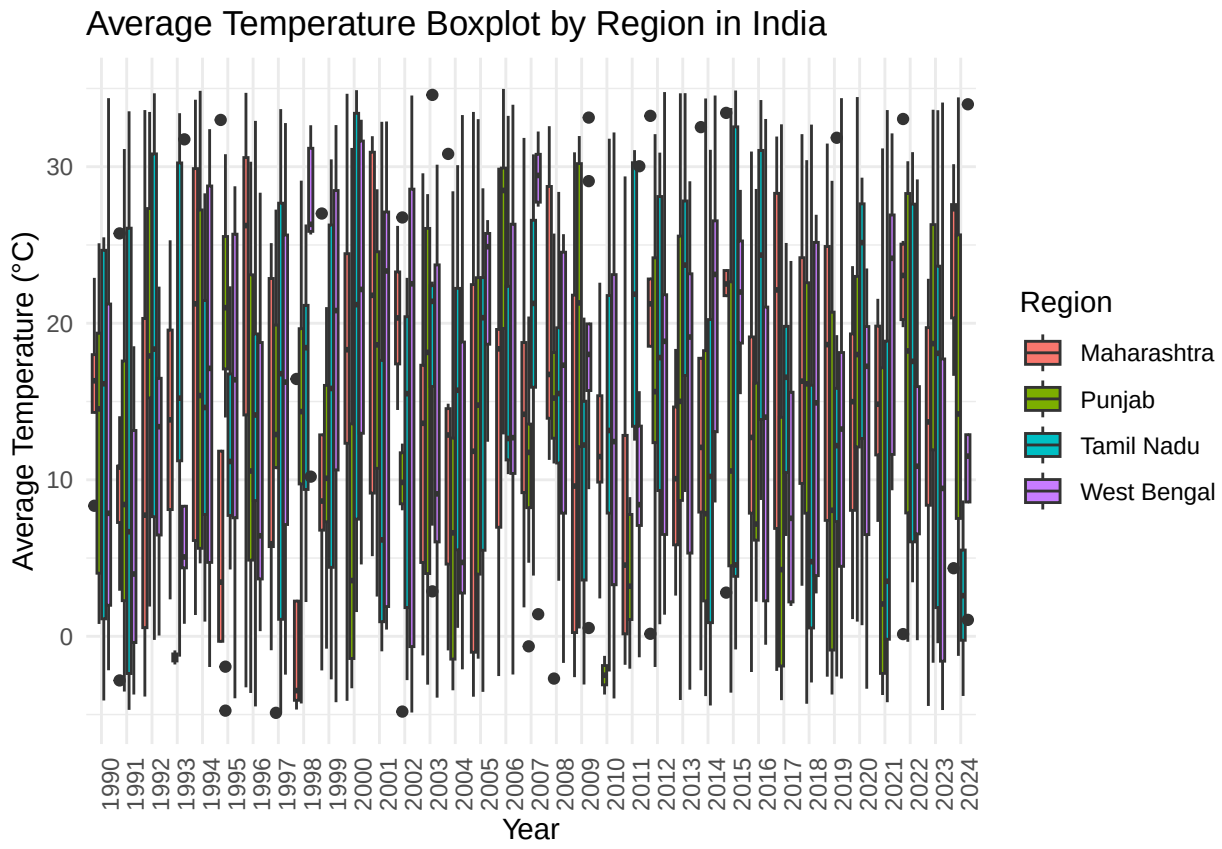



```
plot_temp_smooth_country(Climate_Data, "India")
```

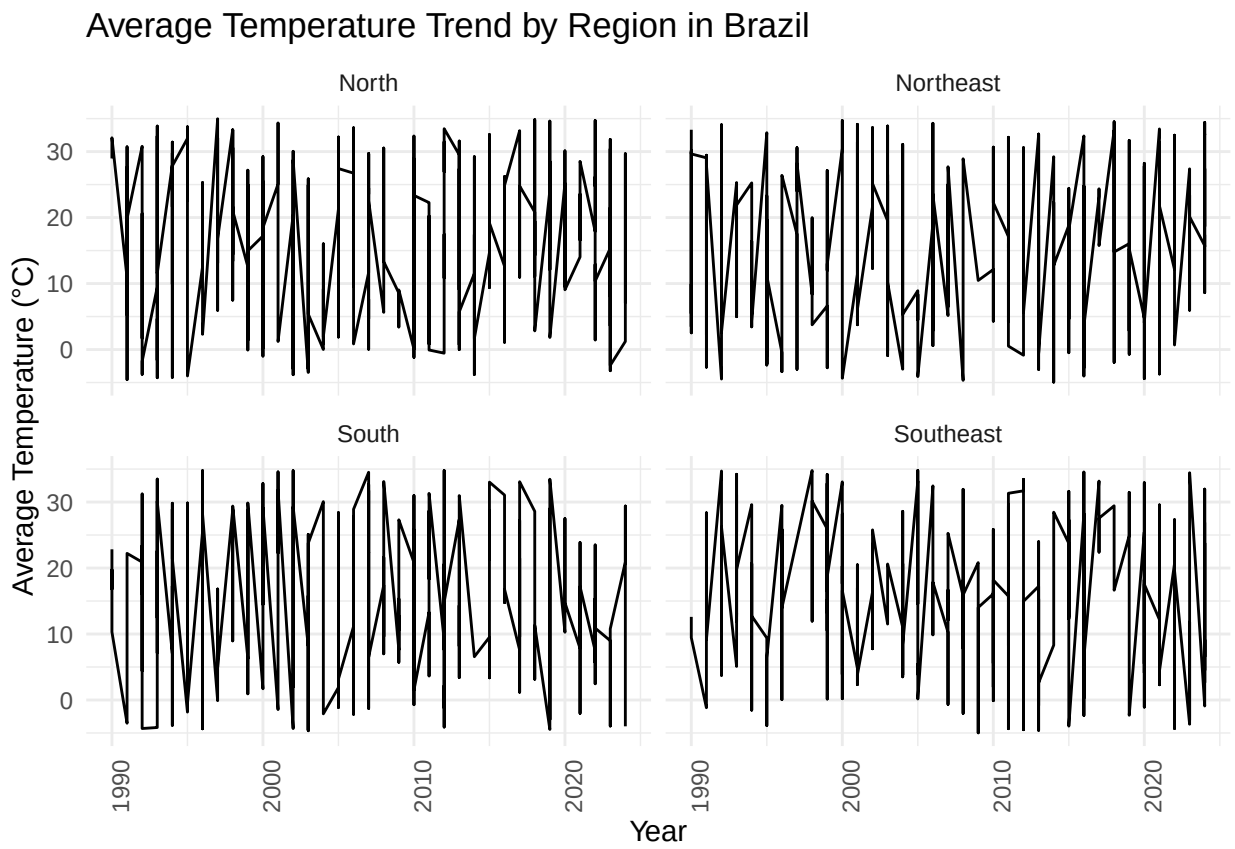
```
## `geom_smooth()` using formula = 'y ~ x'
```




```
plot_temp_boxplot_country(Climate_Data, "India")
```

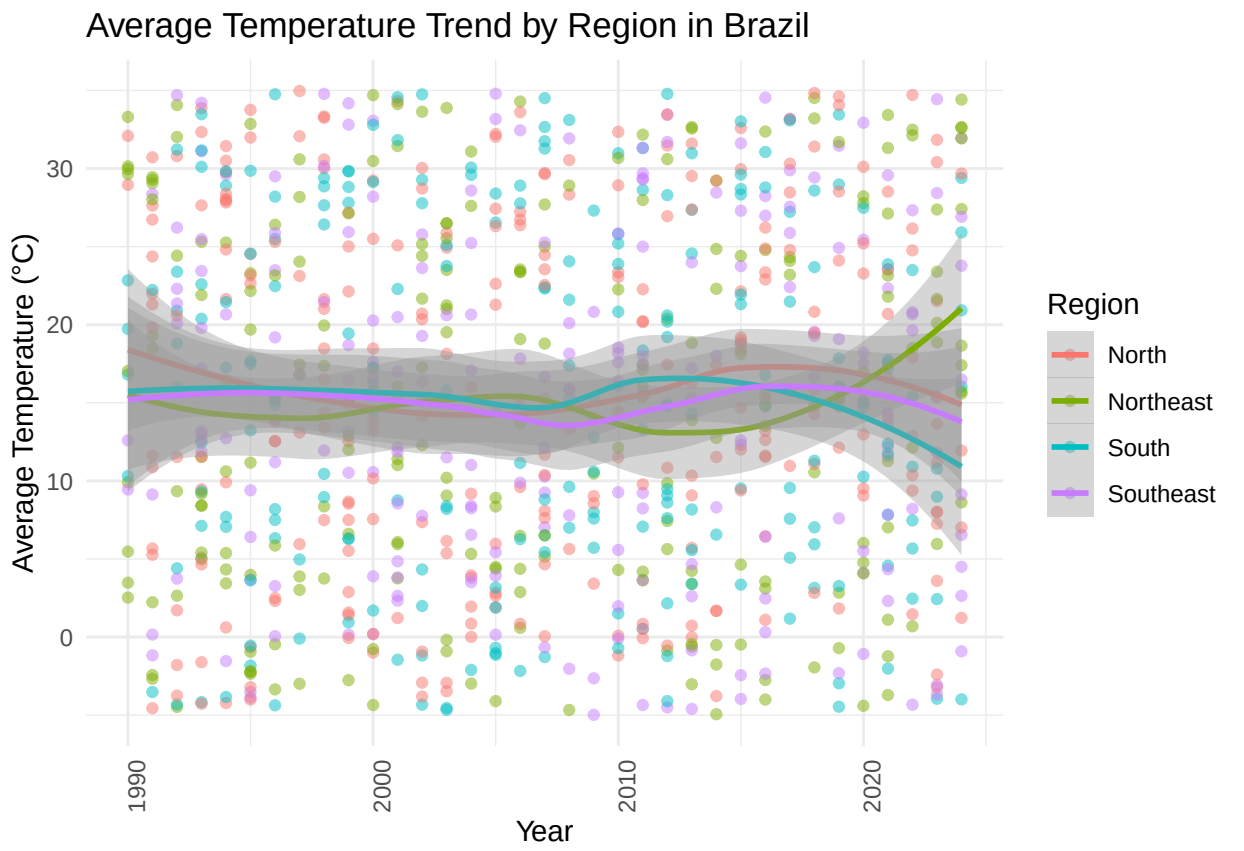



```
# Brazil
plot_temp_trend_country_facet(Climate_Data, "Brazil")
```

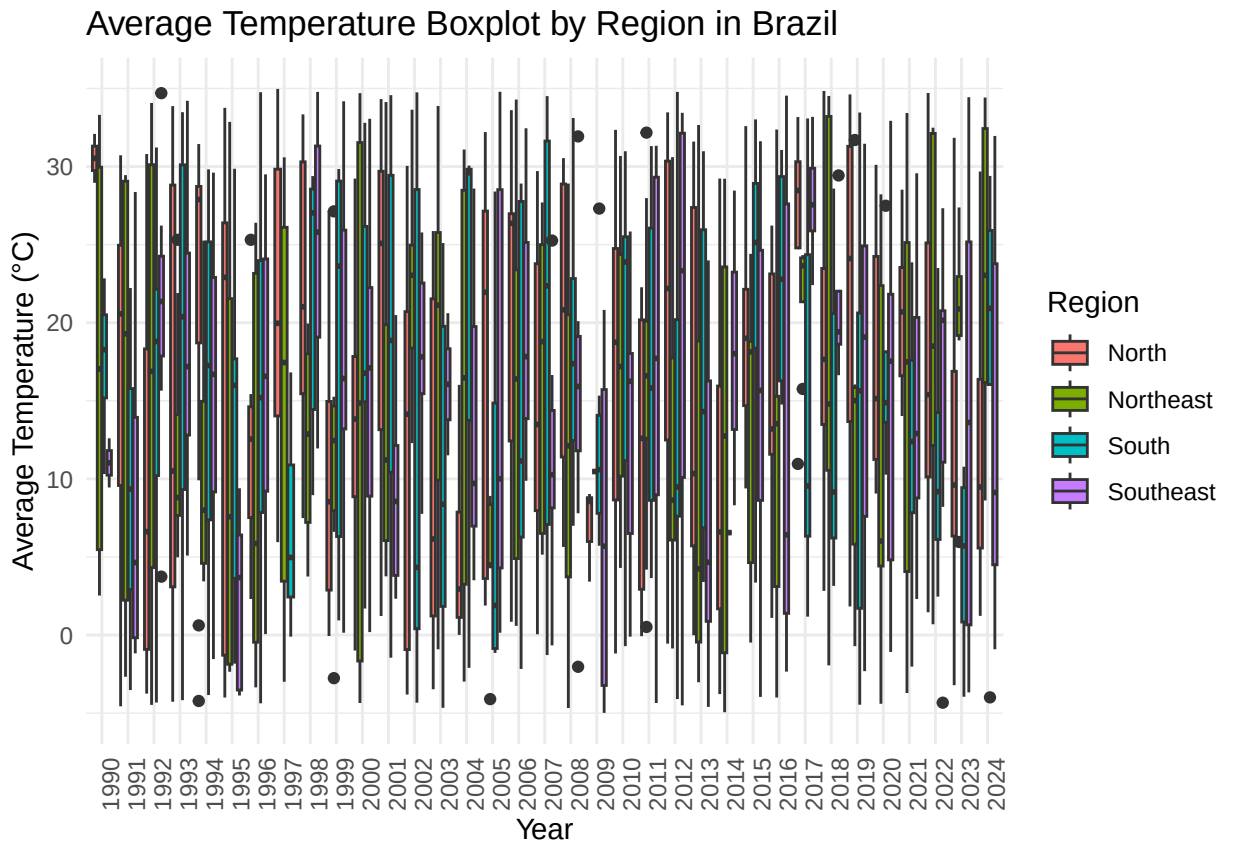



```
plot_temp_smooth_country(Climate_Data, "Brazil")
```

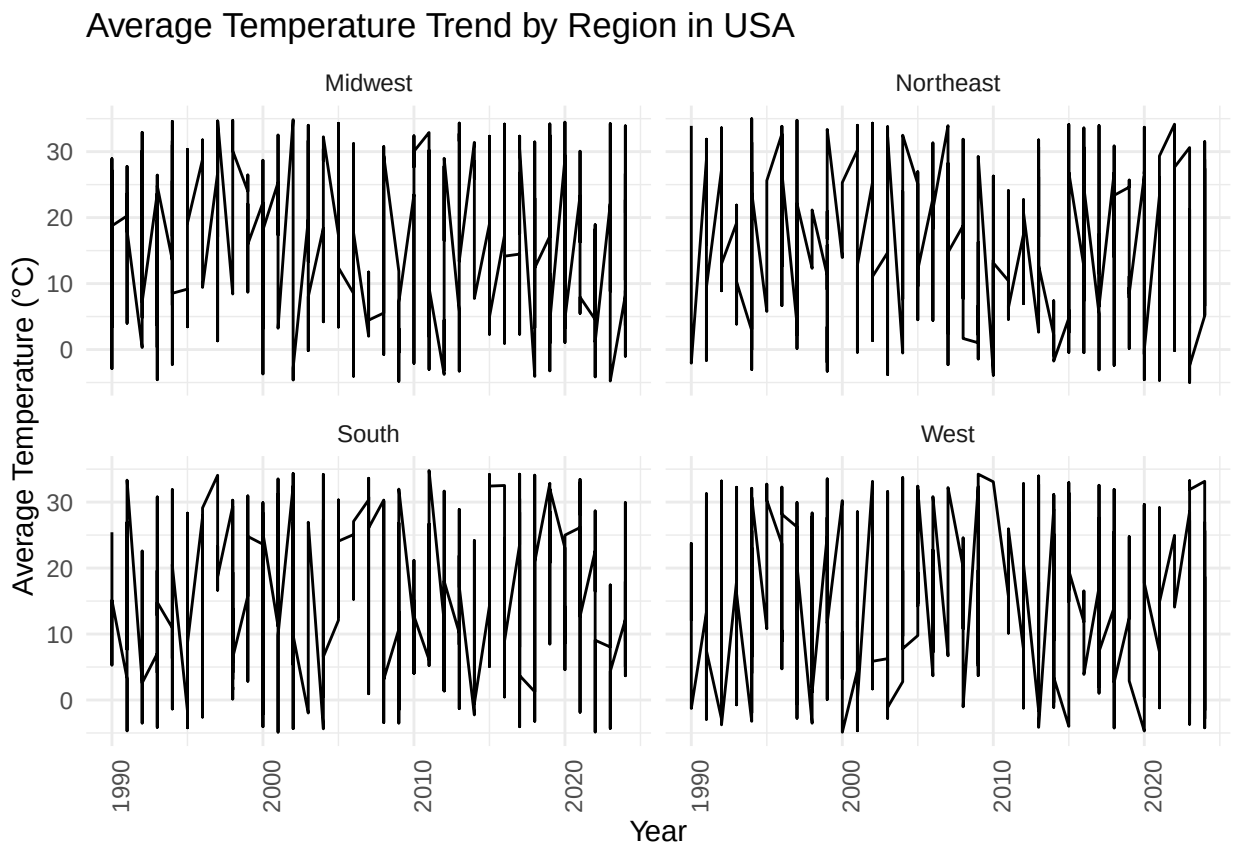
```
## `geom_smooth()` using formula = 'y ~ x'
```




```
plot_temp_boxplot_country(Climate_Data, "Brazil")
```

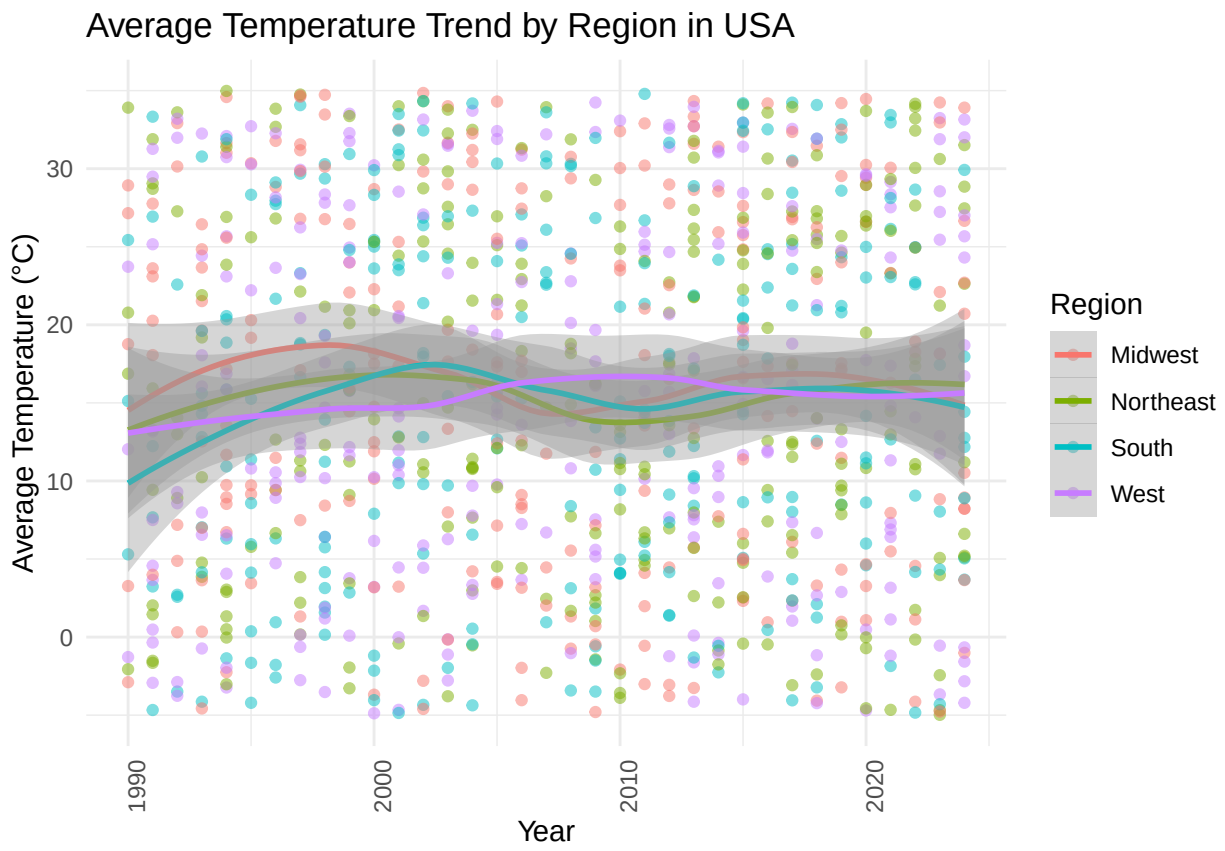



```
# USA
plot_temp_trend_country_facet(Climate_Data, "USA")
```

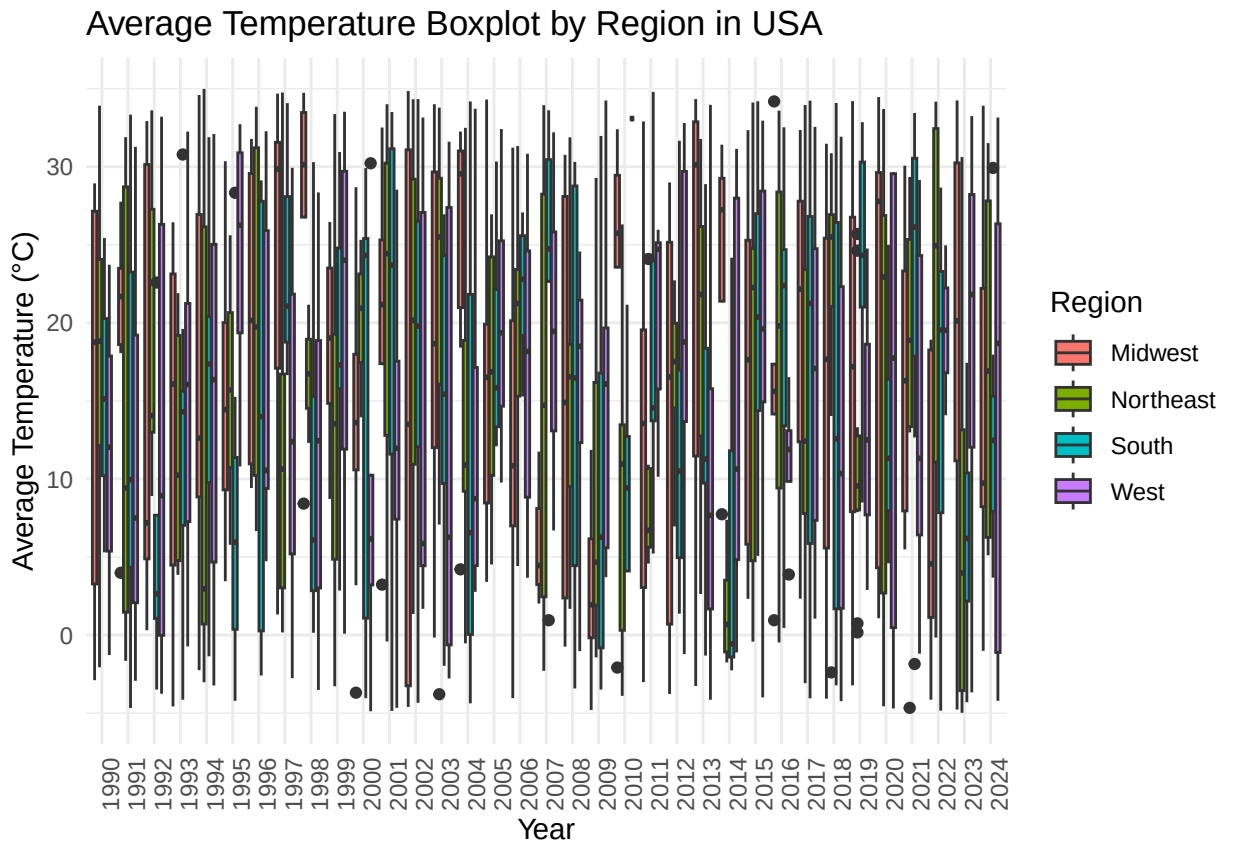



```
plot_temp_smooth_country(Climate_Data, "USA")
```

```
## `geom_smooth()` using formula = 'y ~ x'
```

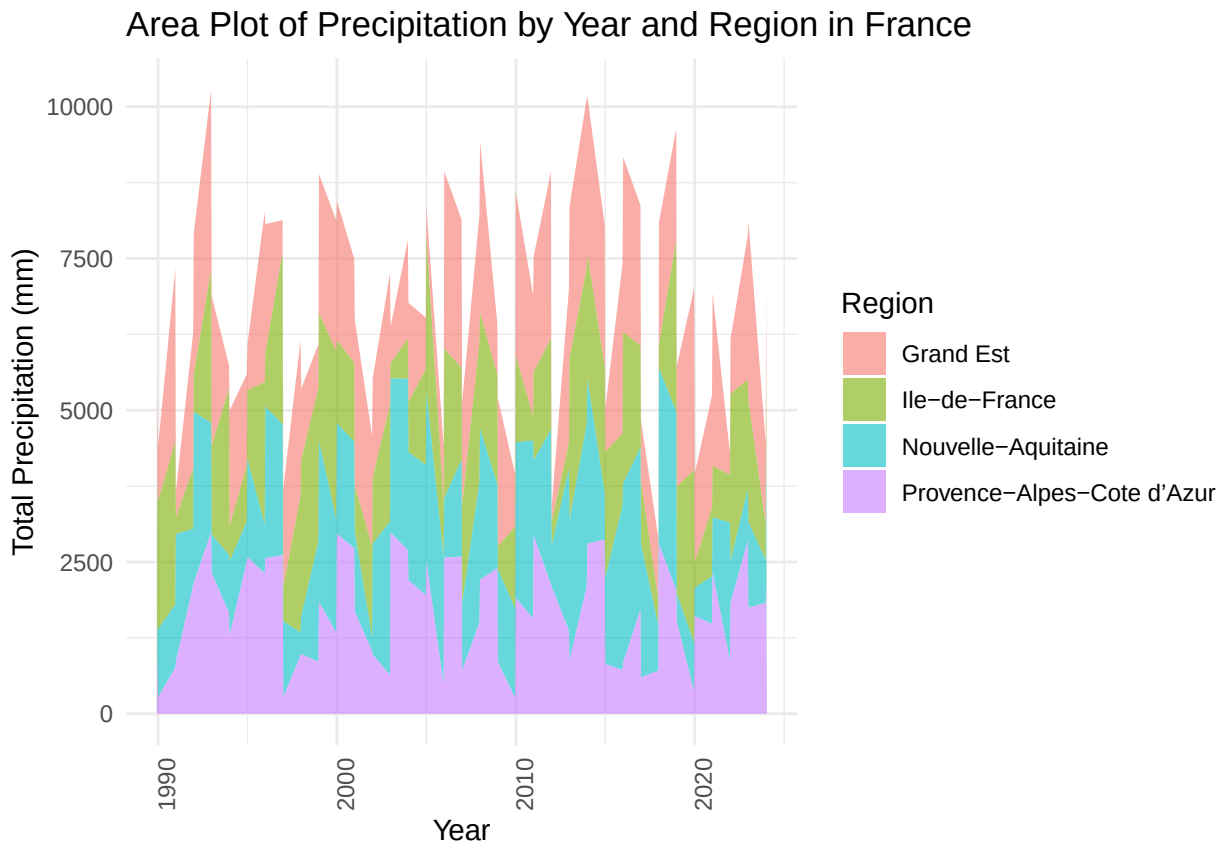



```
plot_temp_boxplot_country(Climate_Data, "USA")
```

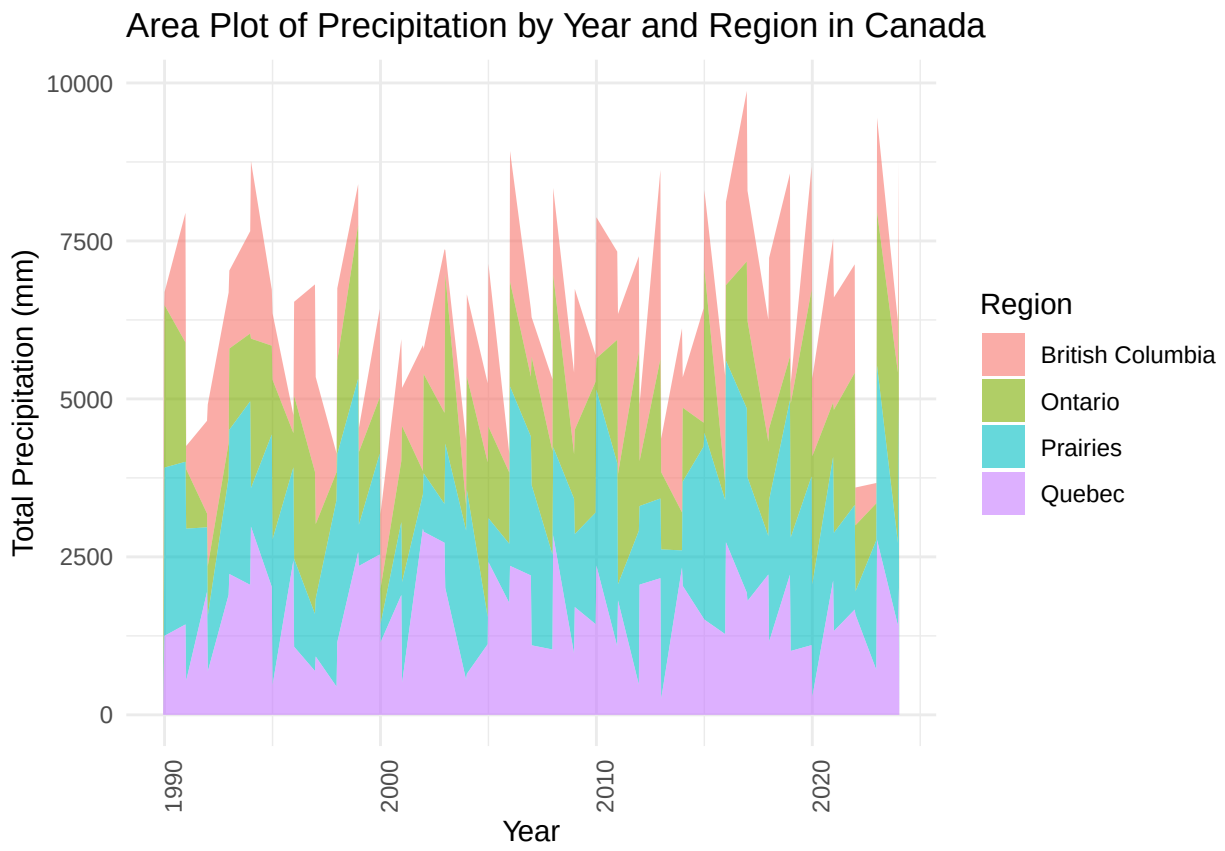



```r
## Function to plot total precipitation for each region in a country

plot_precipitation_area <- function(data, country_name) {
  if (!is.data.frame(data)) {
    stop("The data argument must be a data frame.")
  }

  filtered_data <- data %>%
    filter(Country == country_name)

  if (nrow(filtered_data) == 0) {
    stop("Country not found in the dataset.")
  }

  required_columns <- c("Region", "Total_Precipitation_mm", "Year")
  missing_columns <- setdiff(required_columns, colnames(filtered_data))

  if (length(missing_columns) > 0) {
    stop(paste("Missing columns in the dataset:", paste(missing_columns, collapse = ", ")))
  }

# Area plot for total precipitation by year and region
  ggplot(filtered_data, aes(x = Year, y = Total_Precipitation_mm, fill = Region)) +
    geom_area(alpha = 0.6, position = "stack") +
    labs(title = paste("Area Plot of Precipitation by Year and Region in", country_name),
         x = "Year",
```

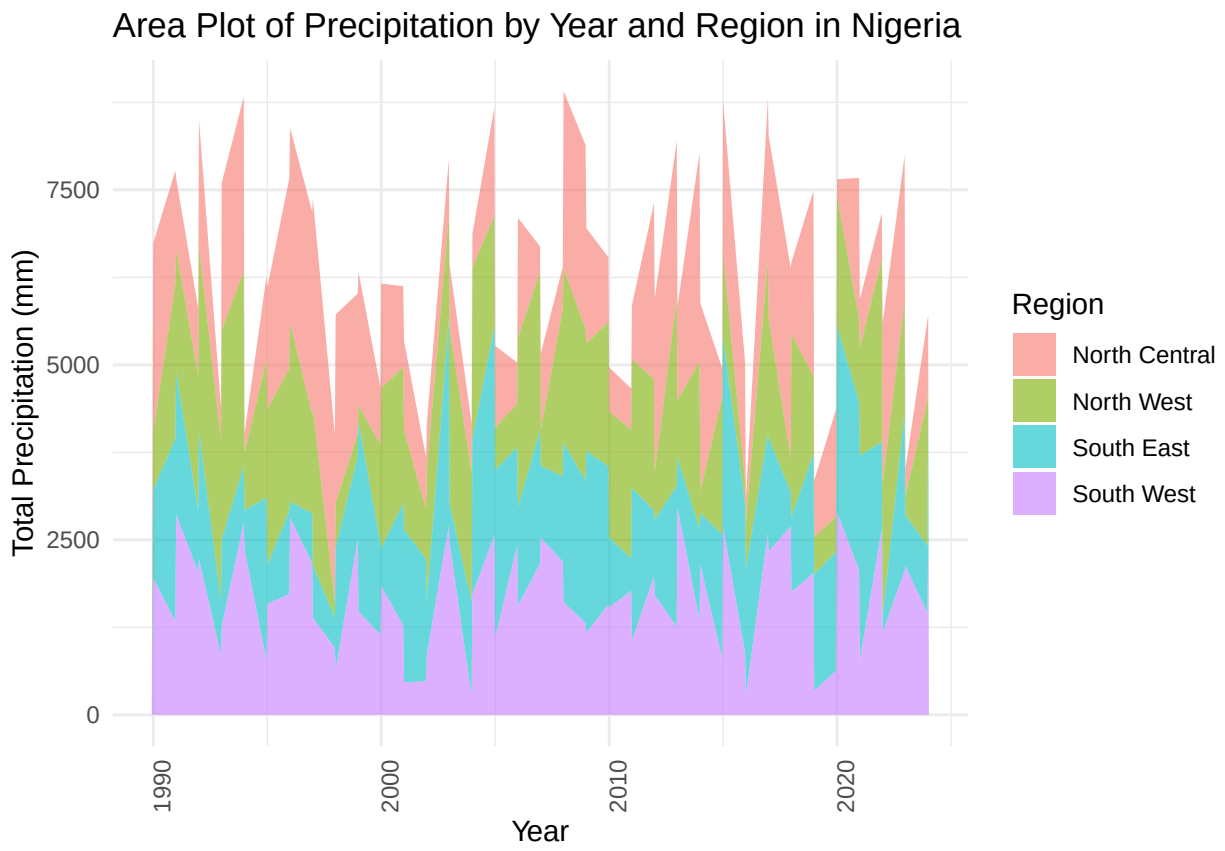
```
         y = "Total Precipitation (mm)") +
    theme_minimal() +
    theme(axis.text.x = element_text(angle = 90, hjust = 1))
}

# France
plot_precipitation_area(Climate_Data, "France")
```



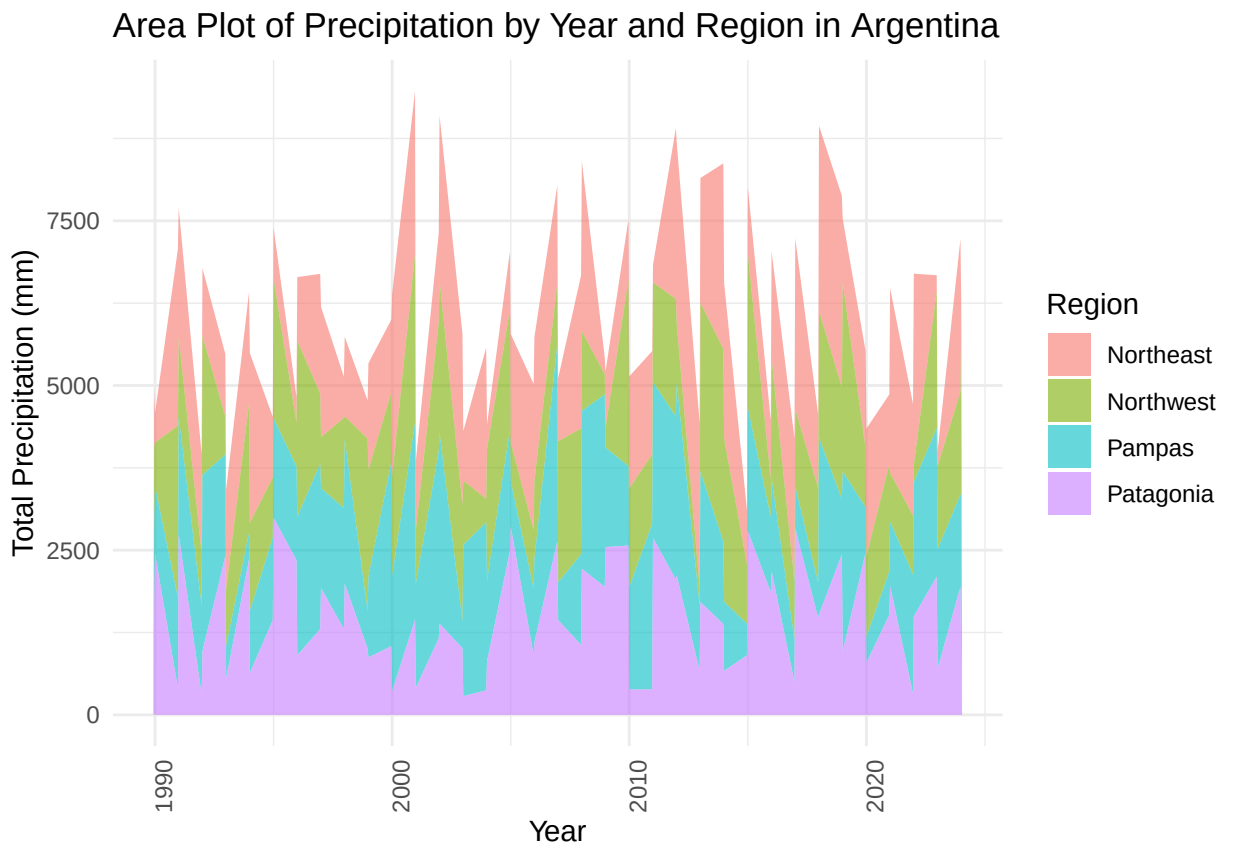

```
# Canada
plot_precipitation_area(Climate_Data, "Canada")
```



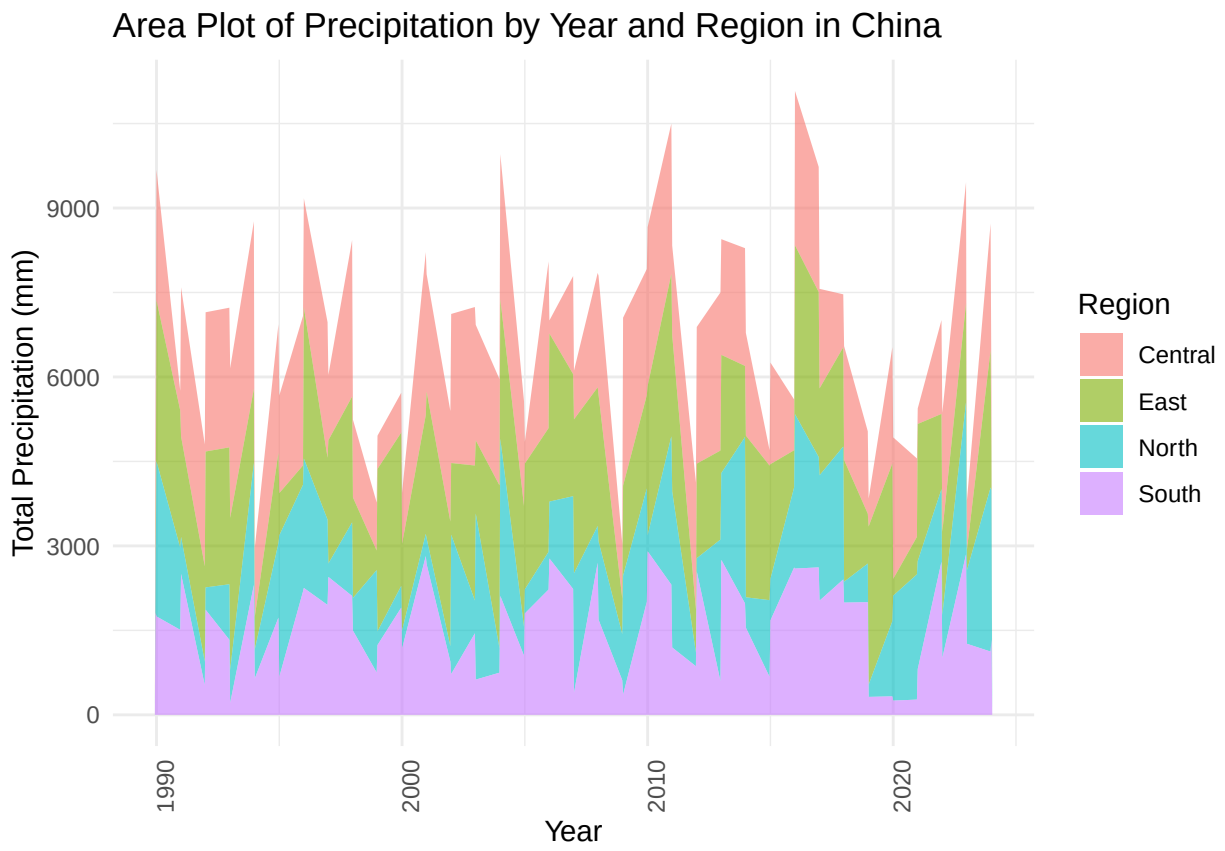

```
# Nigeria
plot_precipitation_area(Climate_Data, "Nigeria")
```



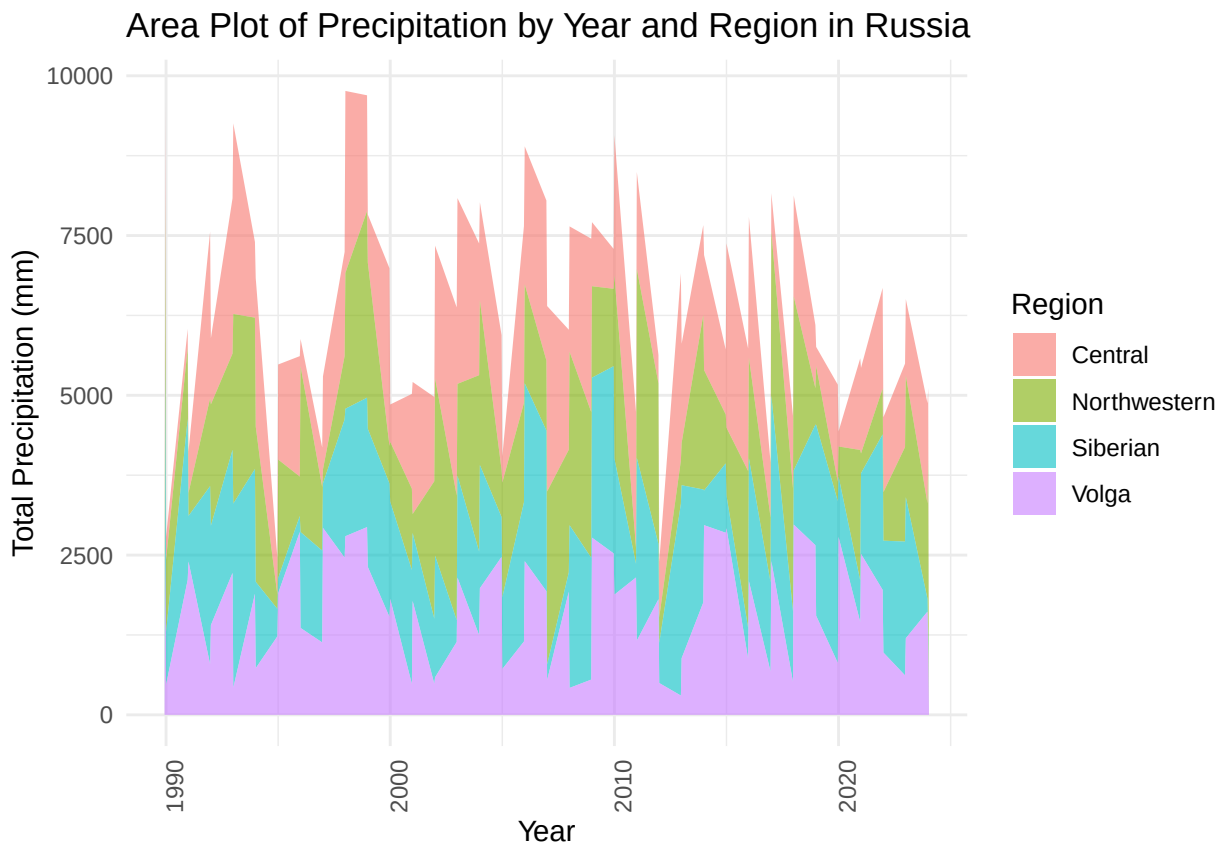

```
# Argentina
plot_precipitation_area(Climate_Data, "Argentina")
```



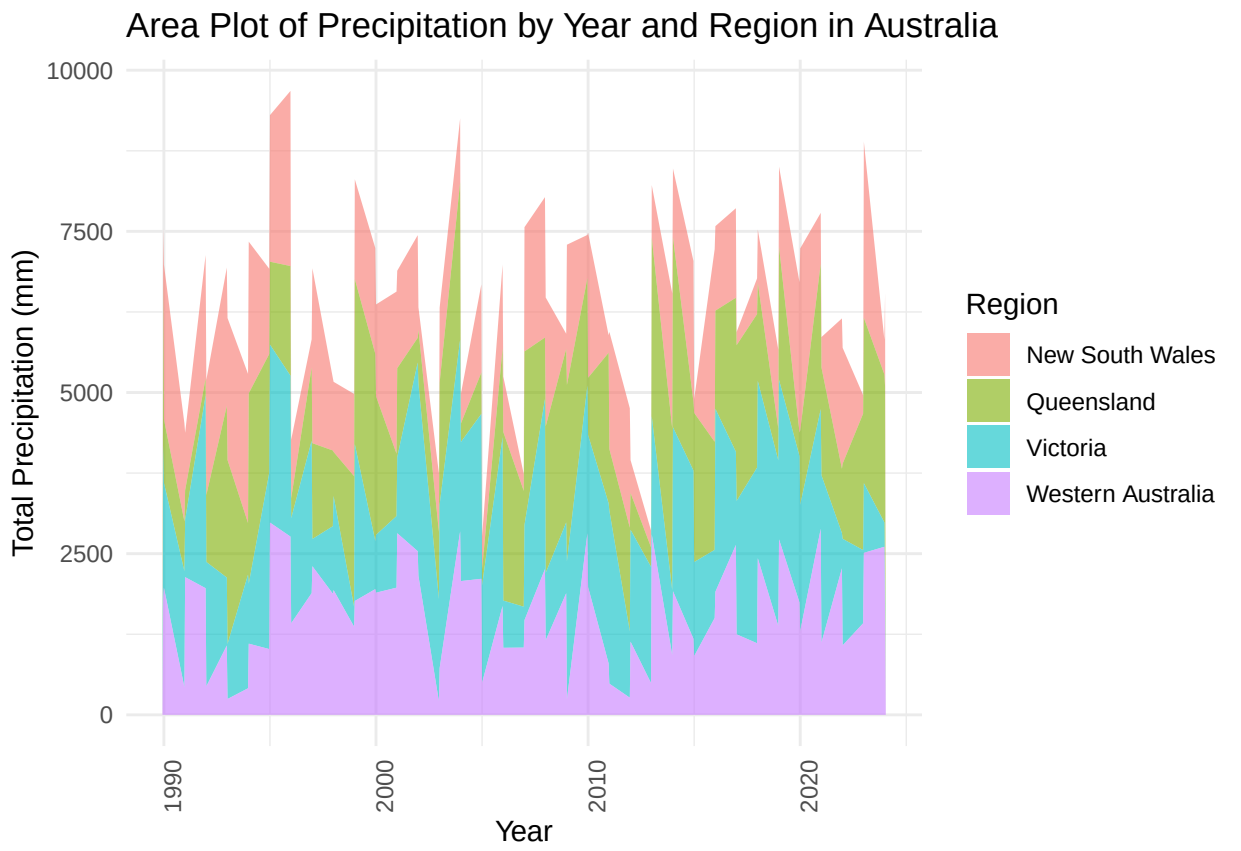

```
# China
plot_precipitation_area(Climate_Data, "China")
```



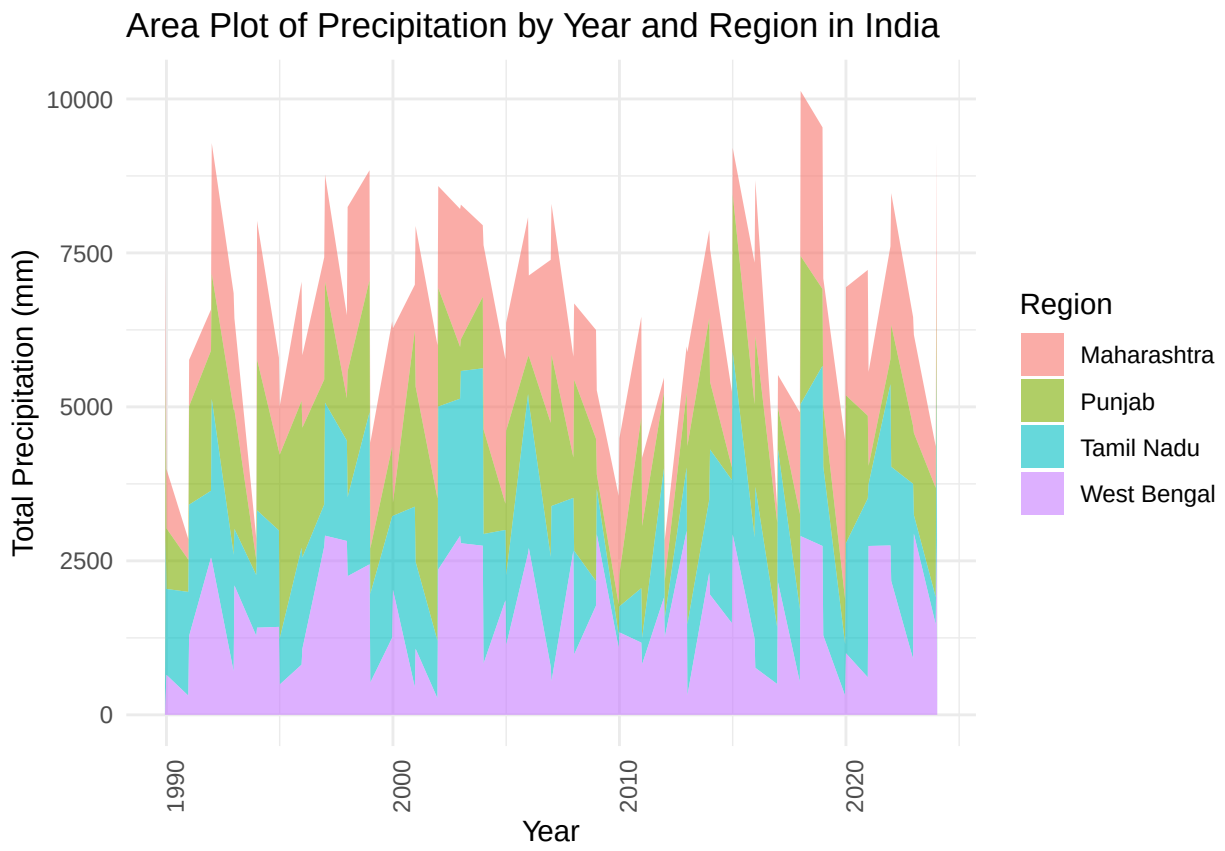

```
# Russia
plot_precipitation_area(Climate_Data, "Russia")
```



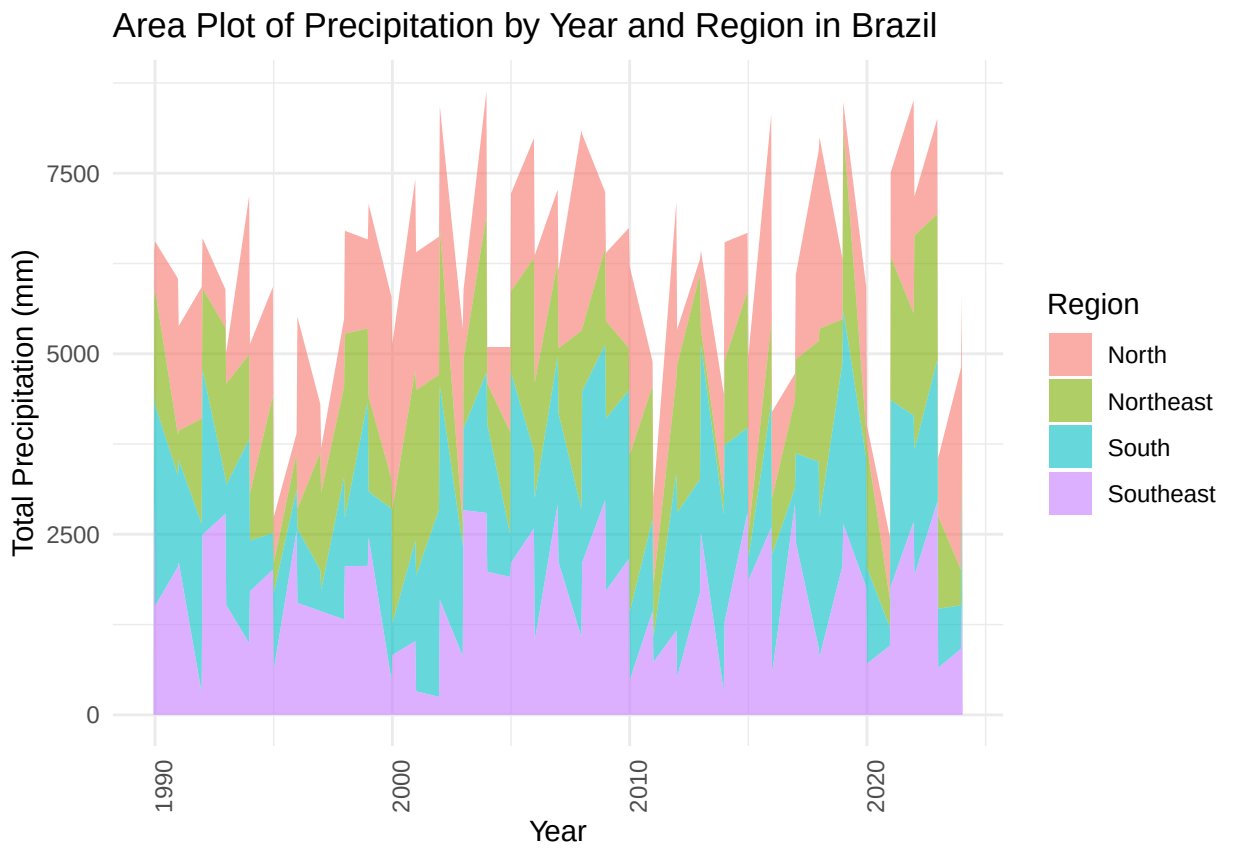

```
# Australia
plot_precipitation_area(Climate_Data, "Australia")
```



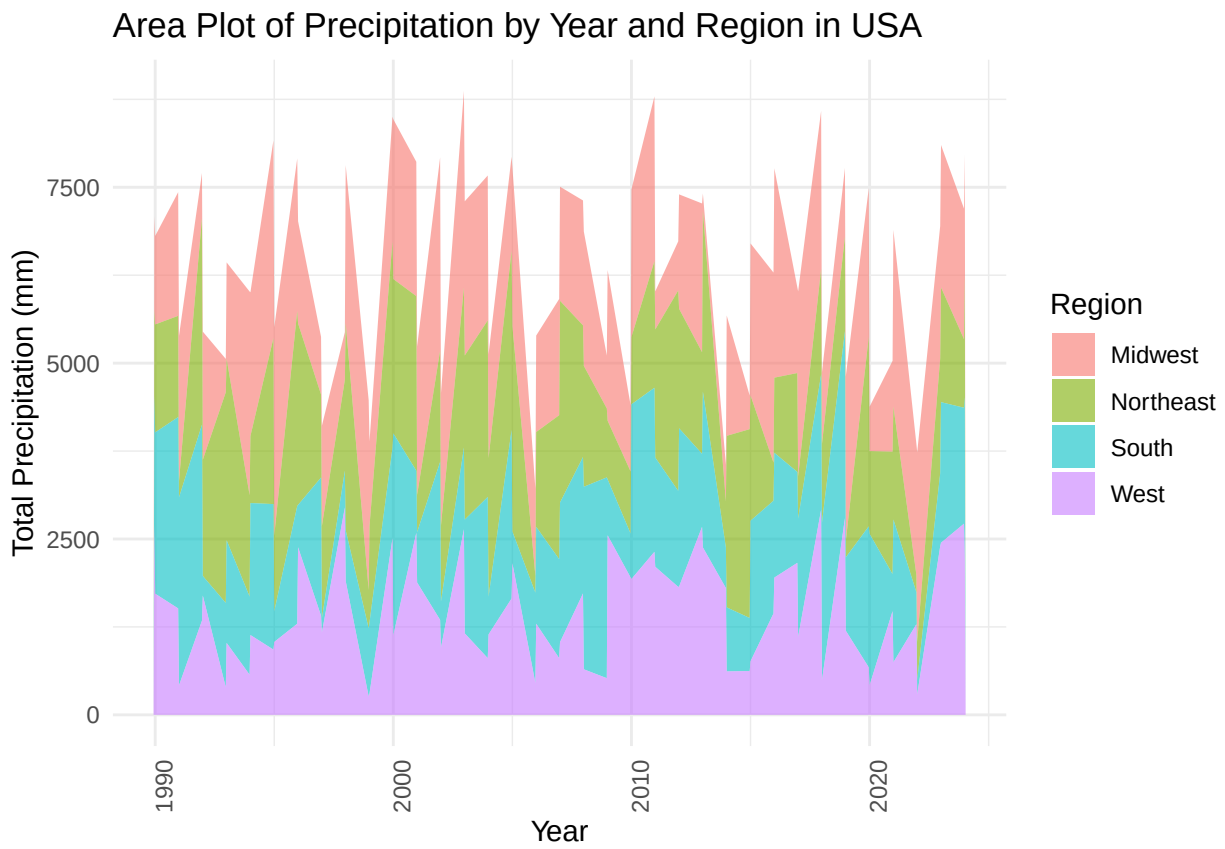

```
# India
plot_precipitation_area(Climate_Data, "India")
```



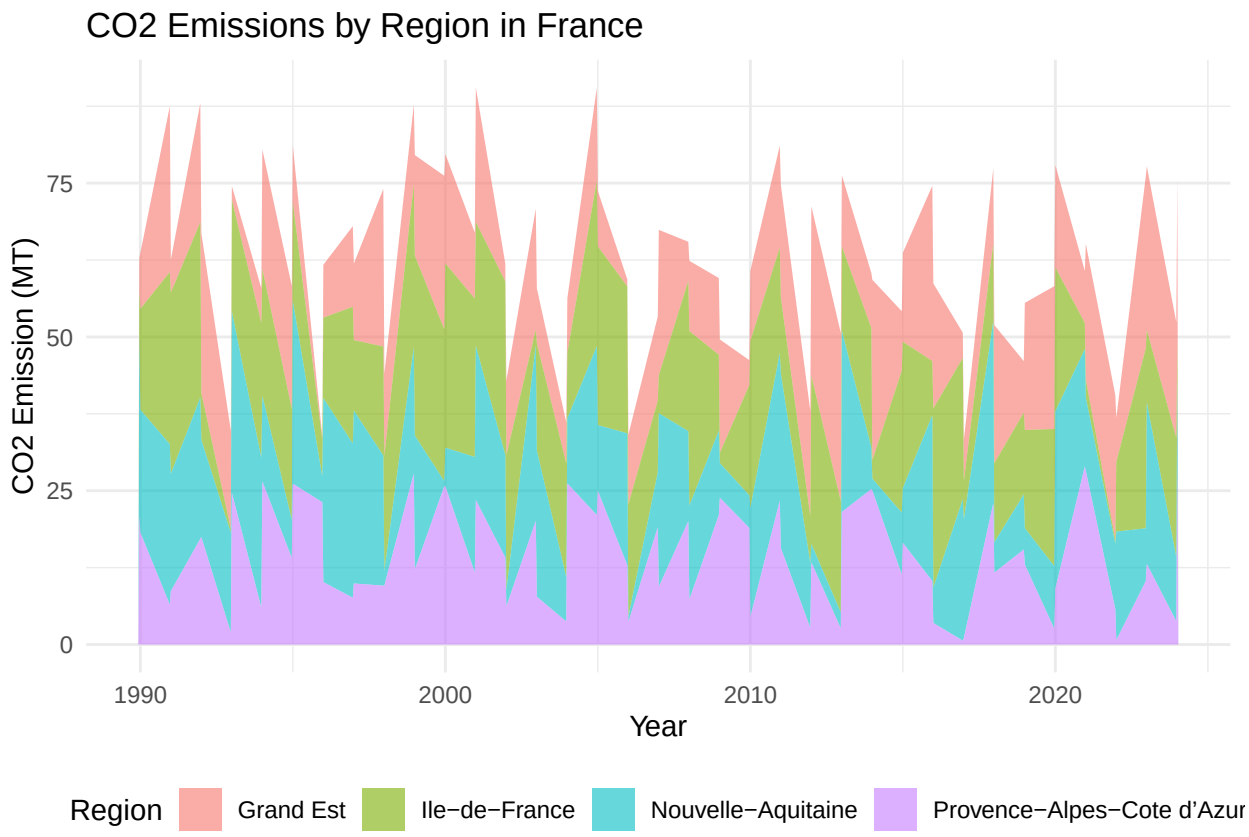

```
# Brazil
plot_precipitation_area(Climate_Data, "Brazil")
```



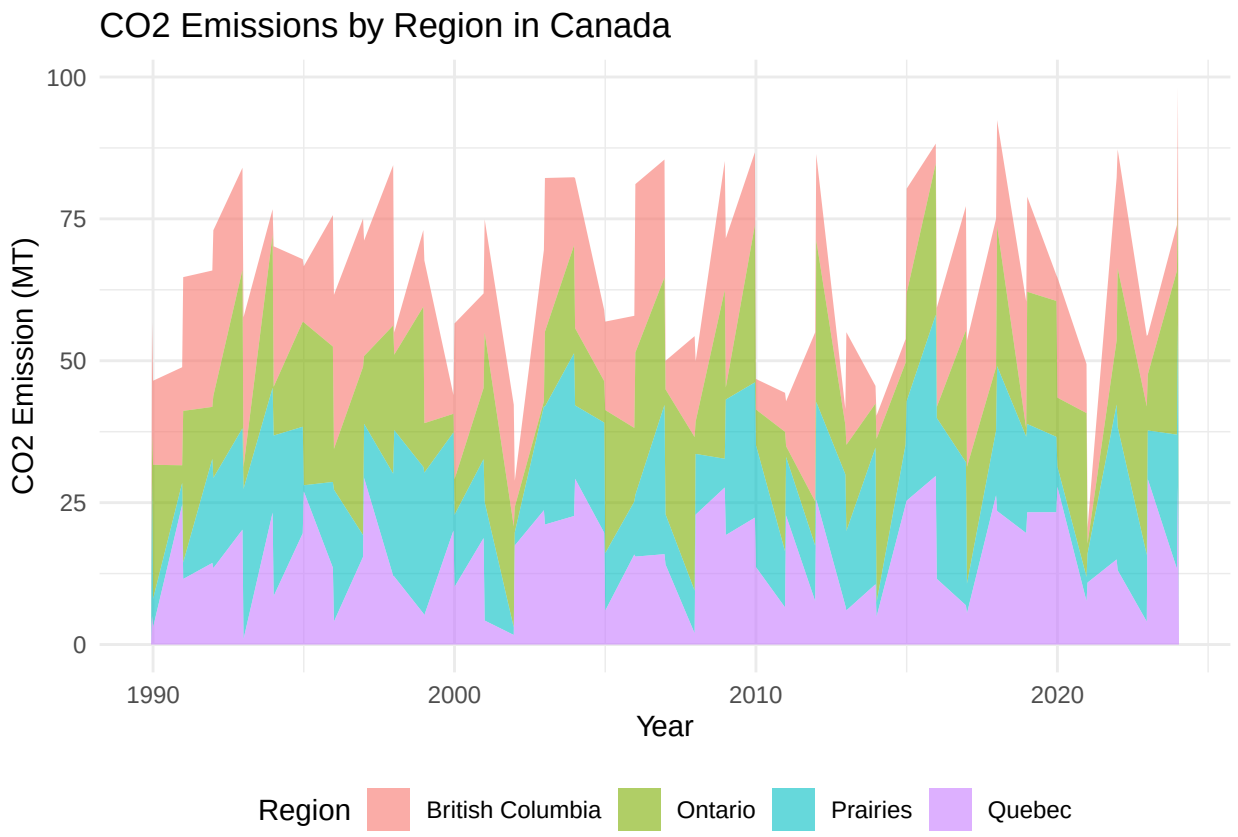

```
# USA
plot_precipitation_area(Climate_Data, "USA")
```



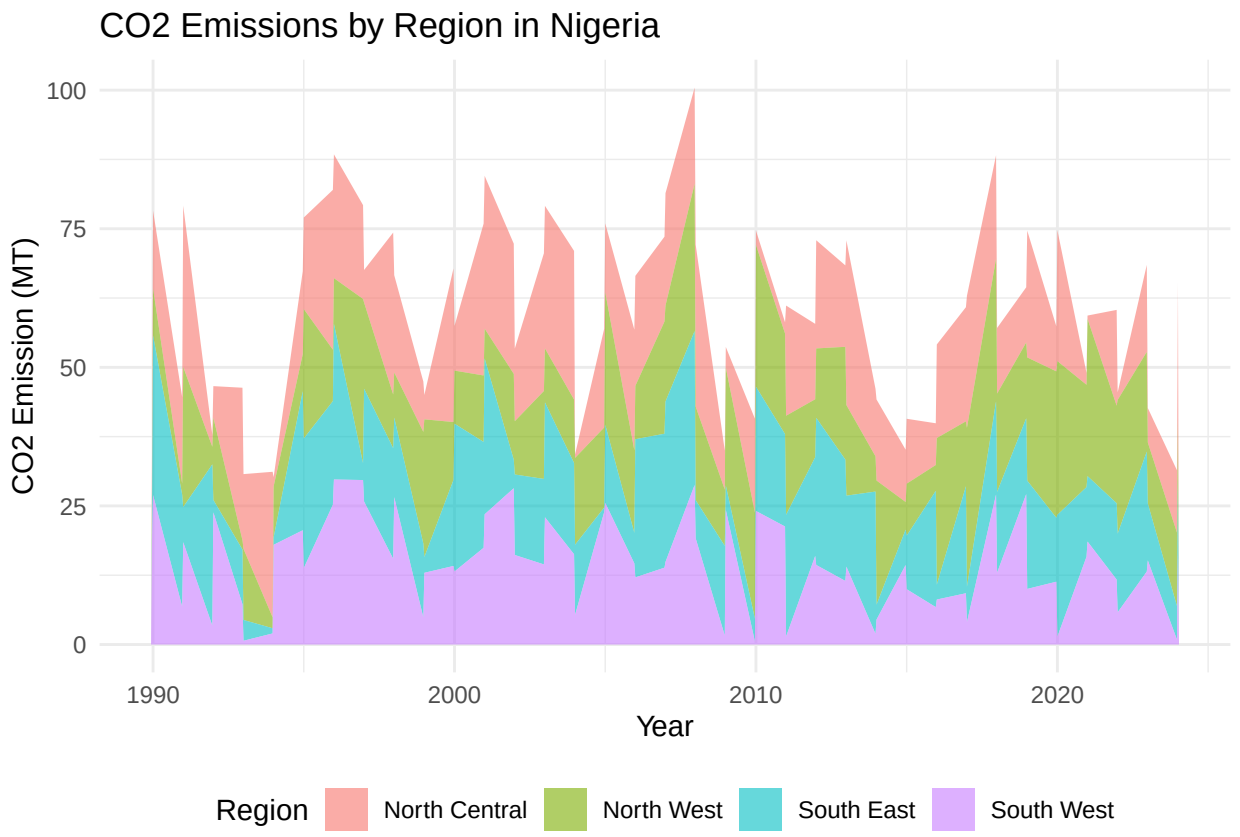

```r
# Creating a function to Visualize the CO2 Emission of all regions of each countries in every Year (199

plot_co2_stacked_area <- function(data, country_name) {
  country_data <- data %>%
    filter(Country == country_name)

  ggplot(country_data, aes(x = Year, y = CO2_Emissions_MT, fill = Region)) +
    geom_area(alpha = 0.6) +
    labs(title = paste("CO2 Emissions by Region in", country_name),
         x = "Year",
         y = "CO2 Emission (MT)") +
    theme_minimal() +
    theme(legend.position = "bottom")
}

# France
plot_co2_stacked_area(Climate_Data, "France")
```



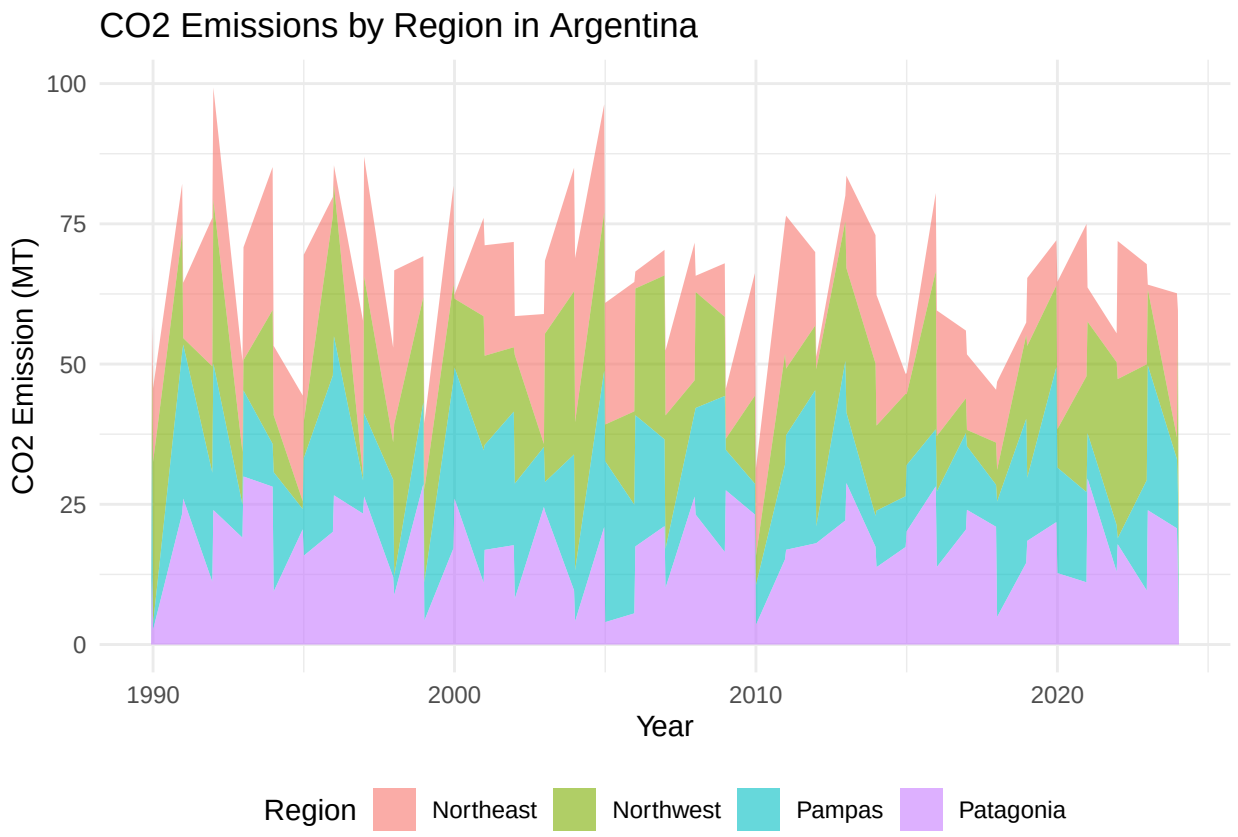

```
# Canada
plot_co2_stacked_area(Climate_Data, "Canada")
```



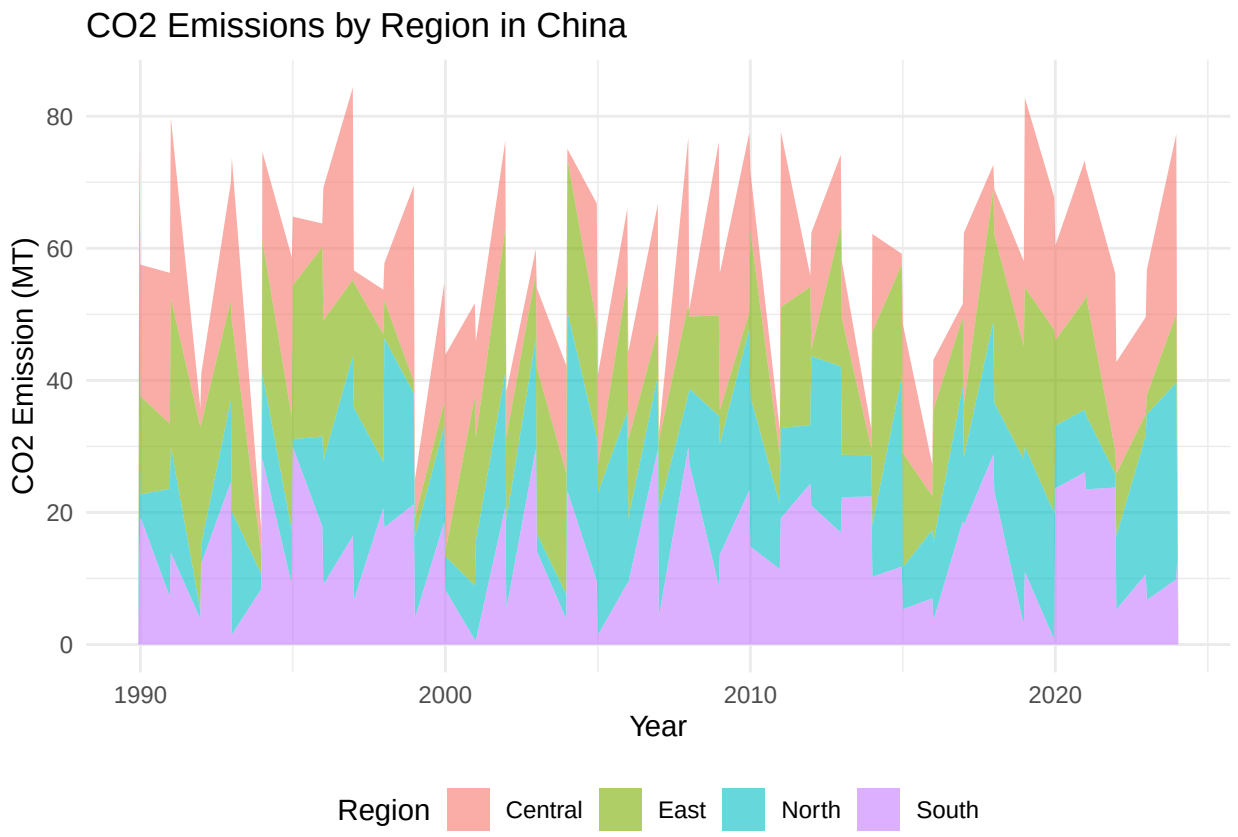

```
# Nigeria
plot_co2_stacked_area(Climate_Data, "Nigeria")
```



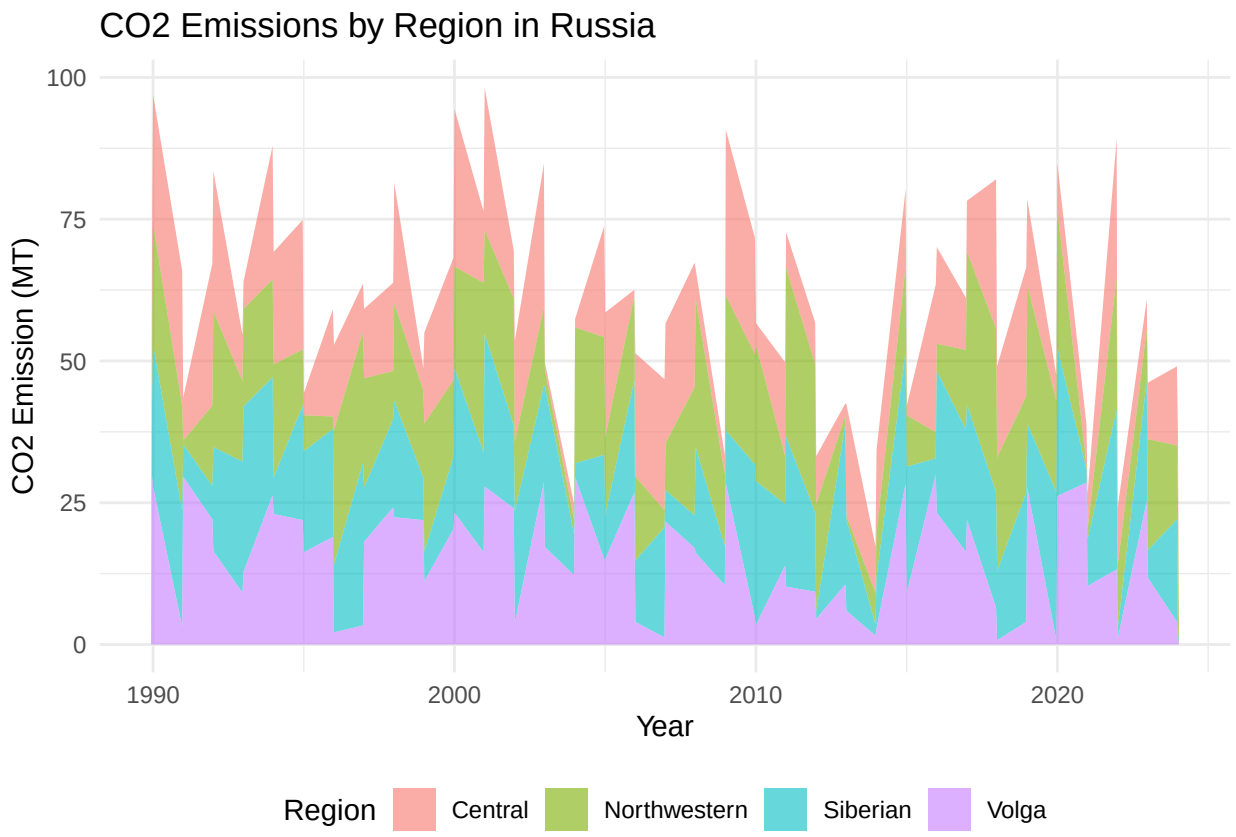

```r
# Argentina
plot_co2_stacked_area(Climate_Data, "Argentina")
```



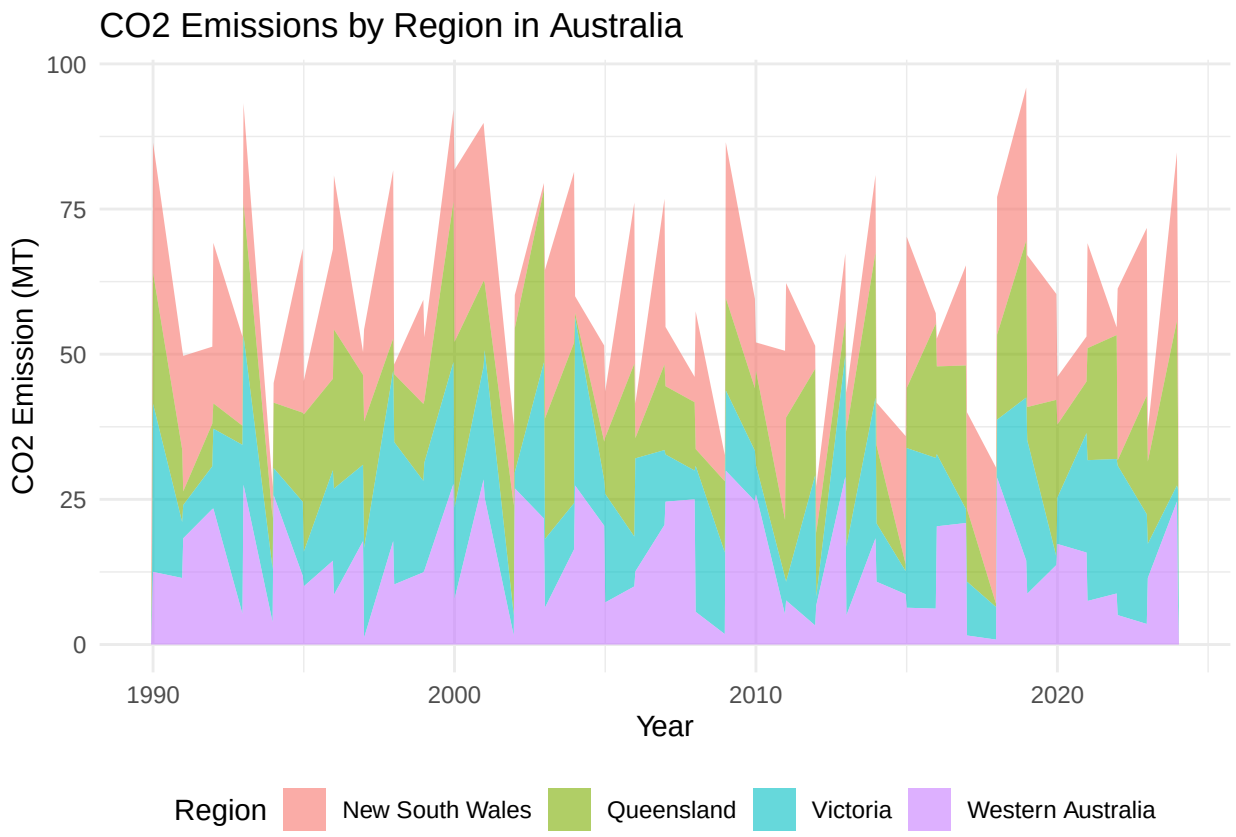

```
# China
plot_co2_stacked_area(Climate_Data, "China")
```



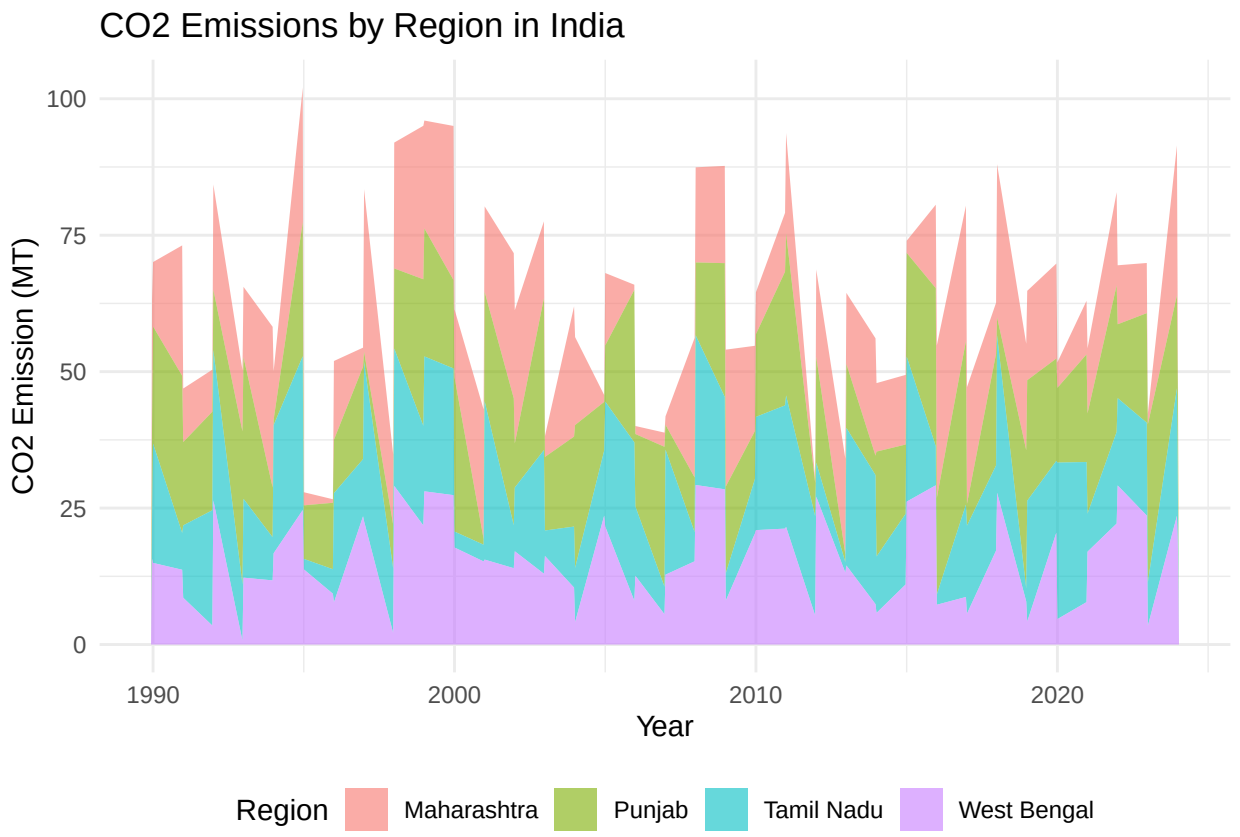

```
# Russia
plot_co2_stacked_area(Climate_Data, "Russia")
```



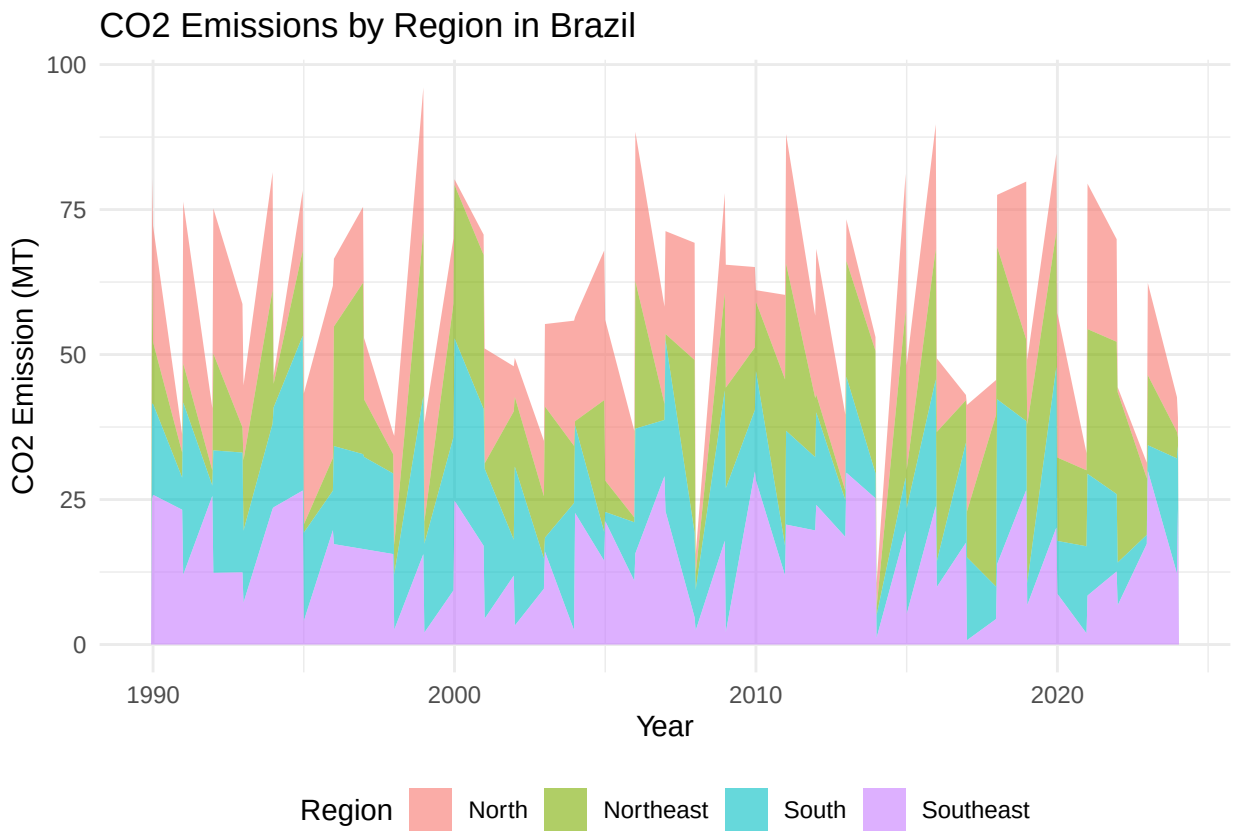

```
# Australia
plot_co2_stacked_area(Climate_Data, "Australia")
```



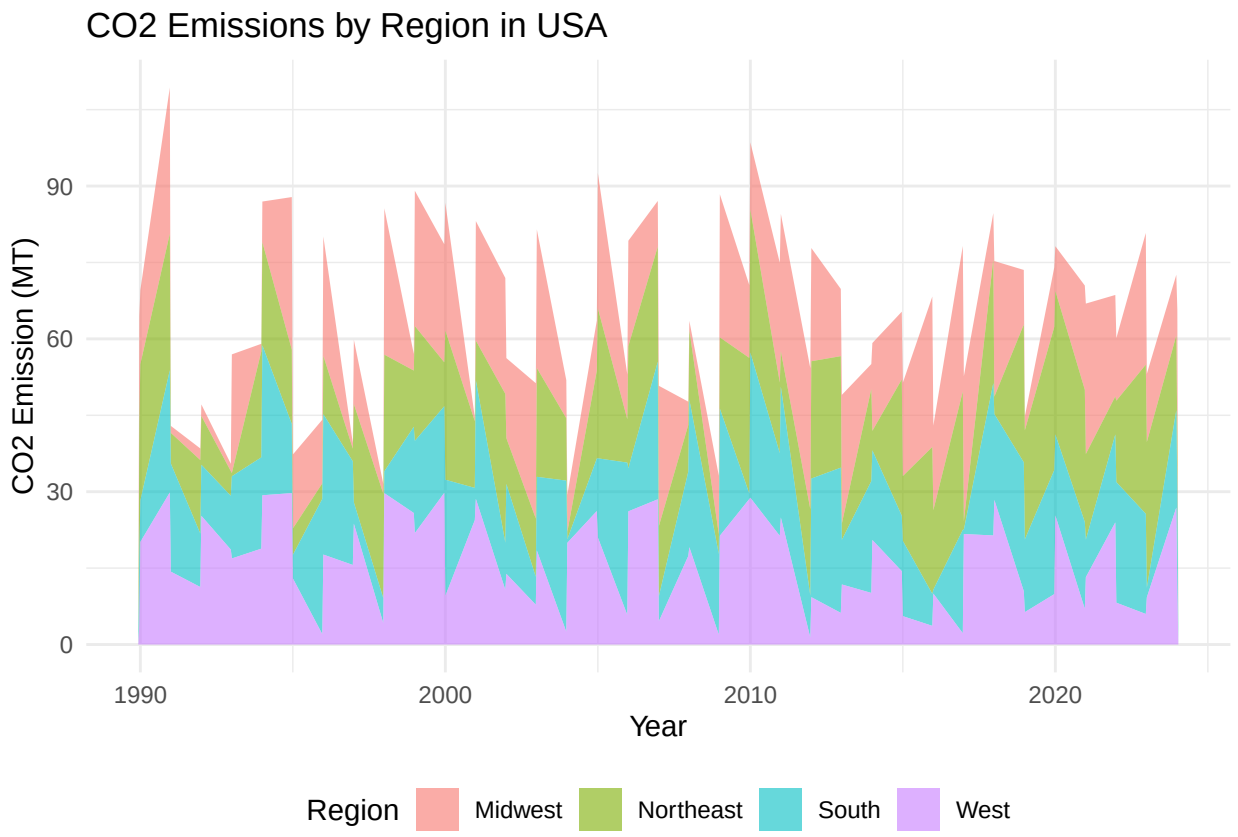

```
# India
plot_co2_stacked_area(Climate_Data, "India")
```




```
# Brazil
plot_co2_stacked_area(Climate_Data, "Brazil")
```




```
# USA
plot_co2_stacked_area(Climate_Data, "USA")
```

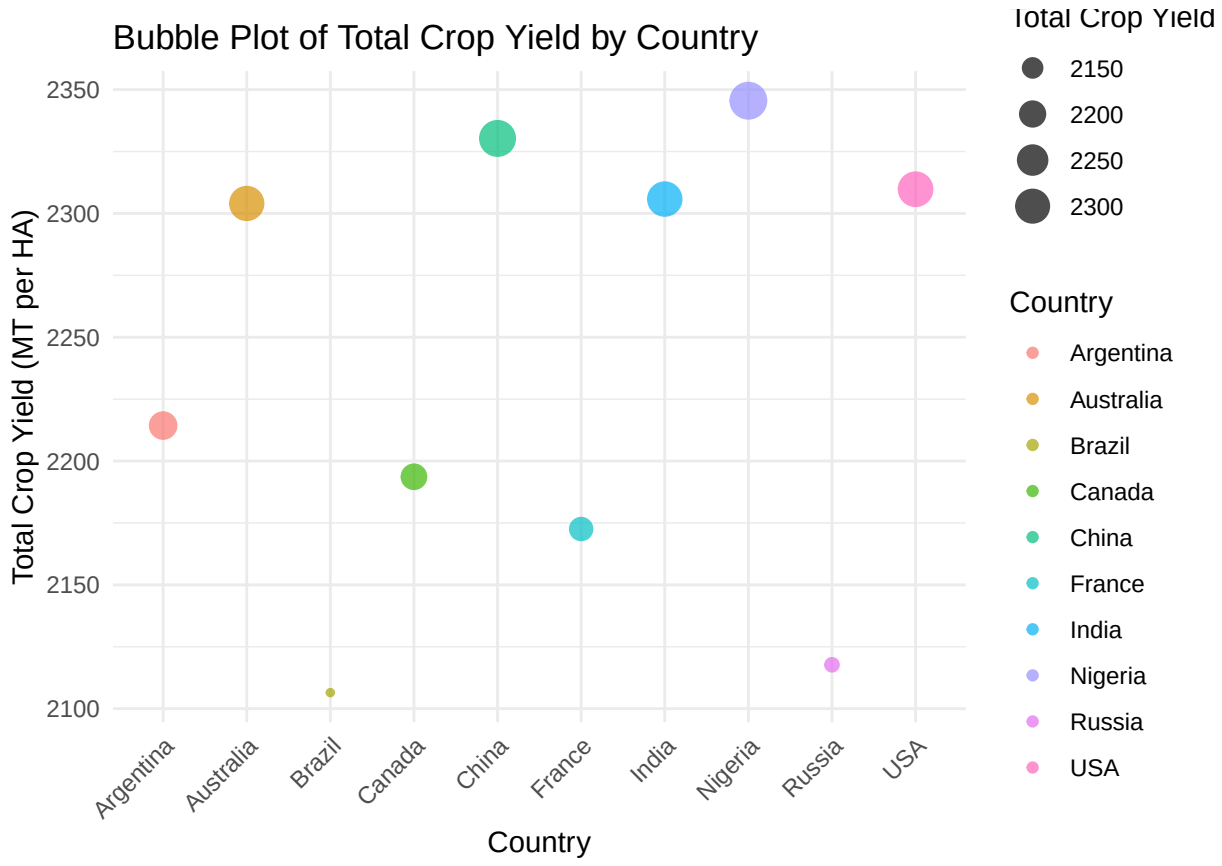



```
## Finding the most Crop Yielded Country

crop_yield_order <- Climate_Data %>%
  group_by(Country) %>%
  summarise(total_yield = sum(Crop_Yield_MT_per_HA, na.rm = TRUE)) %>%
  arrange(desc(total_yield))

print(crop_yield_order)
```

```
## # A tibble: 10 x 2
##    Country   total_yield
##    <chr>           <dbl>
##  1 Nigeria         2346.
##  2 China           2330.
##  3 USA             2310.
##  4 India           2306.
##  5 Australia       2304.
##  6 Argentina       2214.
##  7 Canada          2194.
##  8 France          2173.
##  9 Russia          2118.
## 10 Brazil          2106.
```

```
# Visualizing Total Crop Yield by Country
```

```r
ggplot(crop_yield_order, aes(x = Country, y = total_yield, size = total_yield, color = Country)) +
  geom_point(alpha = 0.7) +
  labs(title = "Bubble Plot of Total Crop Yield by Country",
       x = "Country",
       y = "Total Crop Yield (MT per HA)",
       size = "Total Crop Yield") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```

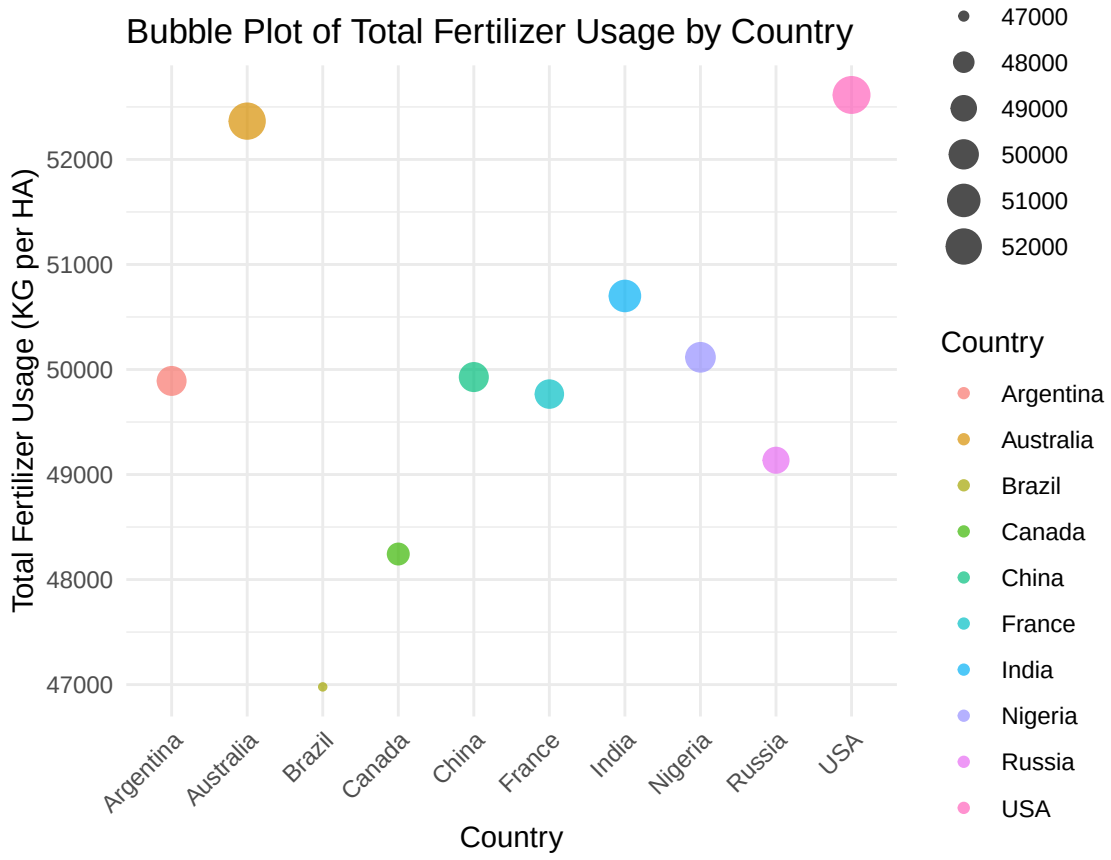



```r
## Fertilizer Usage by Each Country

fertilizer_usage_by_country <- Climate_Data %>%
  group_by(Country) %>%
  summarise(total_fertilizer_usage = sum(Fertilizer_Use_KG_per_HA, na.rm = TRUE)) %>%
  arrange(desc(total_fertilizer_usage))

print(fertilizer_usage_by_country)
```

```
## # A tibble: 10 x 2
##    Country   total_fertilizer_usage
##    <chr>                      <dbl>
##  1 USA                       52614.
##  2 Australia                 52365.
##  3 India                     50700.
##  4 Nigeria                   50116.
```

```
##  5 China                     49928.
##  6 Argentina                 49891.
##  7 France                    49766.
##  8 Russia                    49136.
##  9 Canada                    48243.
## 10 Brazil                    46978.
```

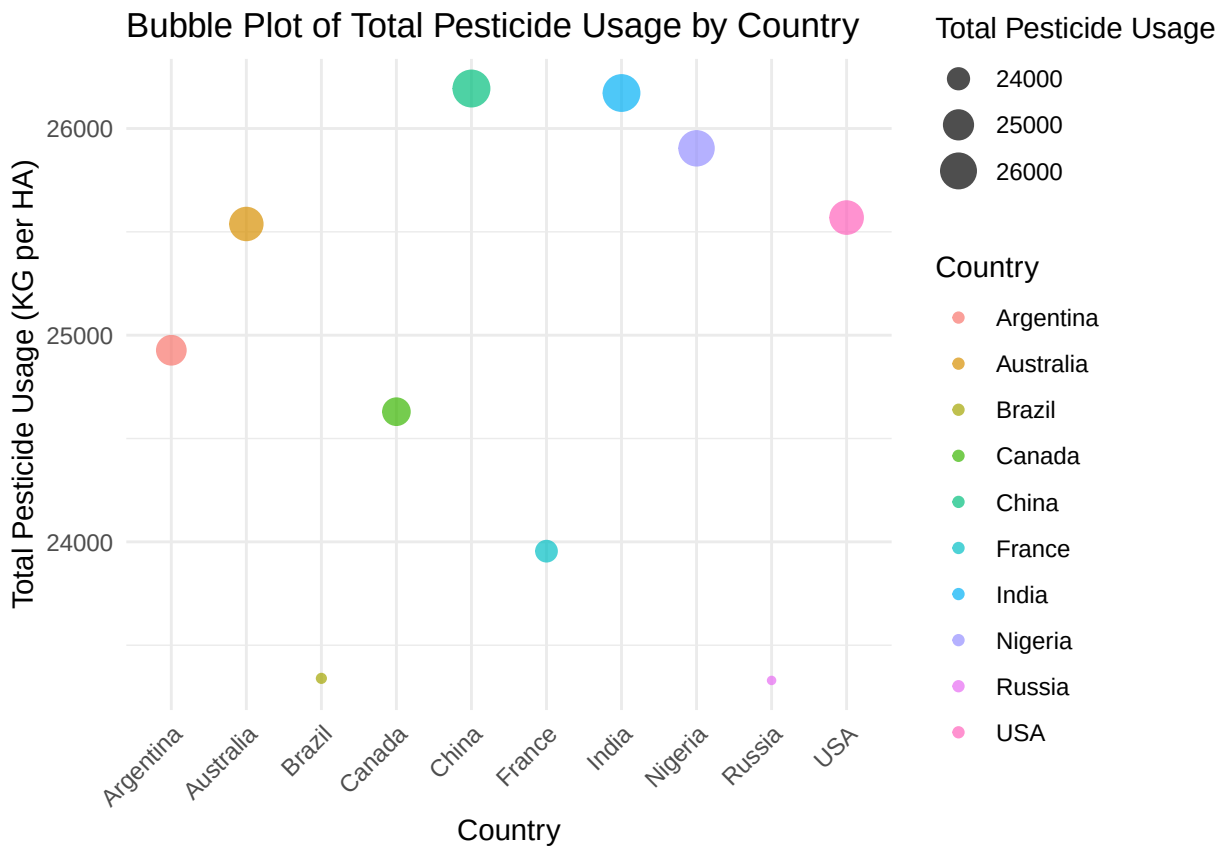
```r
# Visualizing Total Fertilizer Usage by Country

ggplot(fertilizer_usage_by_country, aes(x = Country, y = total_fertilizer_usage, size = total_fertilizer
  geom_point(alpha = 0.7) +
  labs(title = "Bubble Plot of Total Fertilizer Usage by Country",
       x = "Country",
       y = "Total Fertilizer Usage (KG per HA)",
       size = "Total Fertilizer Usage") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```



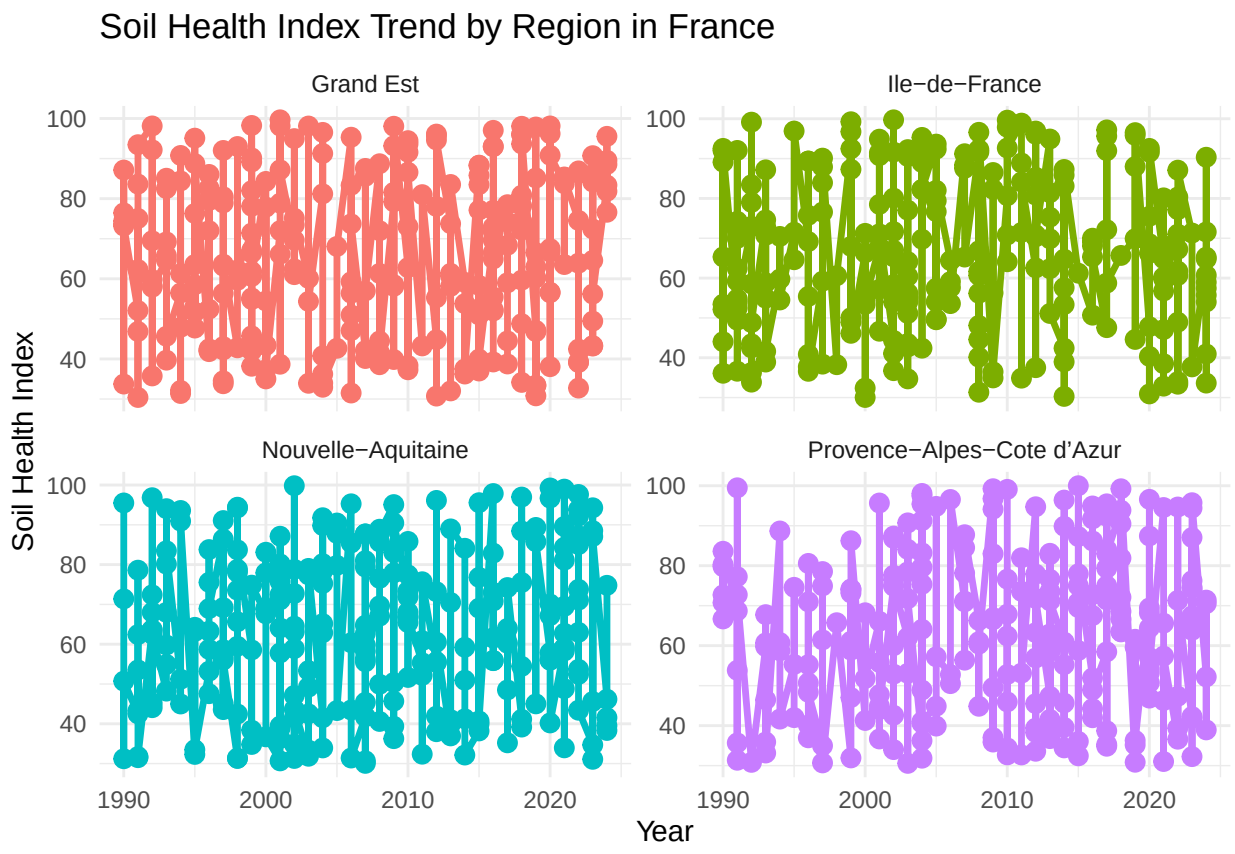

```r
## Pesticide Usage by Each Country

pesticide_usage_by_country <- Climate_Data %>%
  group_by(Country) %>%
  summarise(total_pesticide_usage = sum(Pesticide_Use_KG_per_HA, na.rm = TRUE)) %>%
  arrange(desc(total_pesticide_usage))

print(pesticide_usage_by_country)
```

```
## # A tibble: 10 x 2
##    Country   total_pesticide_usage
##    <chr>                     <dbl>
##  1 China                    26193.
##  2 India                    26172.
##  3 Nigeria                  25904.
##  4 USA                      25569.
##  5 Australia                25538
##  6 Argentina                24927.
##  7 Canada                   24630.
##  8 France                   23955.
##  9 Brazil                   23340.
## 10 Russia                   23330.
```

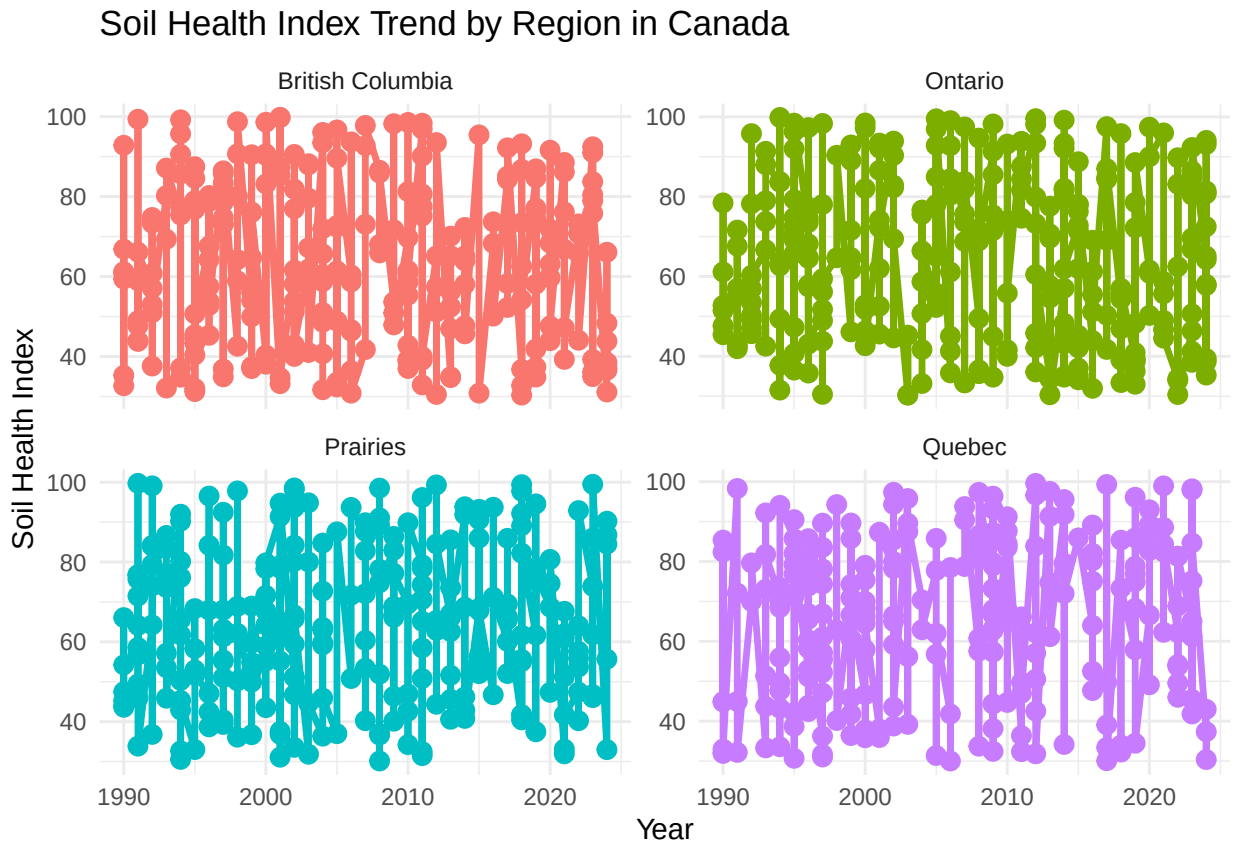
```r
# Visualizing Total Pesticide Usage by Country

ggplot(pesticide_usage_by_country, aes(x = Country, y = total_pesticide_usage, size = total_pesticide_us
  geom_point(alpha = 0.7) +
  labs(title = "Bubble Plot of Total Pesticide Usage by Country",
       x = "Country",
       y = "Total Pesticide Usage (KG per HA)",
       size = "Total Pesticide Usage") +
  theme_minimal() +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```



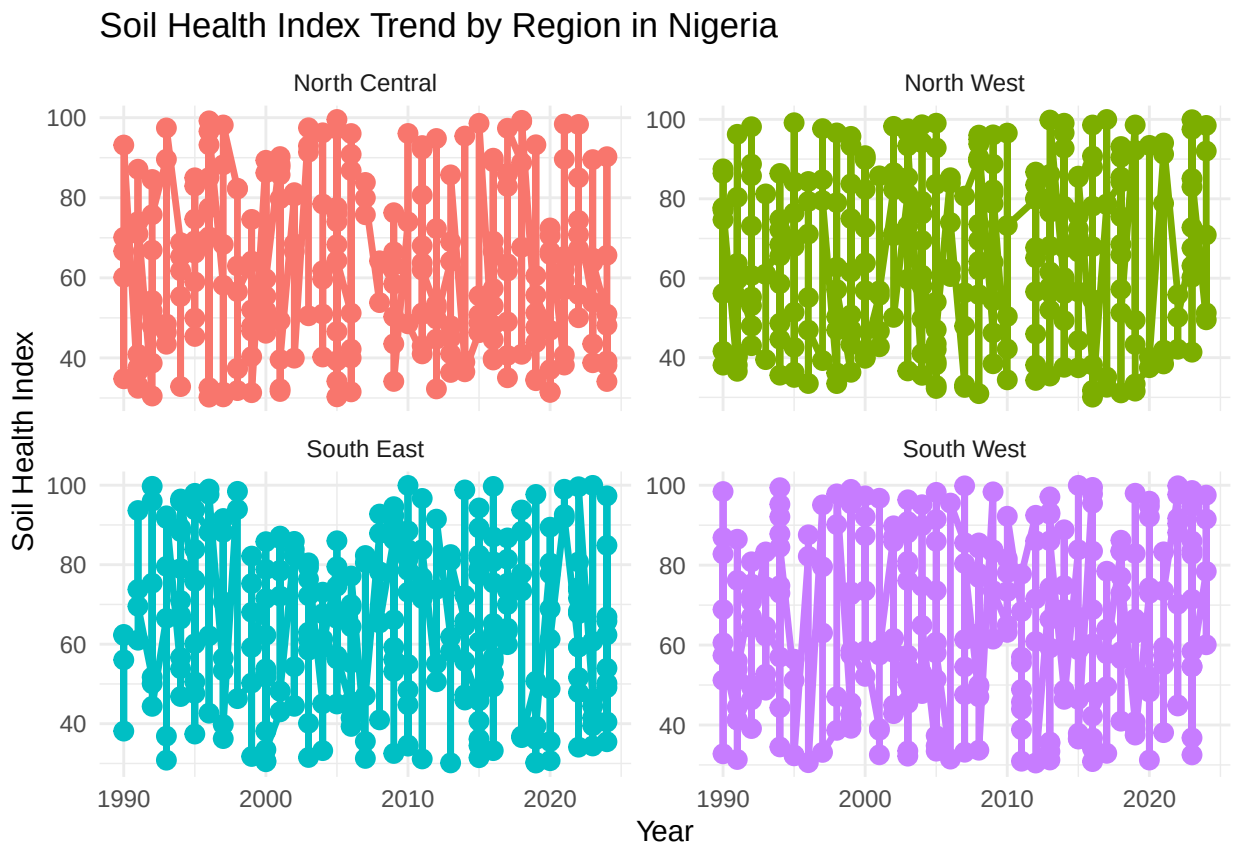
```r
# Creating Function to visualize Soil Health index of All Regions of Each Countries

plot_soil_health_facet <- function(data, country_name) {
  country_data <- data %>%
    filter(Country == country_name)

  if (nrow(country_data) == 0) {
    stop("No data available for the specified country.")
  }

  ggplot(country_data, aes(x = Year, y = Soil_Health_Index, color = Region)) +
    geom_line(size = 1.2) +
    geom_point(size = 3) +
    labs(title = paste("Soil Health Index Trend by Region in", country_name),
         x = "Year",
         y = "Soil Health Index") +
    theme_minimal() +
    facet_wrap(~ Region, scales = "free_y") +
    theme(legend.position = "none")
}


# France
plot_soil_health_facet(Climate_Data, "France")
```



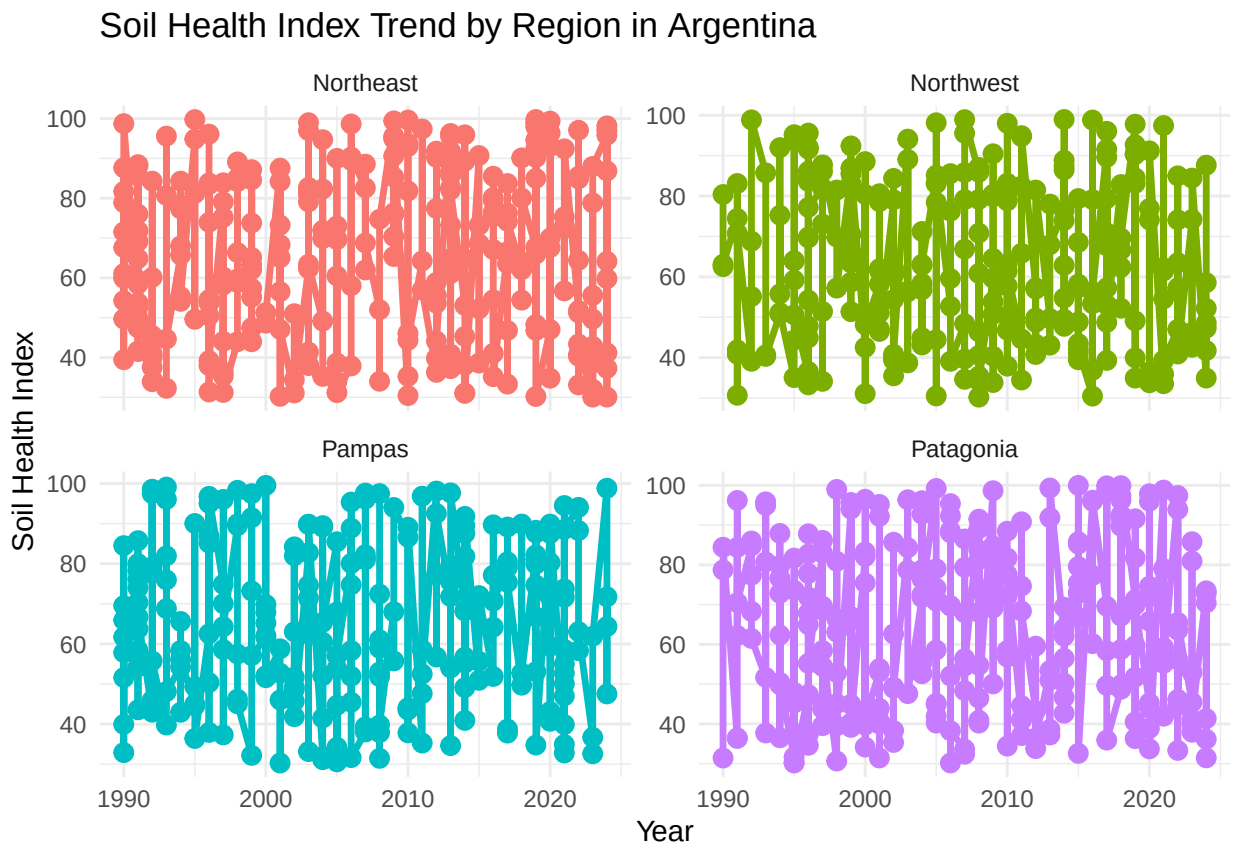
```
# Canada
plot_soil_health_facet(Climate_Data, "Canada")
```



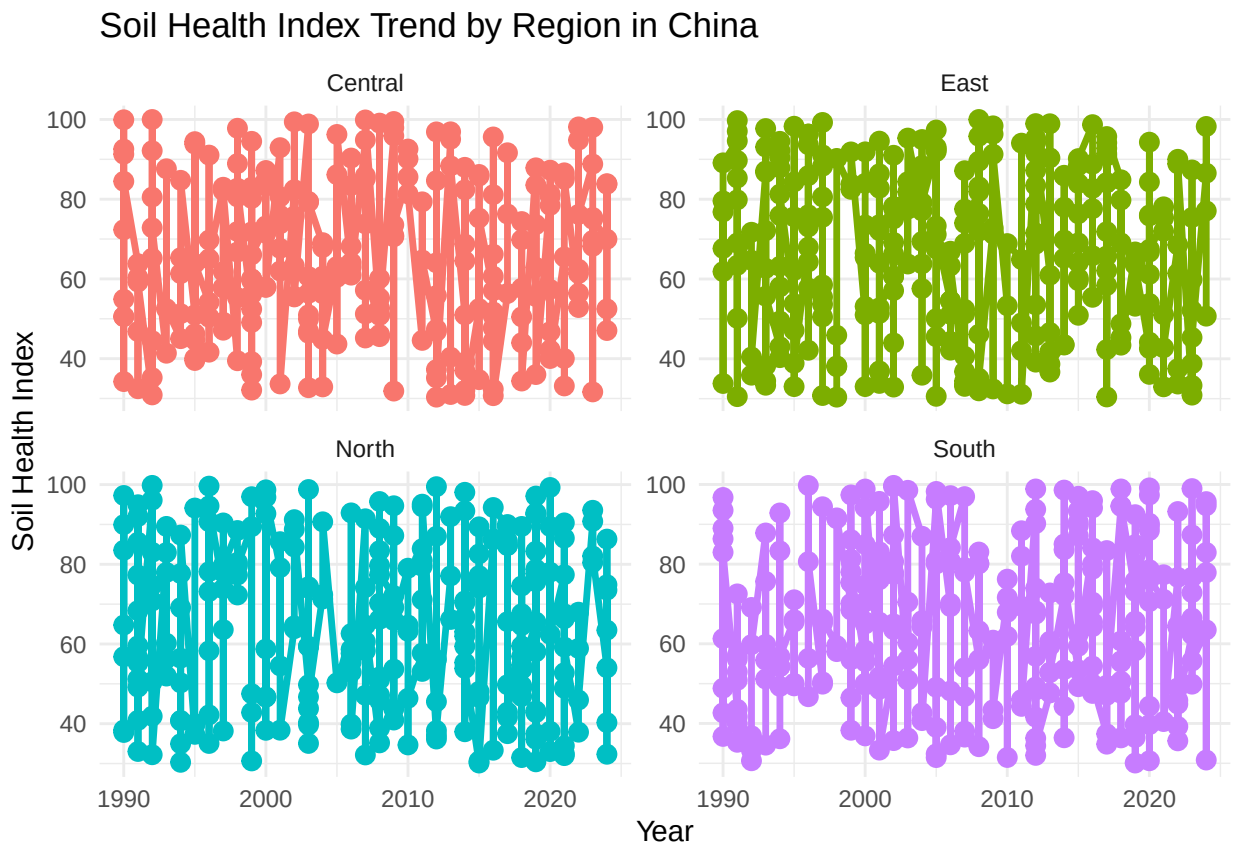

```
# Nigeria
plot_soil_health_facet(Climate_Data, "Nigeria")
```



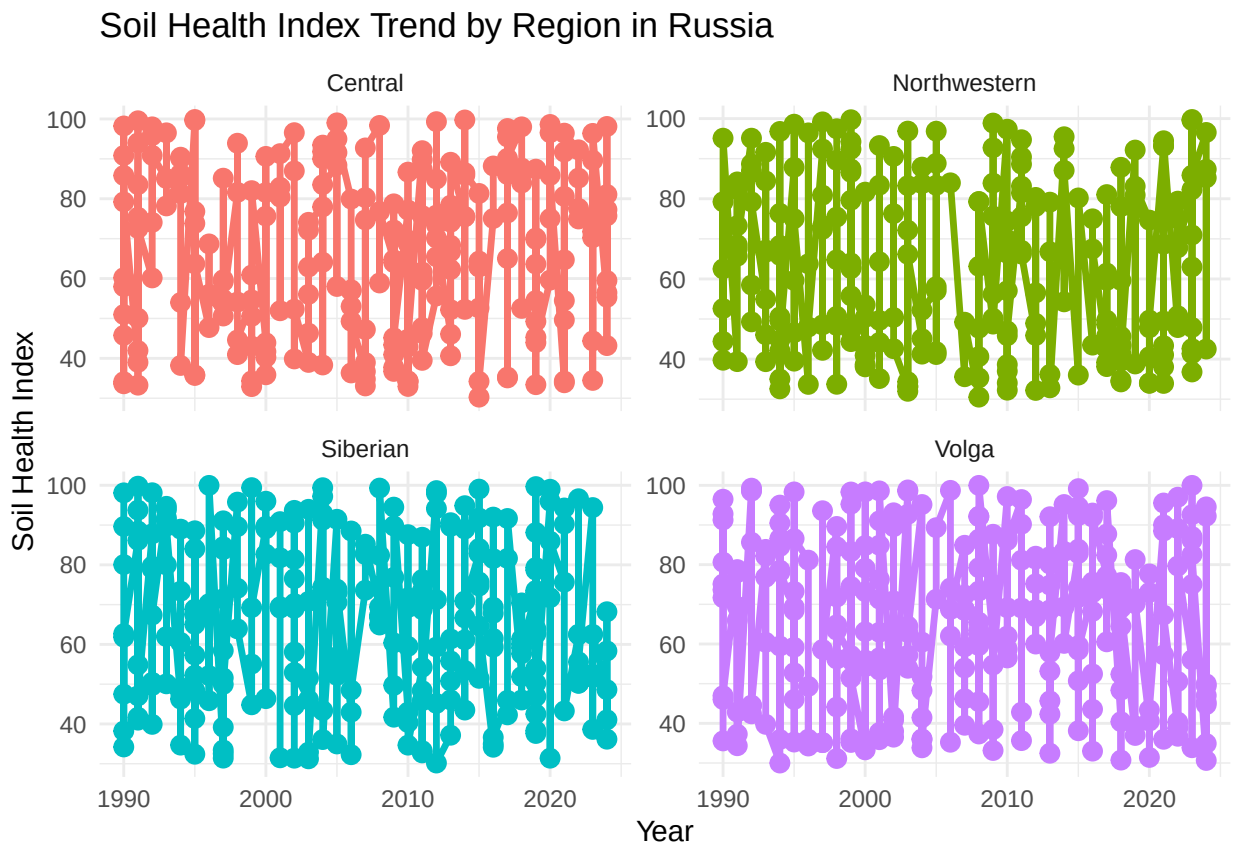

```
# Argentina
plot_soil_health_facet(Climate_Data, "Argentina")
```



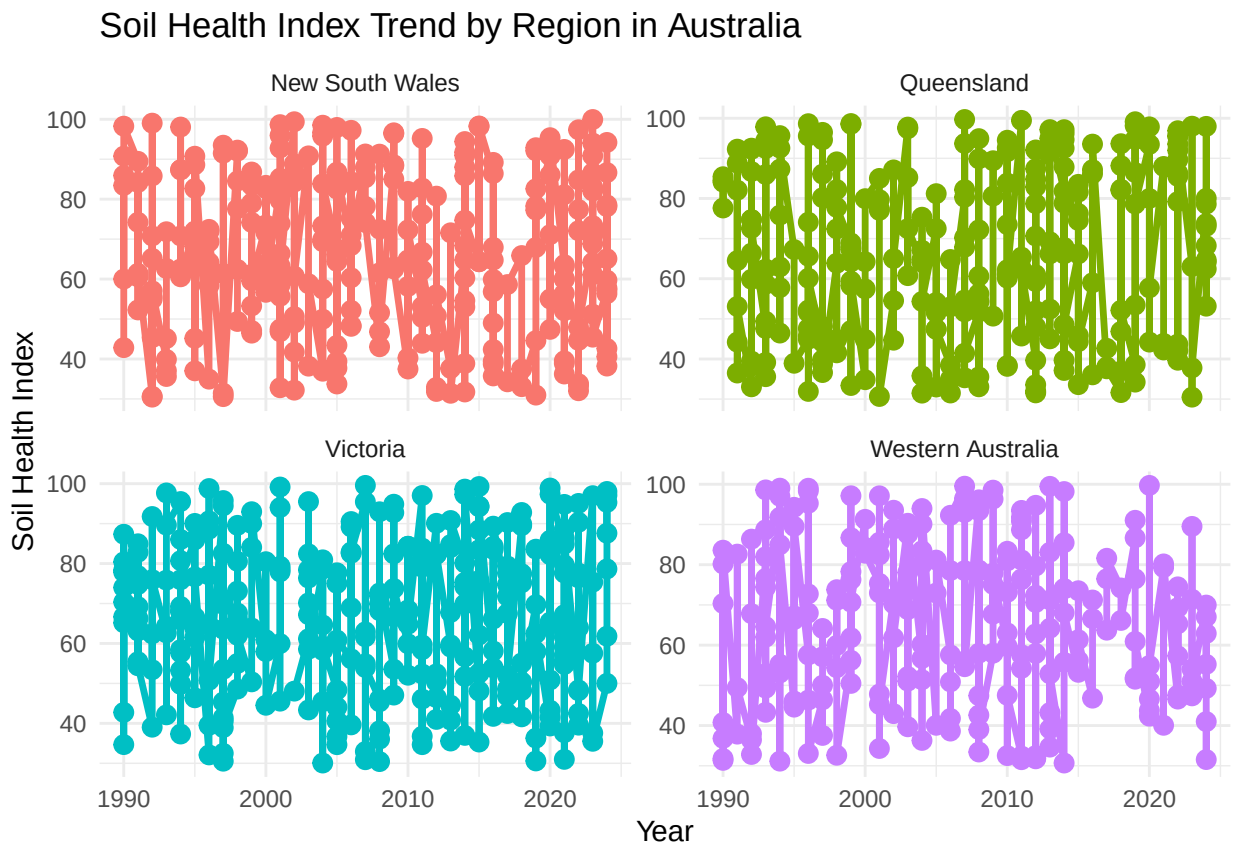

```
# China
plot_soil_health_facet(Climate_Data, "China")
```



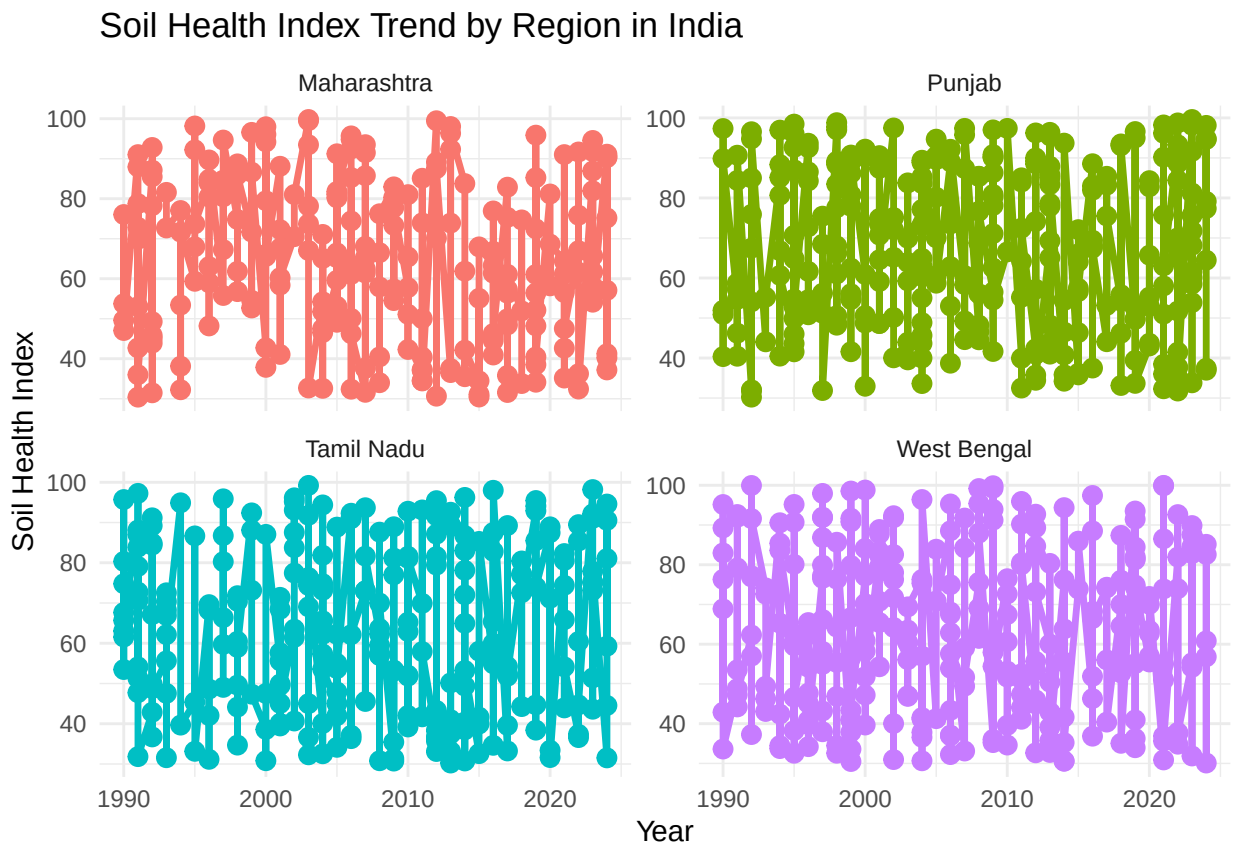

```
# Russia
plot_soil_health_facet(Climate_Data, "Russia")
```



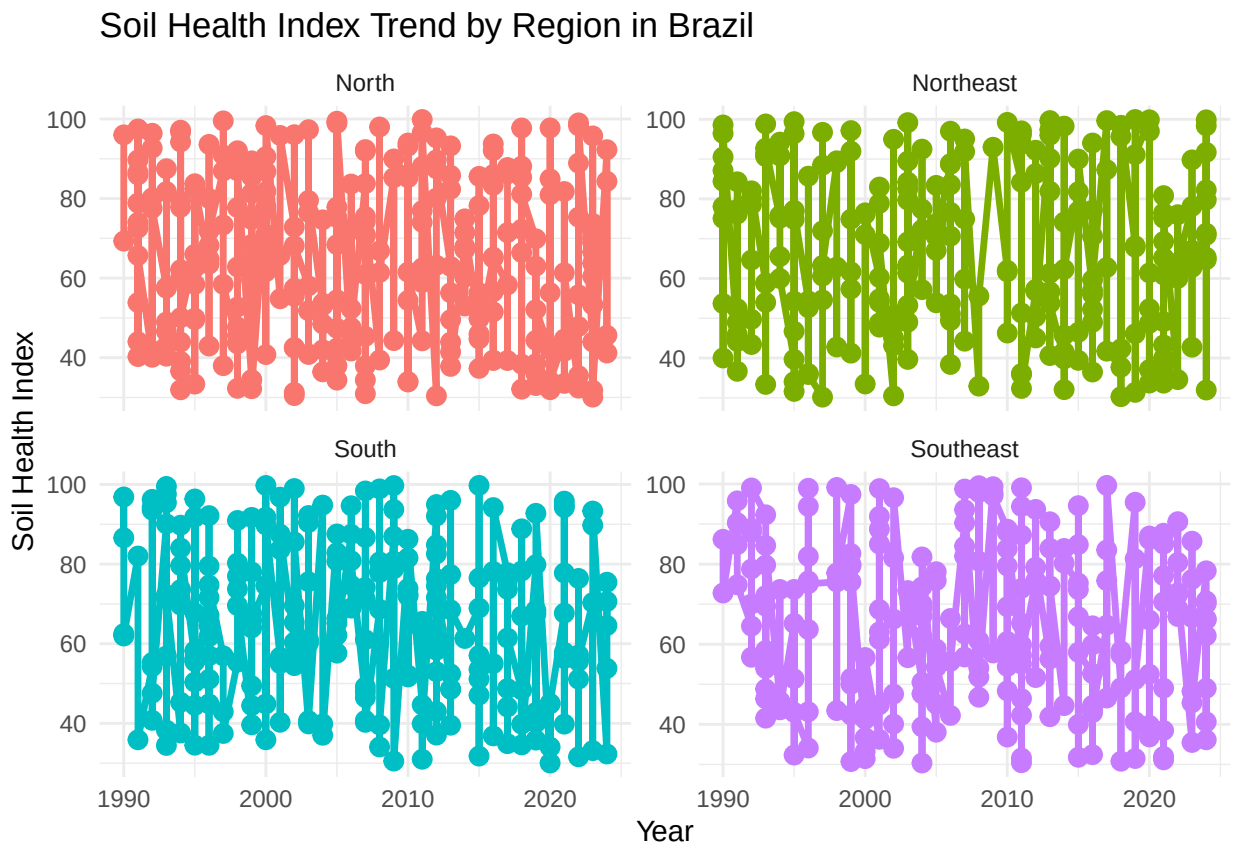

```
# Australia
plot_soil_health_facet(Climate_Data, "Australia")
```



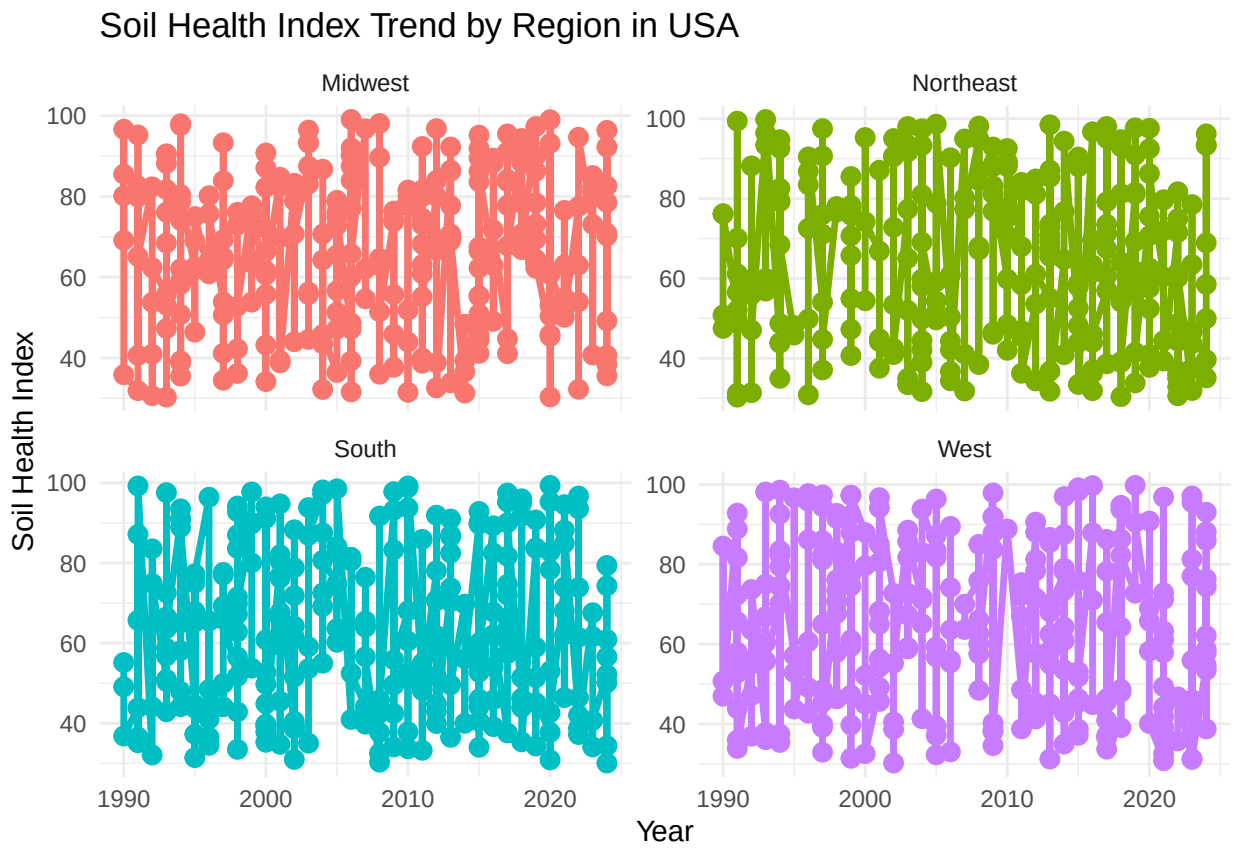

```
# India
plot_soil_health_facet(Climate_Data, "India")
```




```
# Brazil
plot_soil_health_facet(Climate_Data, "Brazil")
```

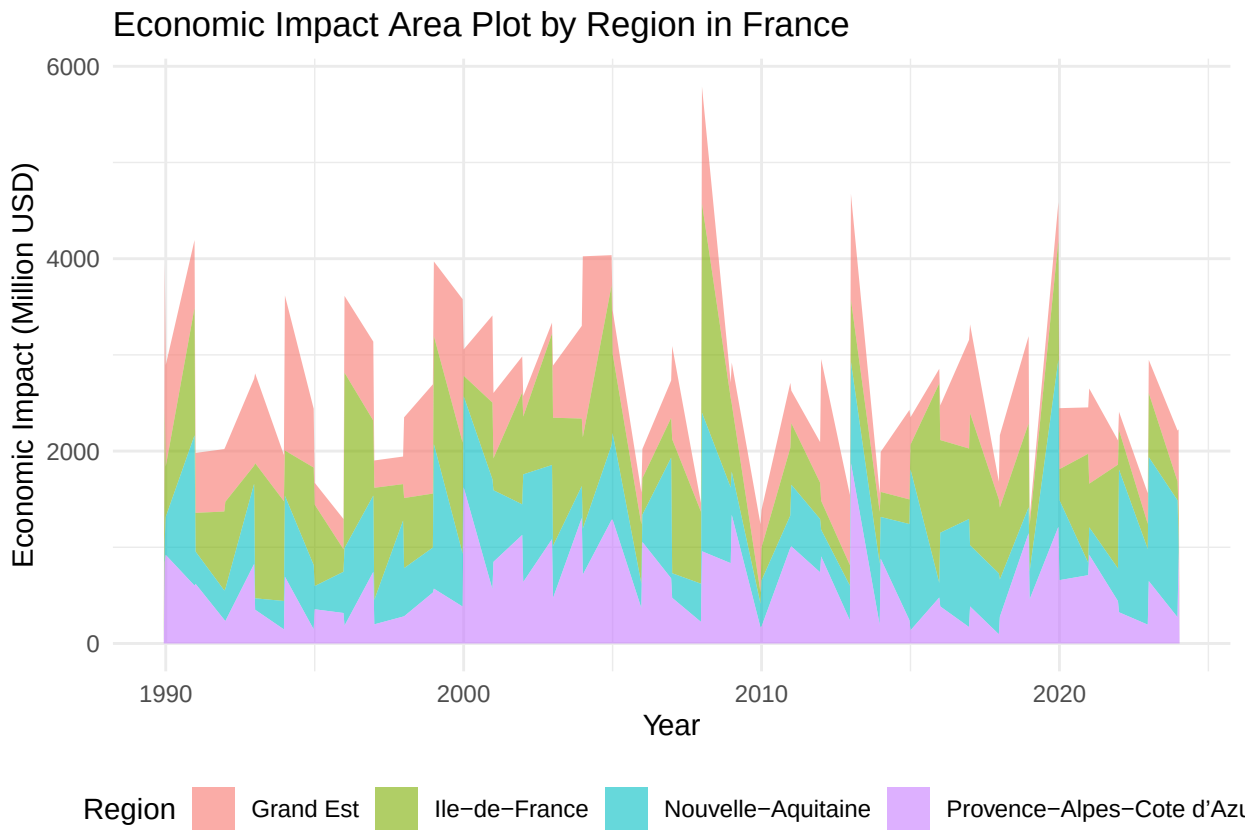



```
# USA
plot_soil_health_facet(Climate_Data, "USA")
```

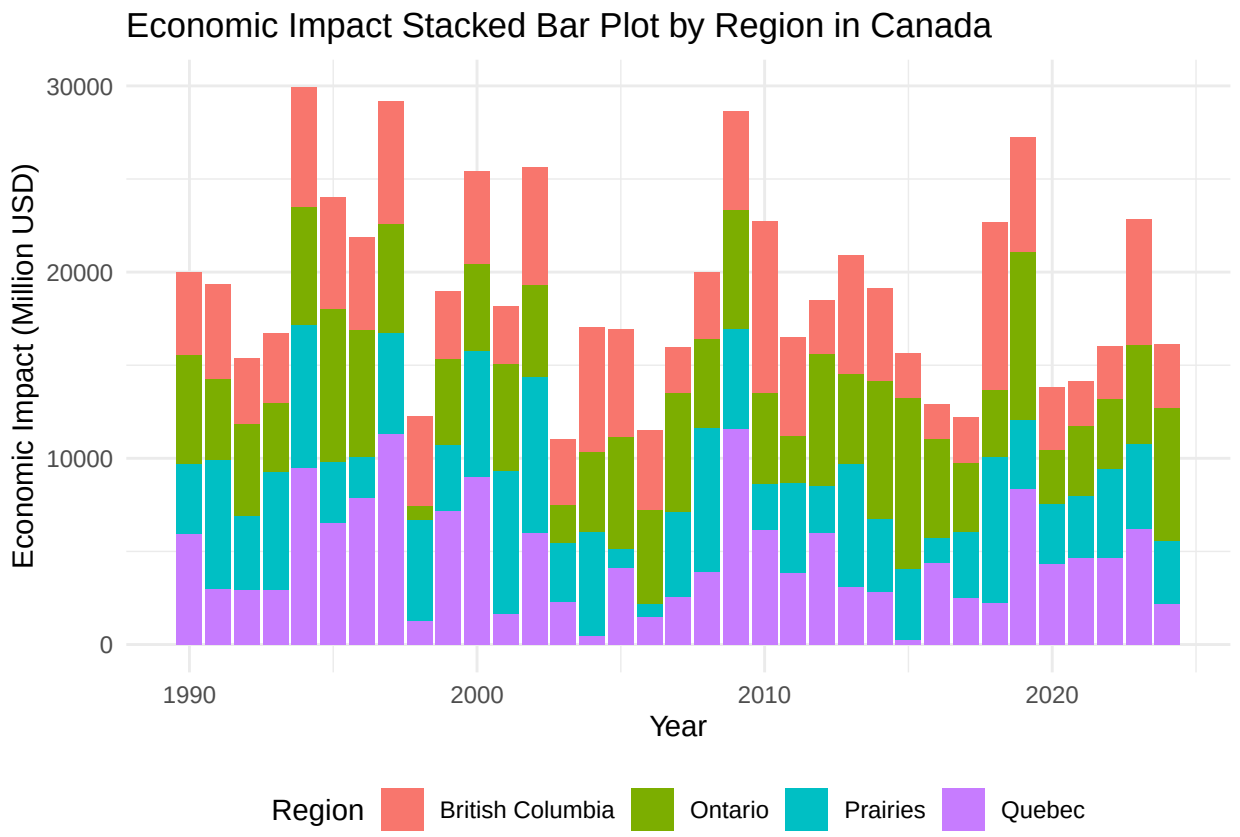



```r
# Function to plot economic impact trend by region for a given country

plot_economic_impact_area <- function(data, country_name) {
  country_data <- data %>%
    filter(Country == country_name)

  if (nrow(country_data) == 0) {
    stop("No data available for the specified country.")
  }

  ggplot(country_data, aes(x = Year, y = Economic_Impact_Million_USD, fill = Region)) +
    geom_area(alpha = 0.6, position = "stack") +
    labs(title = paste("Economic Impact Area Plot by Region in", country_name),
         x = "Year",
         y = "Economic Impact (Million USD)") +
    theme_minimal() +
    theme(legend.position = "bottom")
}


plot_economic_impact_stacked_bar <- function(data, country_name) {
  country_data <- data %>%
    filter(Country == country_name)

  if (nrow(country_data) == 0) {
    stop("No data available for the specified country.")
```

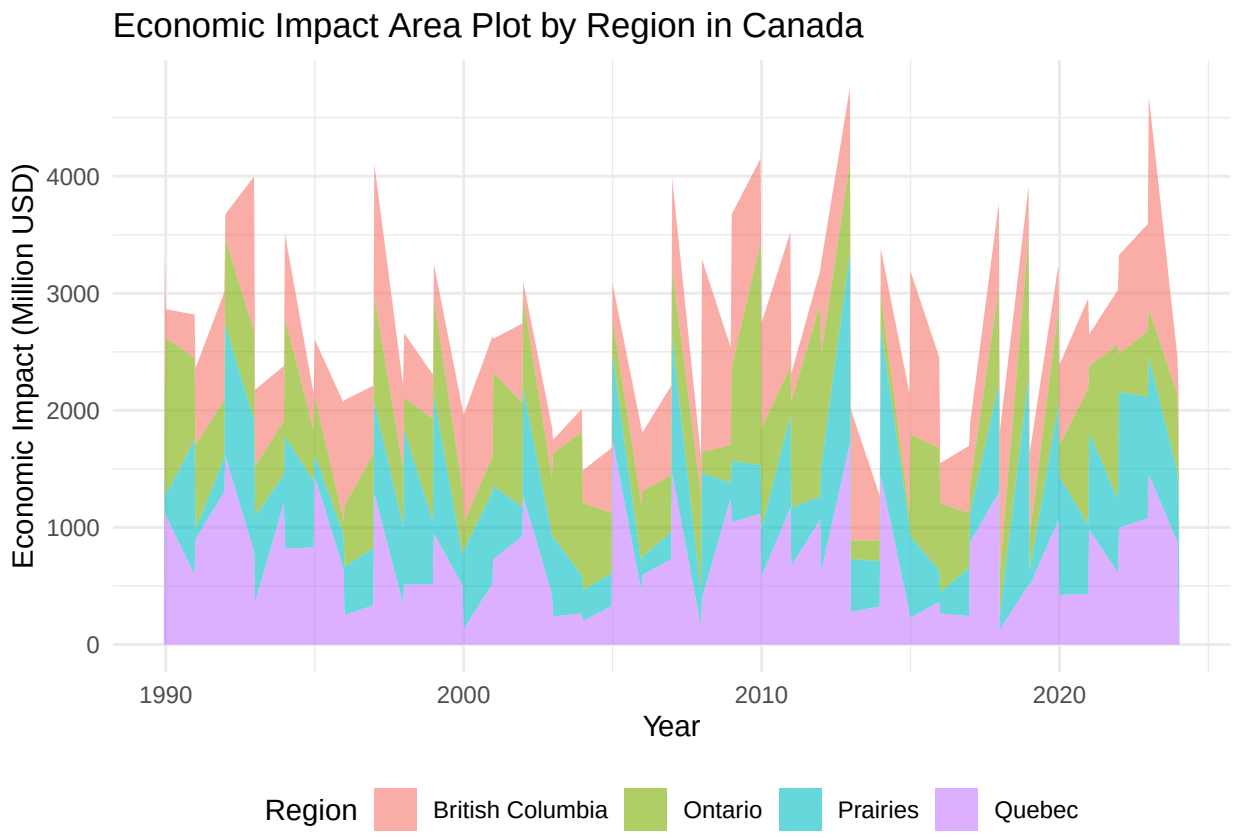
```
  }

  ggplot(country_data, aes(x = Year, y = Economic_Impact_Million_USD, fill = Region)) +
    geom_bar(stat = "identity") +
    labs(title = paste("Economic Impact Stacked Bar Plot by Region in", country_name),
         x = "Year",
         y = "Economic Impact (Million USD)") +
    theme_minimal() +
    theme(legend.position = "bottom")
}



# France
plot_economic_impact_area(Climate_Data, "France")
```



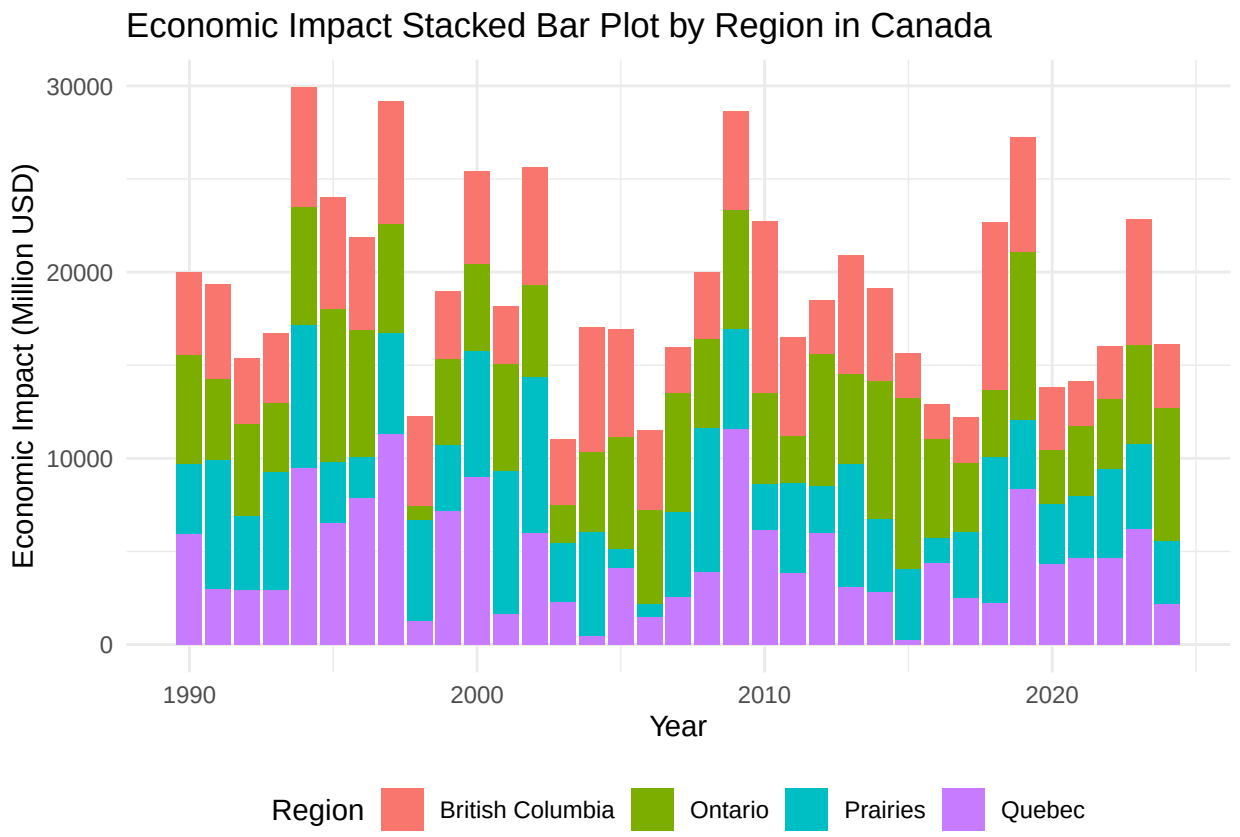

```
plot_economic_impact_stacked_bar(Climate_Data, "Canada")
```



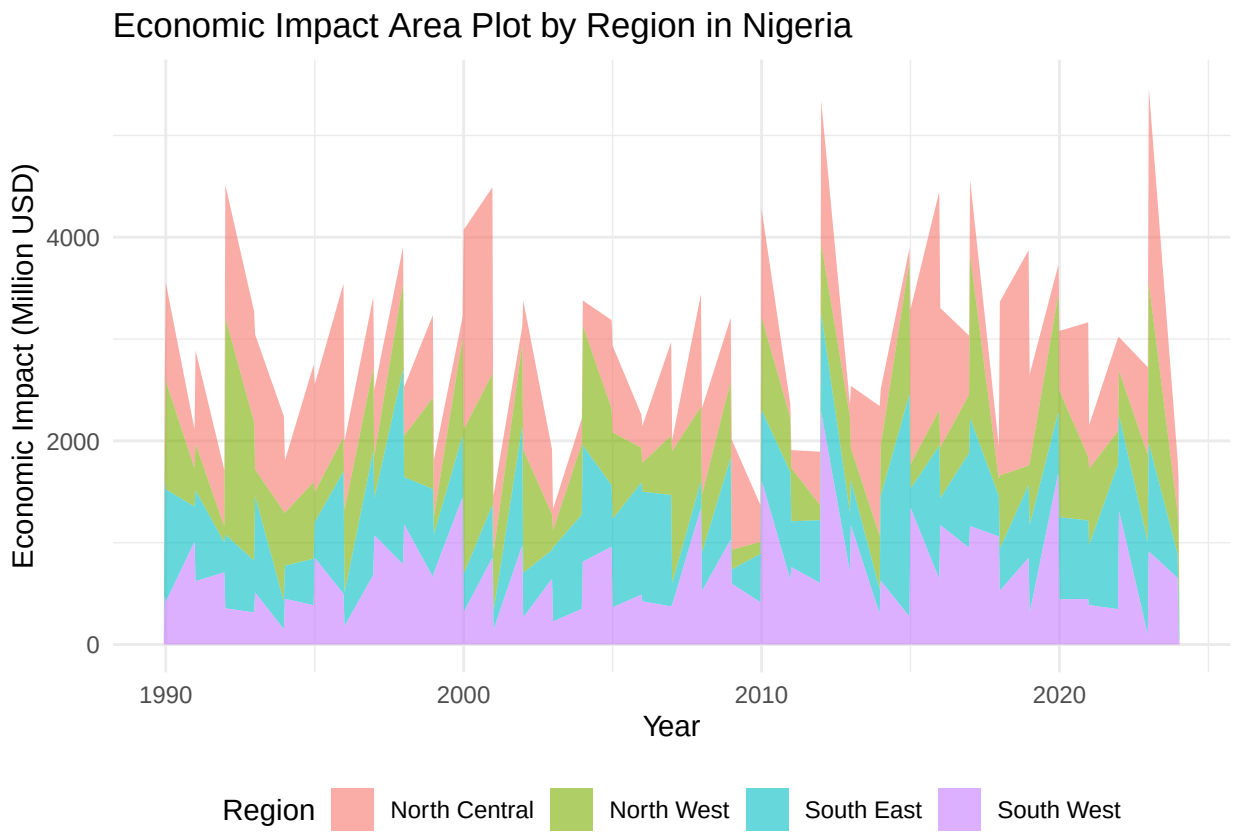

```
# Canada
plot_economic_impact_area(Climate_Data, "Canada")
```



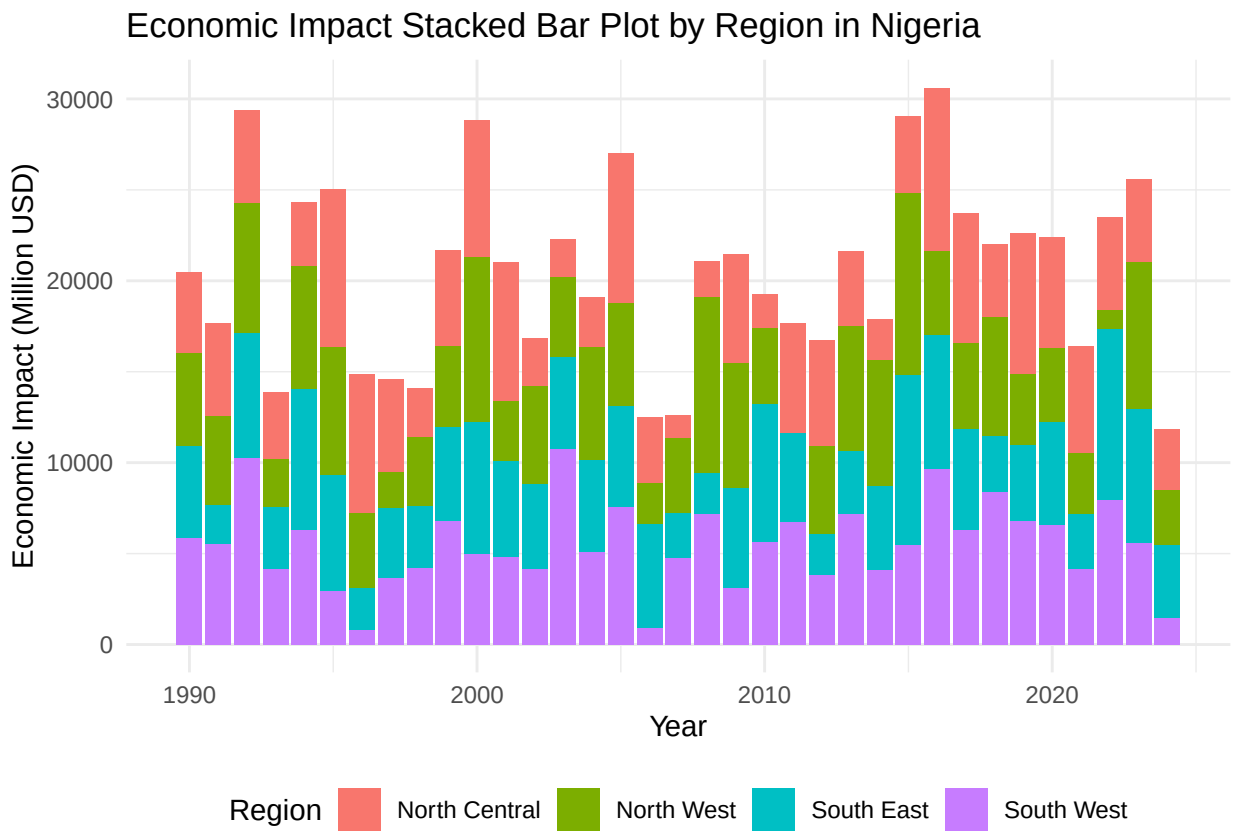

```
plot_economic_impact_stacked_bar(Climate_Data, "Canada")
```



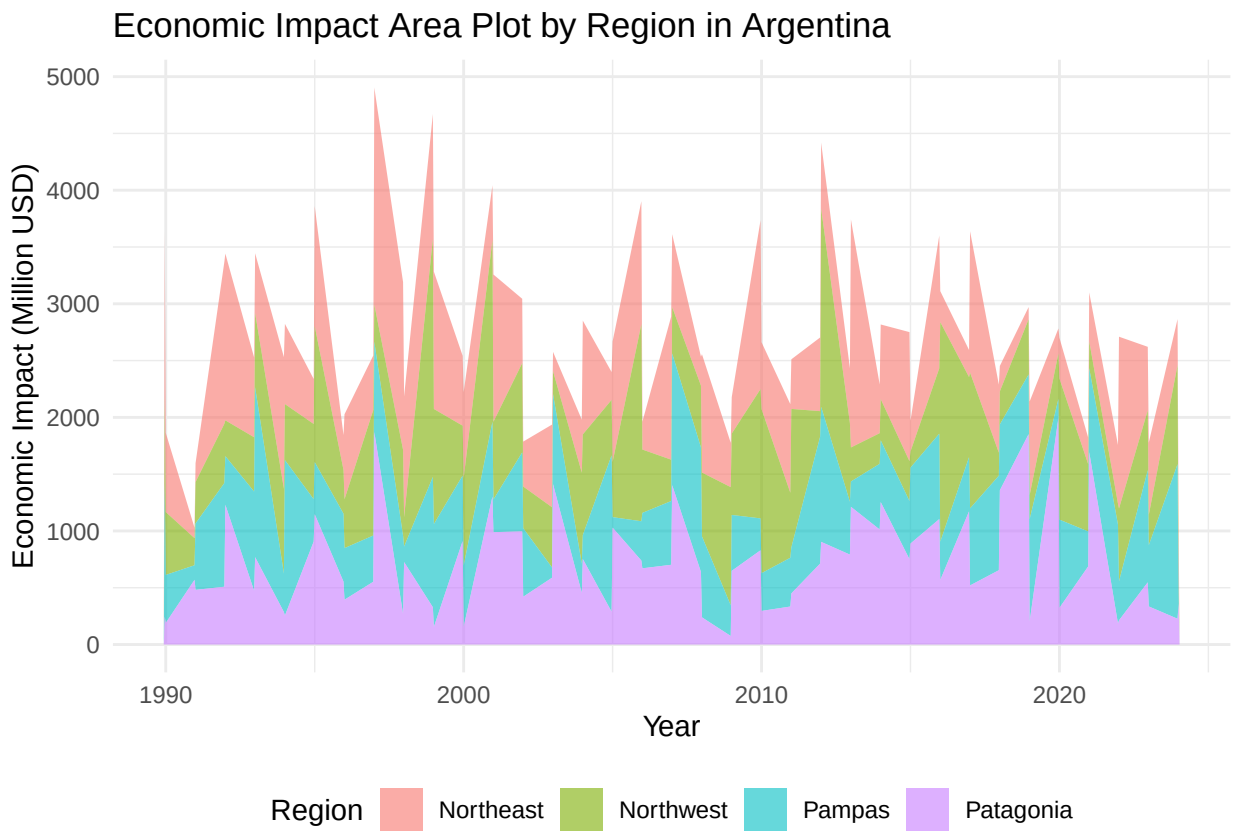

```
# Nigeria
plot_economic_impact_area(Climate_Data, "Nigeria")
```



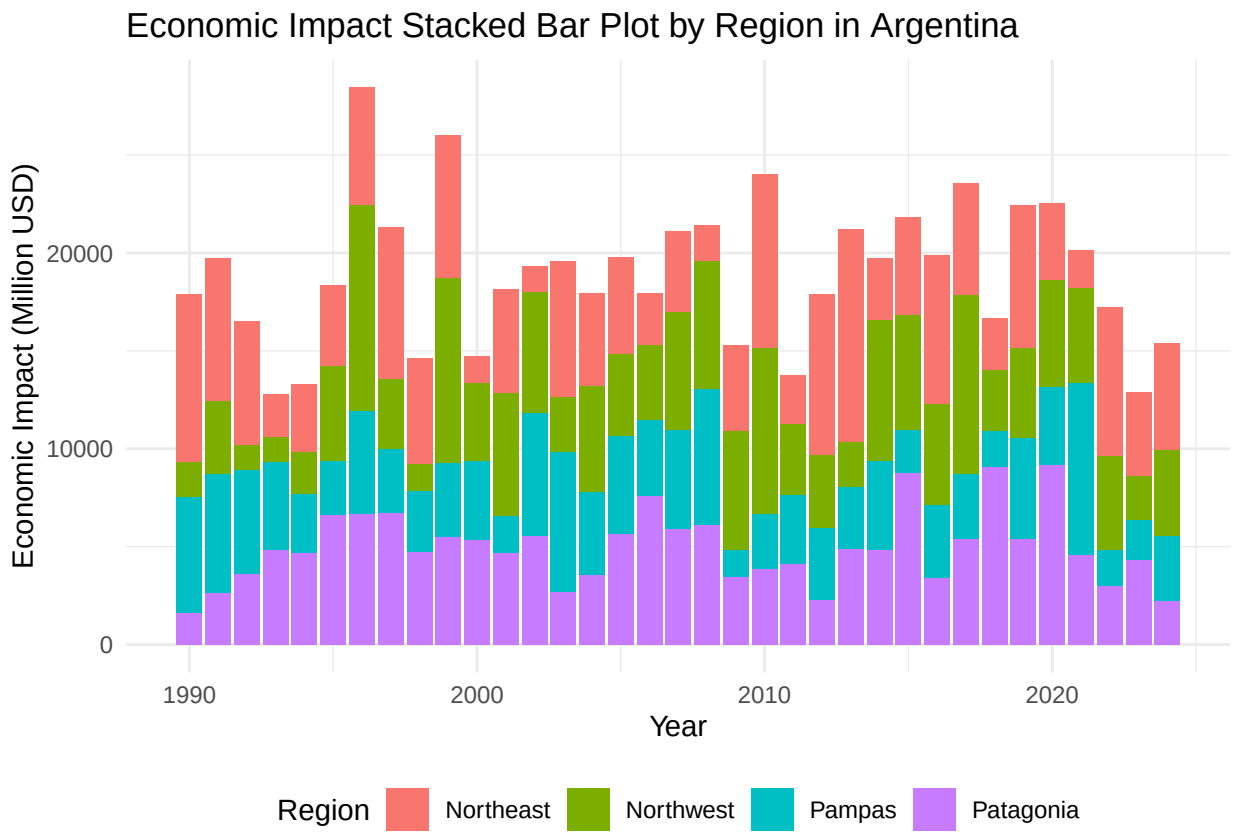

```
plot_economic_impact_stacked_bar(Climate_Data, "Nigeria")
```



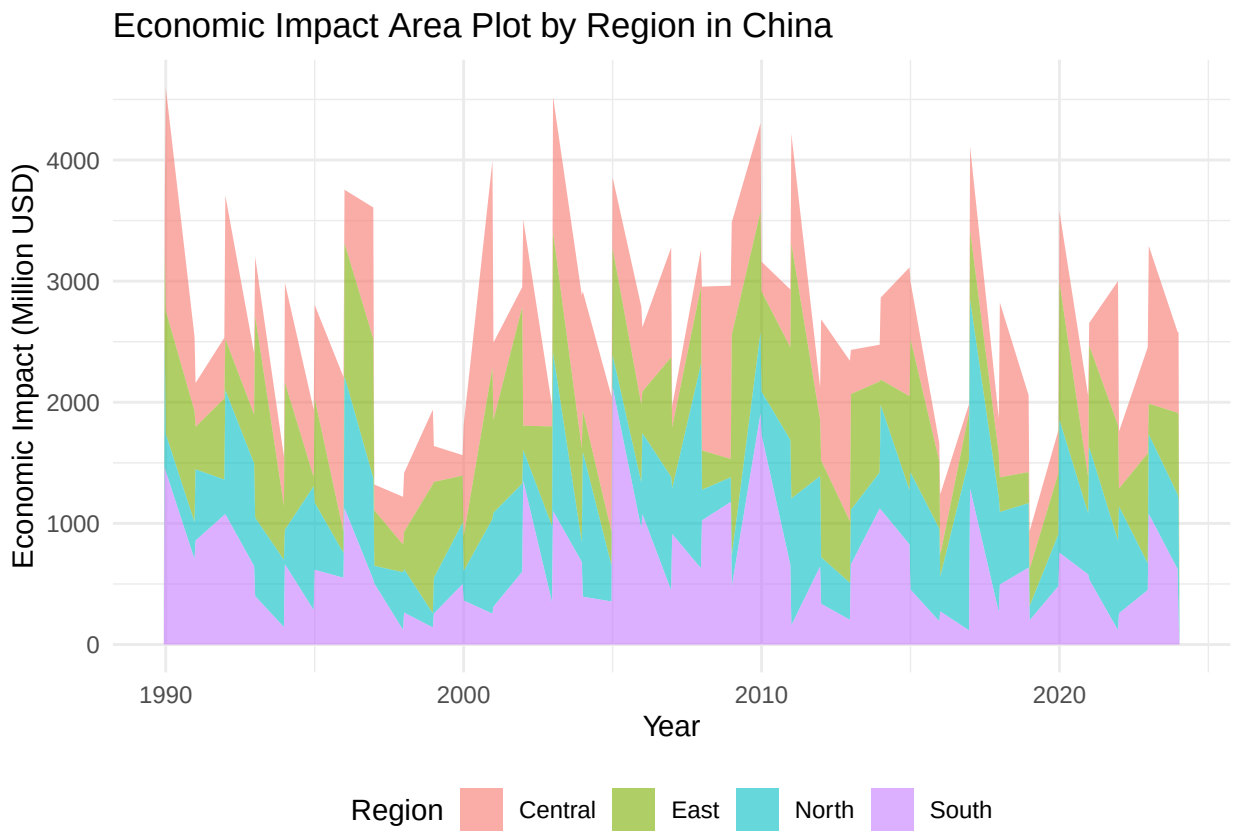

```
# Argentina
plot_economic_impact_area(Climate_Data, "Argentina")
```



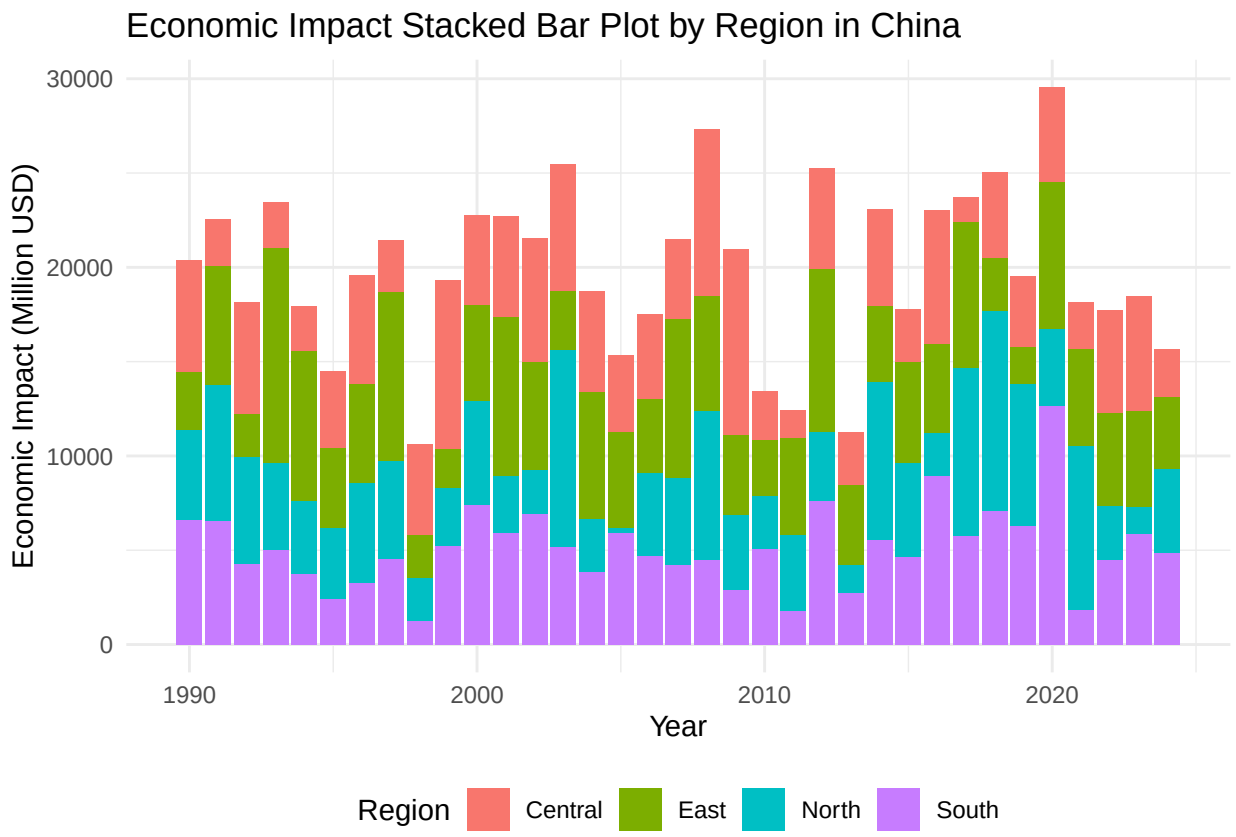

```
plot_economic_impact_stacked_bar(Climate_Data, "Argentina")
```



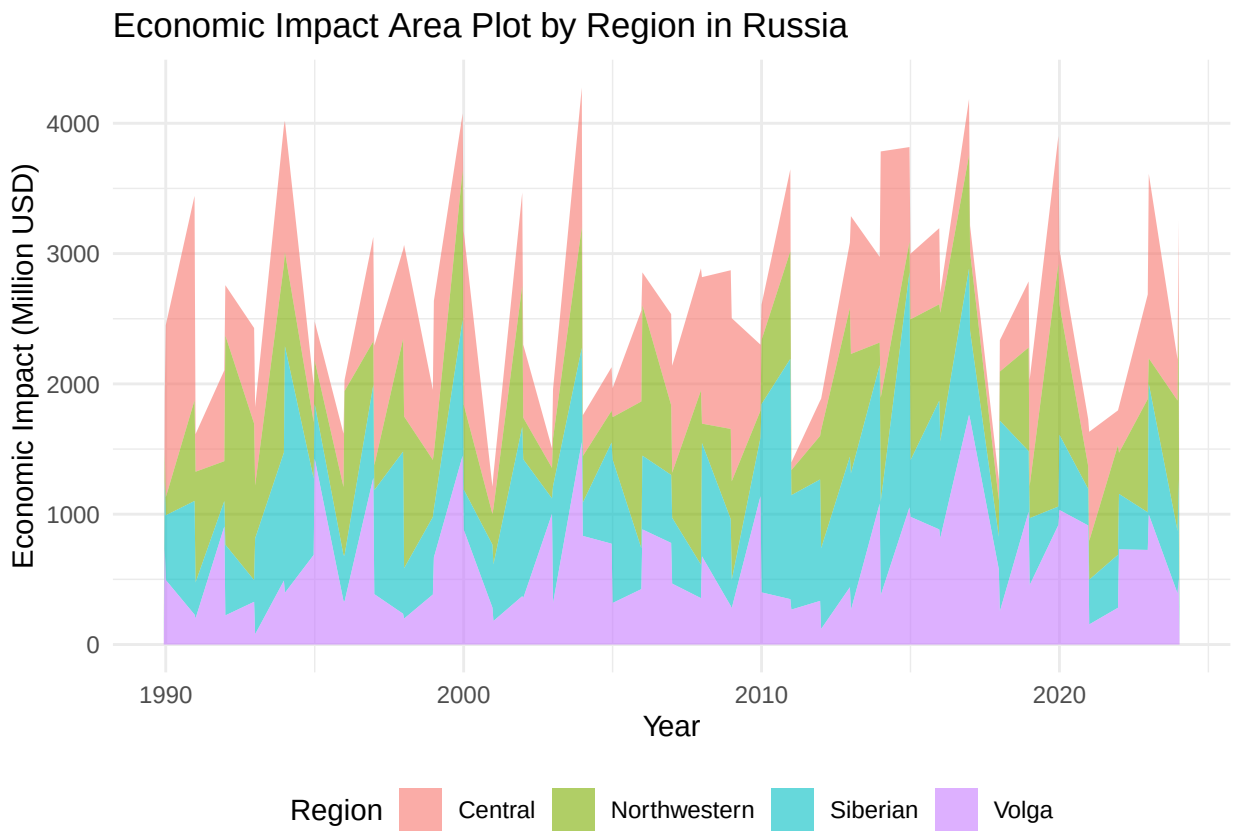

```
# China
plot_economic_impact_area(Climate_Data, "China")
```



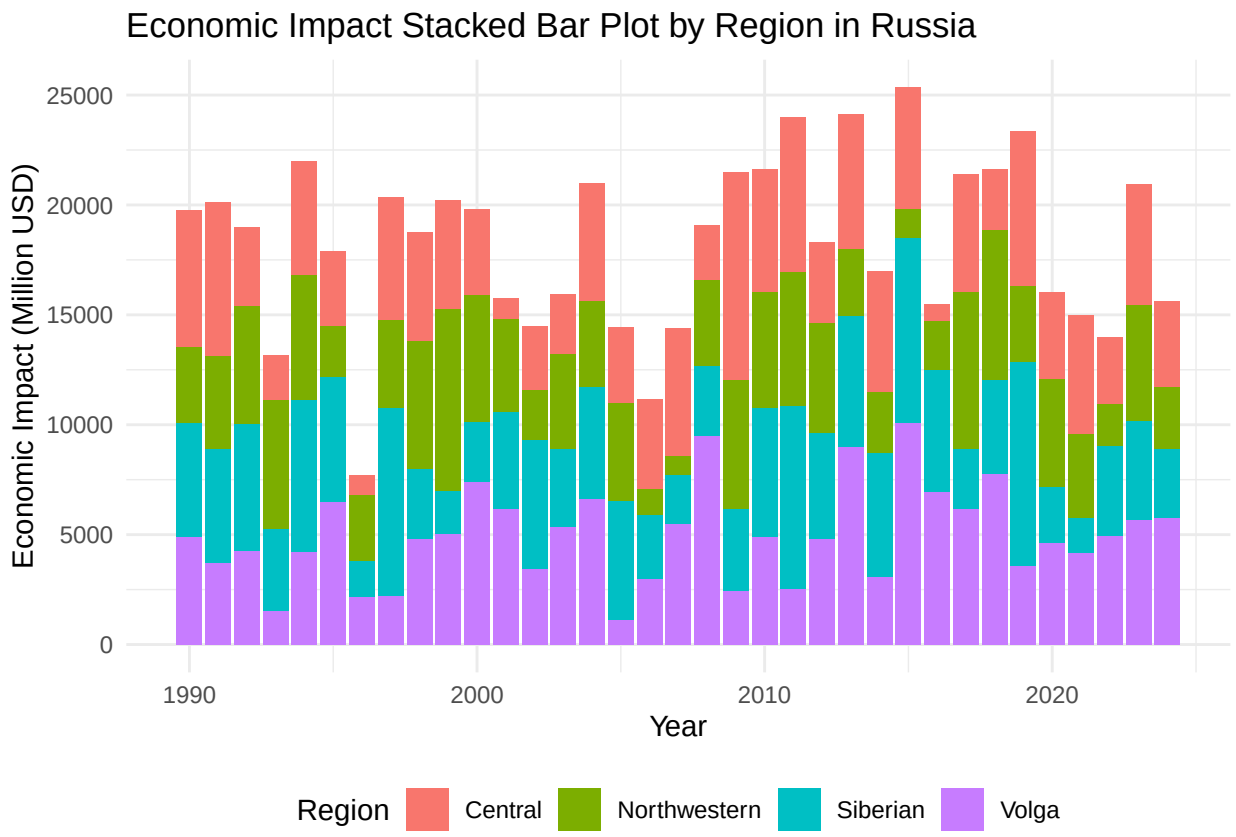

```
plot_economic_impact_stacked_bar(Climate_Data, "China")
```



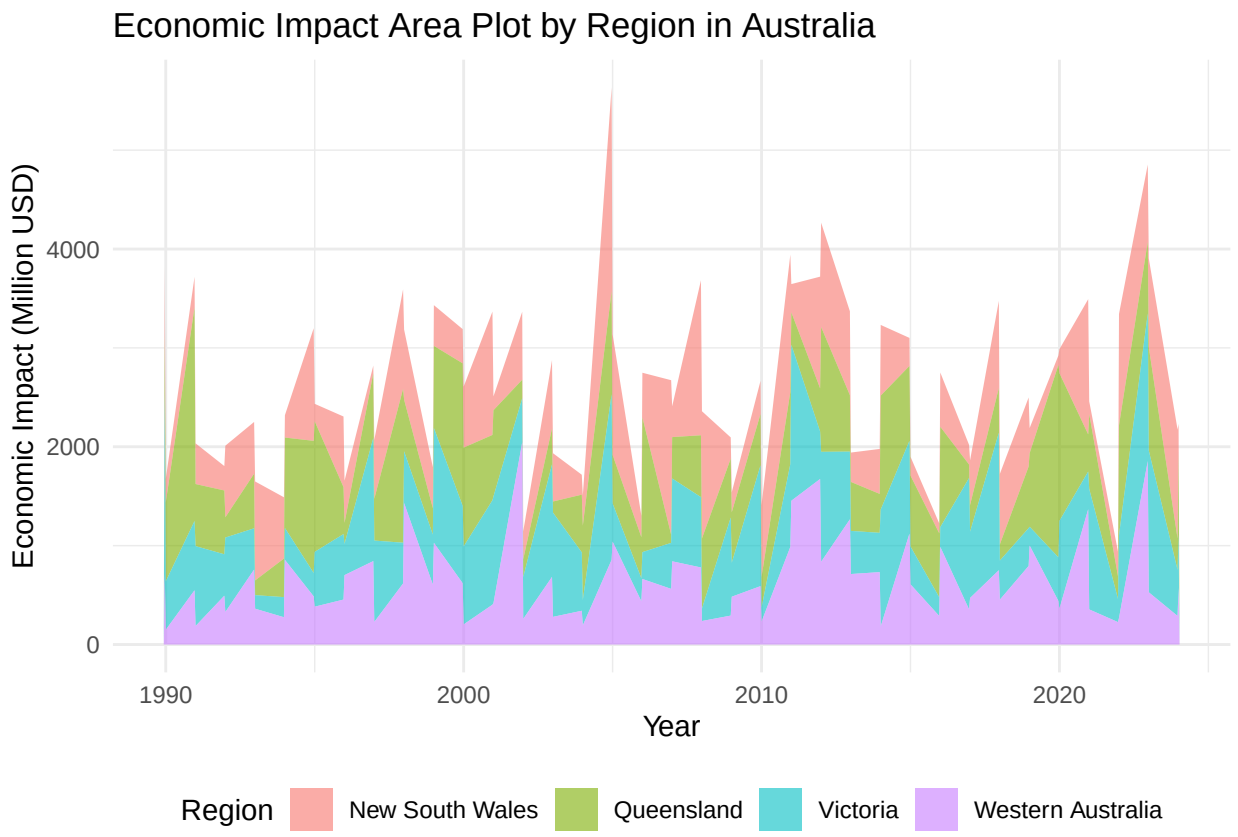

```r
# Russia
plot_economic_impact_area(Climate_Data, "Russia")
```



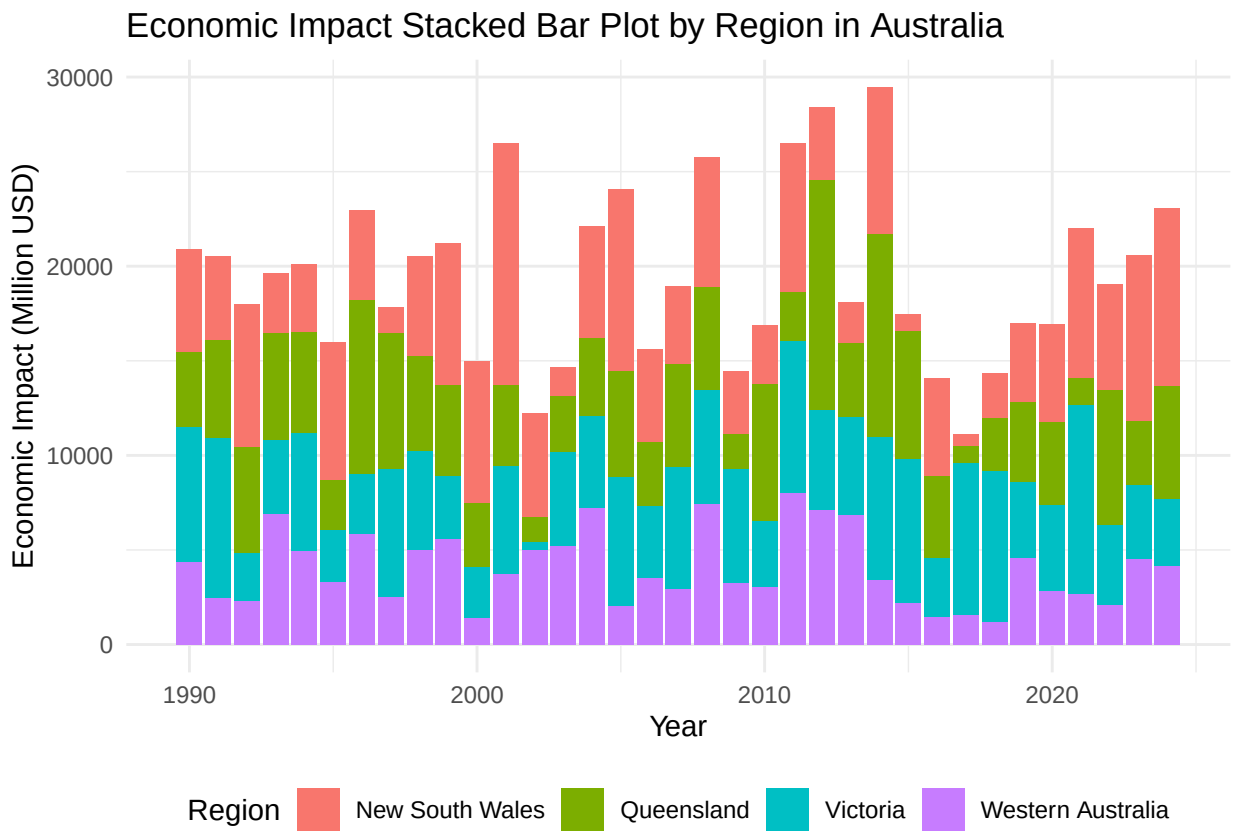

```
plot_economic_impact_stacked_bar(Climate_Data, "Russia")
```



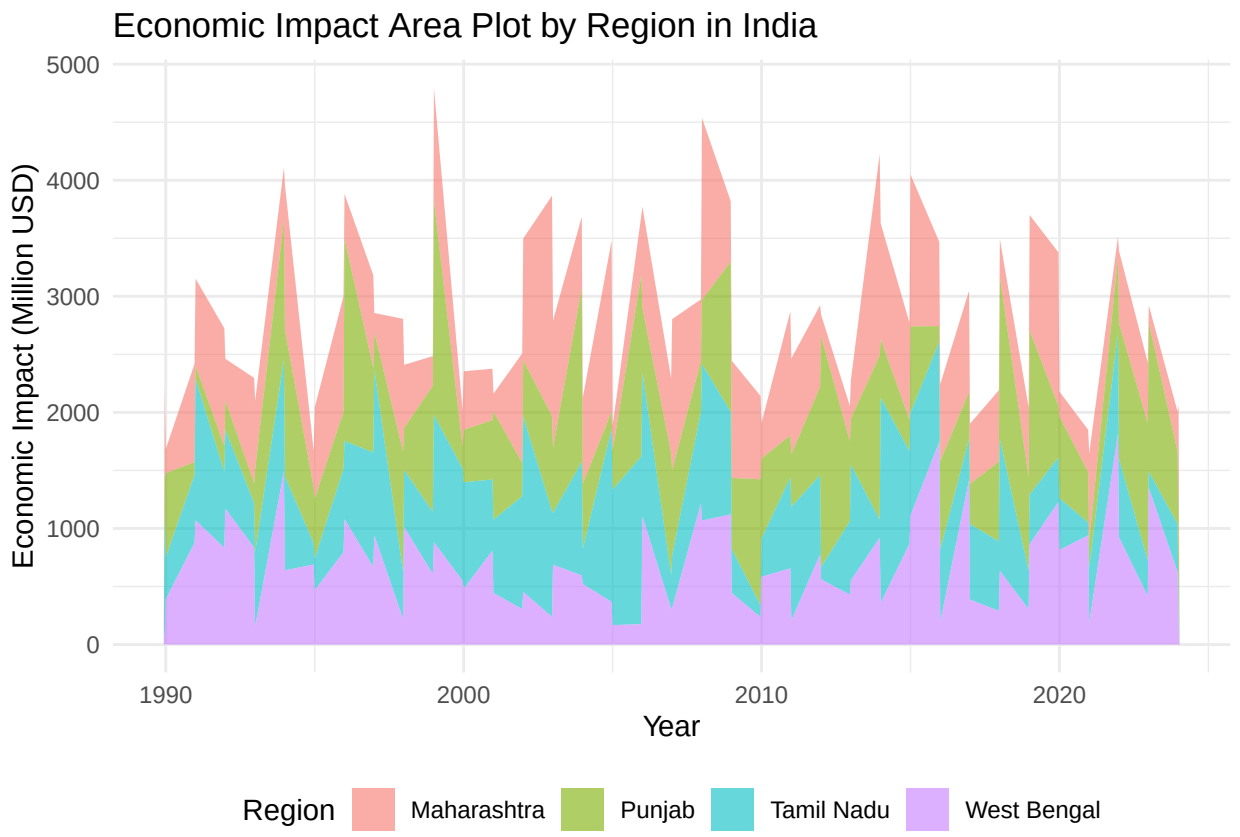

```r
# Australia
plot_economic_impact_area(Climate_Data, "Australia")
```



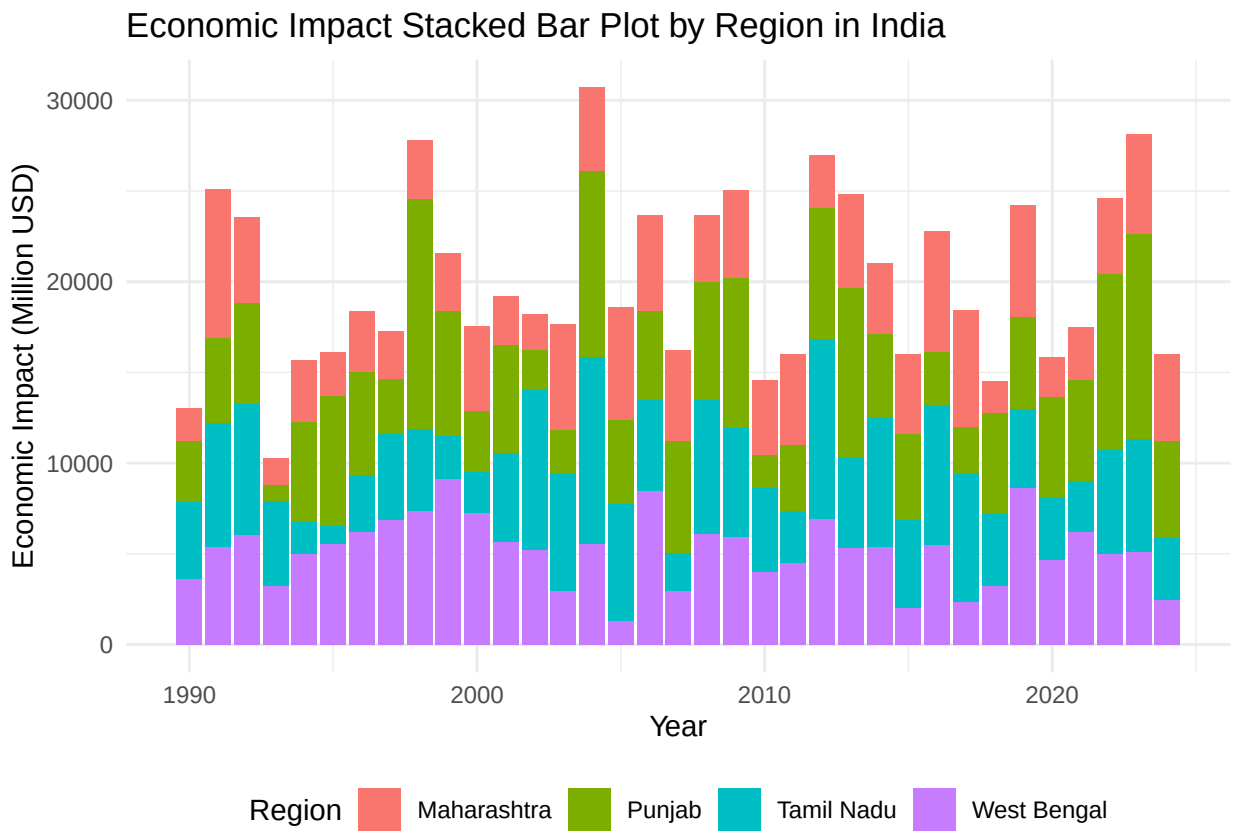

```
plot_economic_impact_stacked_bar(Climate_Data, "Australia")
```



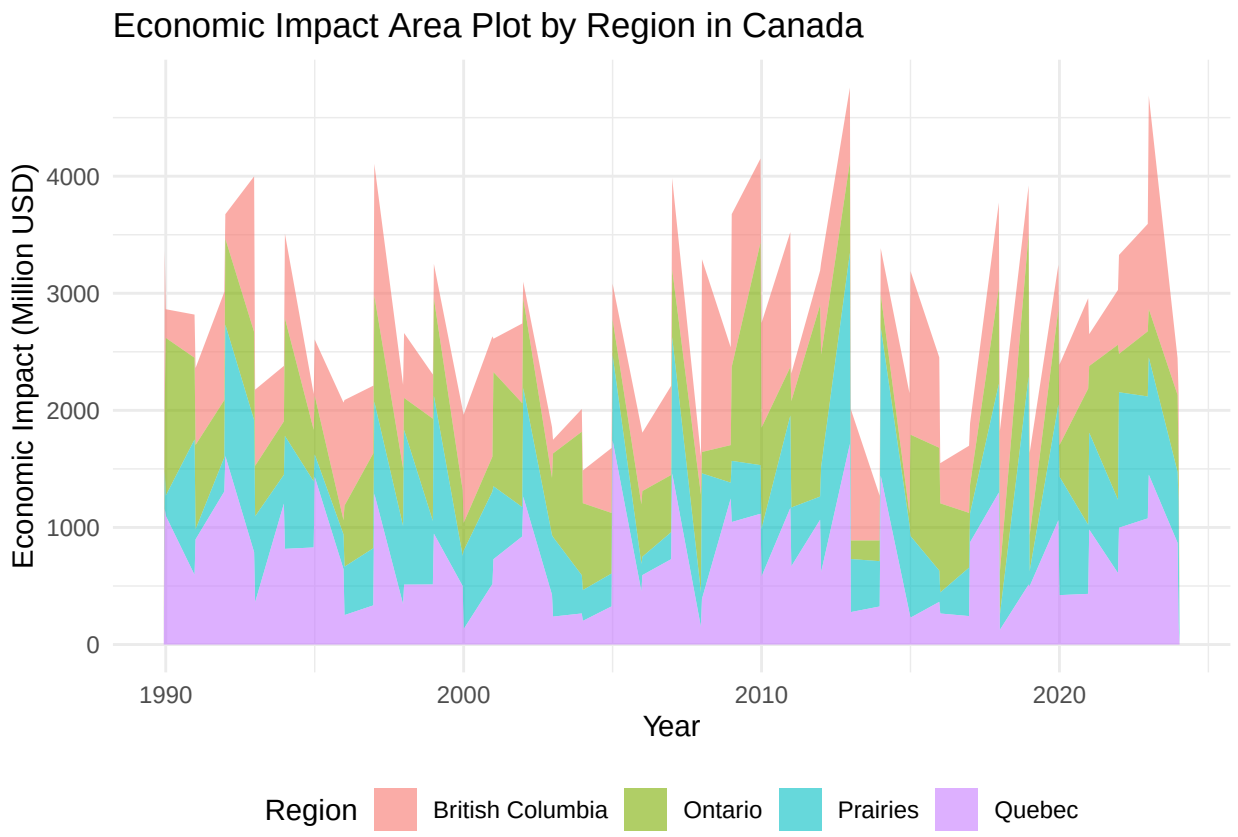

```
# India
plot_economic_impact_area(Climate_Data, "India")
```



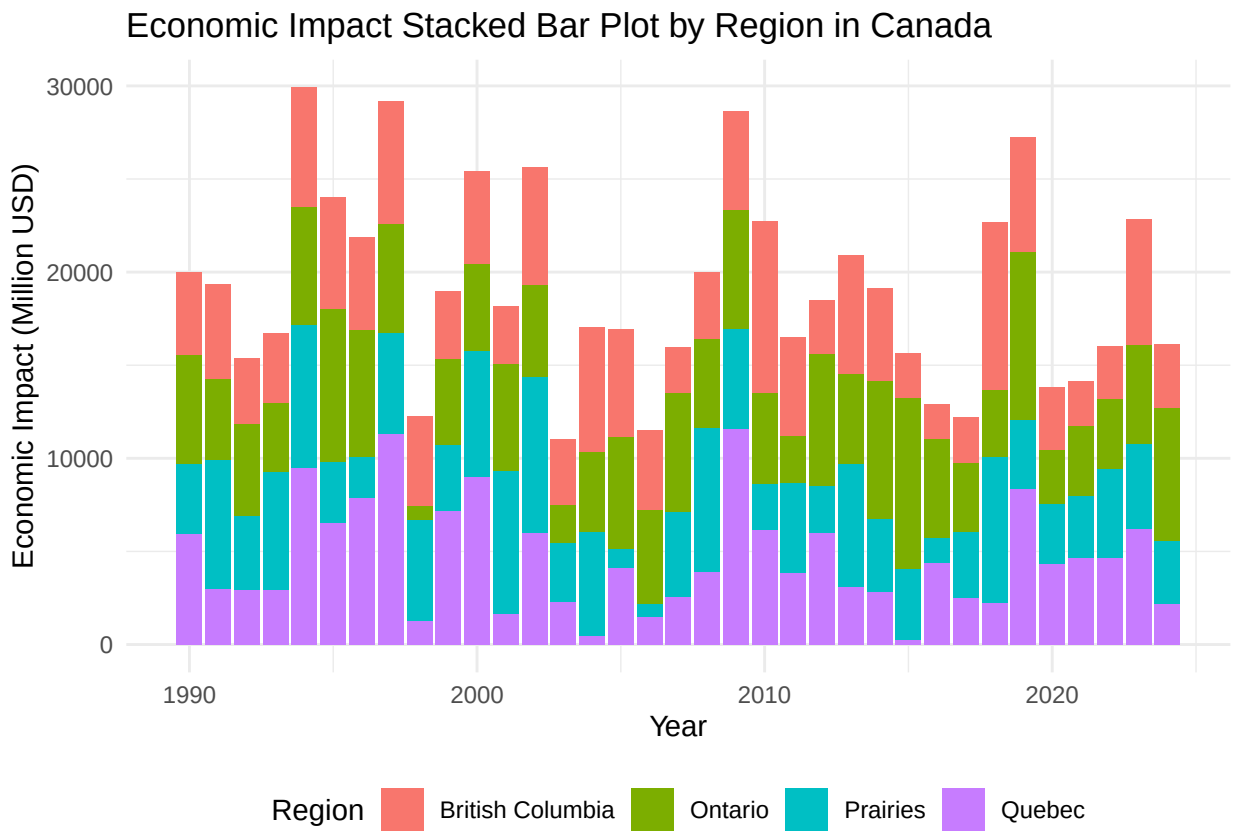

```
plot_economic_impact_stacked_bar(Climate_Data, "India")
```



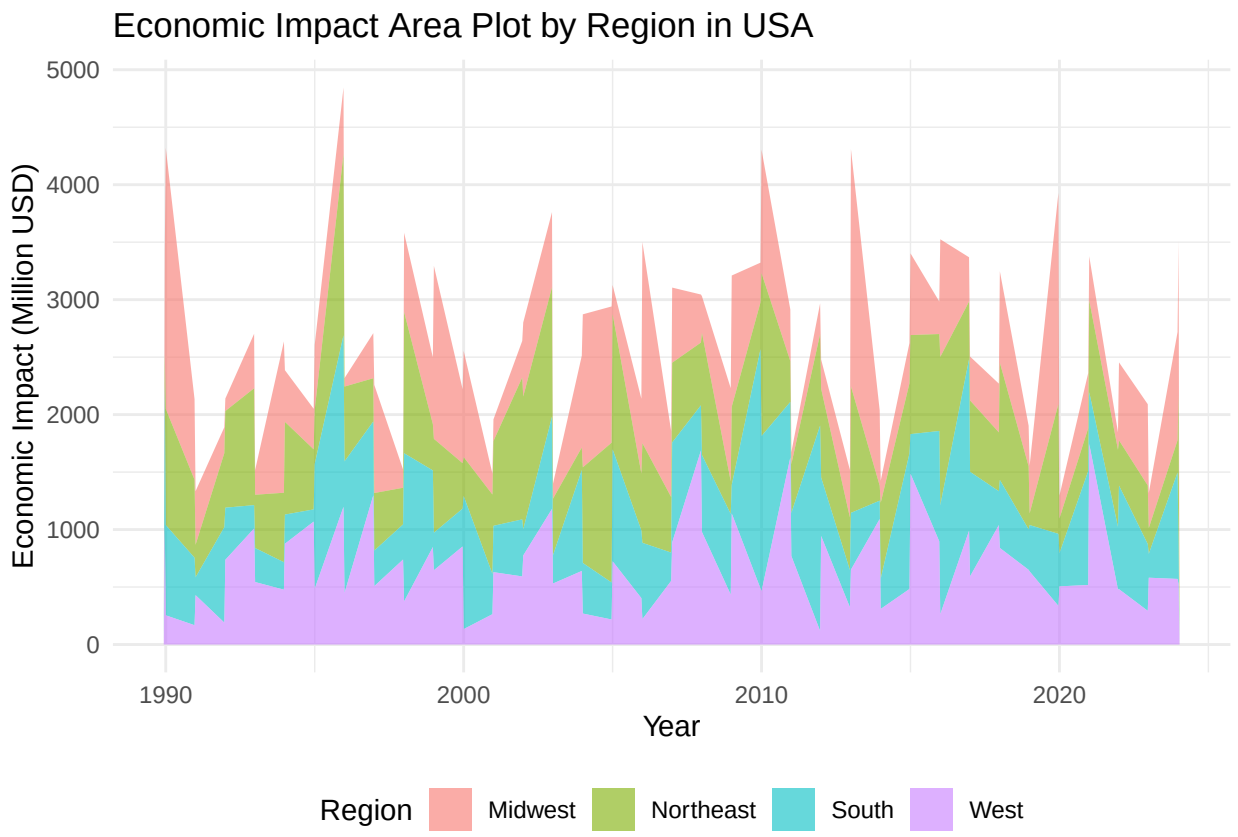

```
# Brazil
plot_economic_impact_area(Climate_Data, "Canada")
```



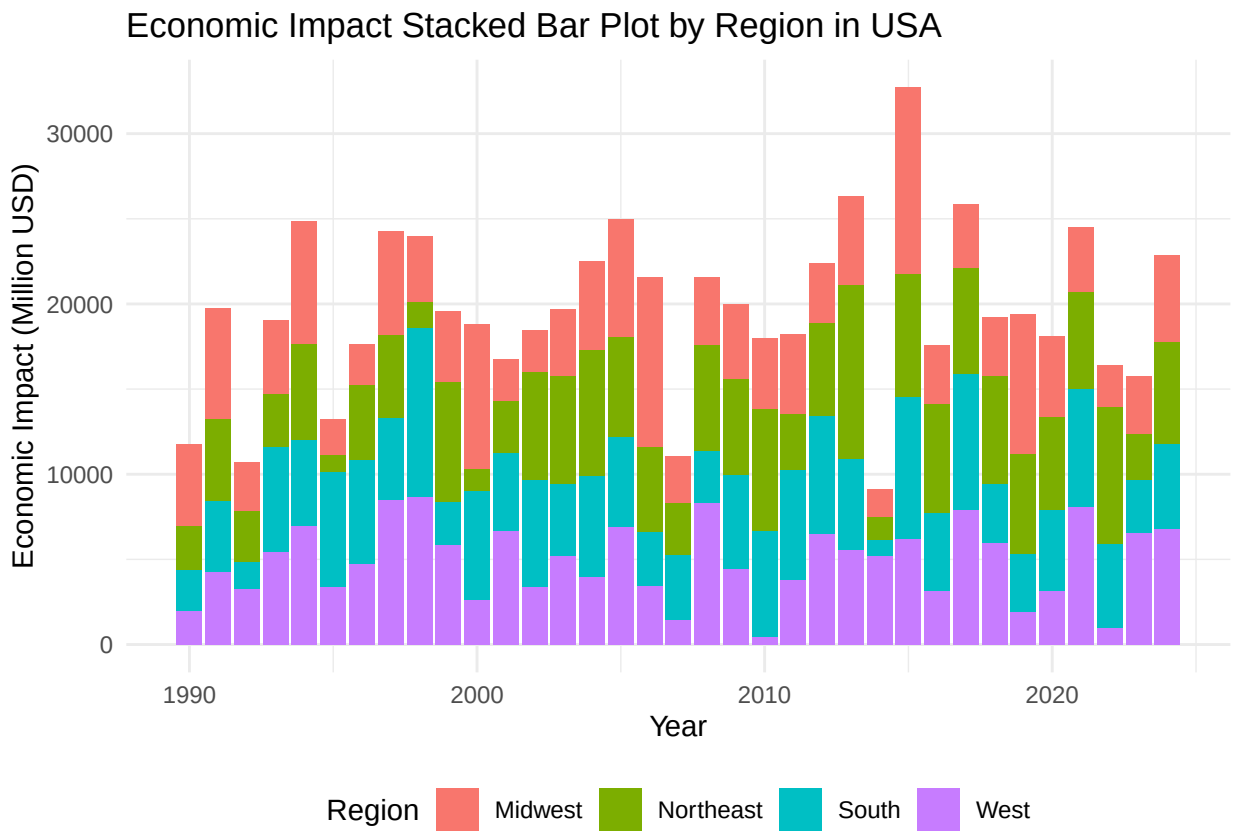

```
plot_economic_impact_stacked_bar(Climate_Data, "Canada")
```




```
# USA
plot_economic_impact_area(Climate_Data, "USA")
```




```
plot_economic_impact_stacked_bar(Climate_Data, "USA")
```


Economic Impact Stacked Bar Plot by Region in USA
Economic Impact (Million USD)
30000
20000
10000
0
1990
2000
2010
2020
Year
Region
Midwest
Northeast
South
West