Armenia Drought Analysis

Contents

1 Setup

```
rm(list=ls())
require(tinytex) #LaTeX
require(ggplot2) #plots
require(haven) #load data
require(dplyr) #data management
require(lubridate) #data dates management
require(zoo) #for lagging
require(jtools) #tables
require(huxtable) #tables
require(lmtest) #reg tests
require(data.table) #for data filtering
require(sandwich) #regression errors
require(readxl) #for reading excel data
require(tidyr) #data
require(tidyverse) #data
require(fixest) #TWFE regression
require(purrr) #for looping plots
options(scipen=999)

latex_format = T

getwd()
setwd("...")
set.seed(123)
```

2 Data Load

```
load("final_data.Rdata")
load("final_data_quartiles.Rdata")
load("final_data_deciles.Rdata")
load("final_data_household.Rdata")
```

Table 1: Summary Statistics

Variable	Mean	SD	Median	Min	Max
agric_income	39837.36	30467.86	30956.55	0.00	161496.48
agric_output	75.97	47.23	69.05	4.90	225.10
agric_stress	6.20	11.62	0.76	0.00	78.37
fdcons	13102.63	6403.40	12615.93	1931.74	40376.19
income	174691.18	87785.61	151666.73	43655.19	429931.04
output_per_field_fruits	6.53	4.19	5.08	0.41	18.16
output_per_field_grains	2.55	0.98	2.55	0.00	4.87
poverty	0.24	0.09	0.24	0.02	0.43
share	0.19	0.16	0.15	0.00	0.64
spei	0.06	0.51	0.05	-1.03	1.31
urban	0.59	0.22	0.50	0.31	1.00

3 Descriptive Evidence

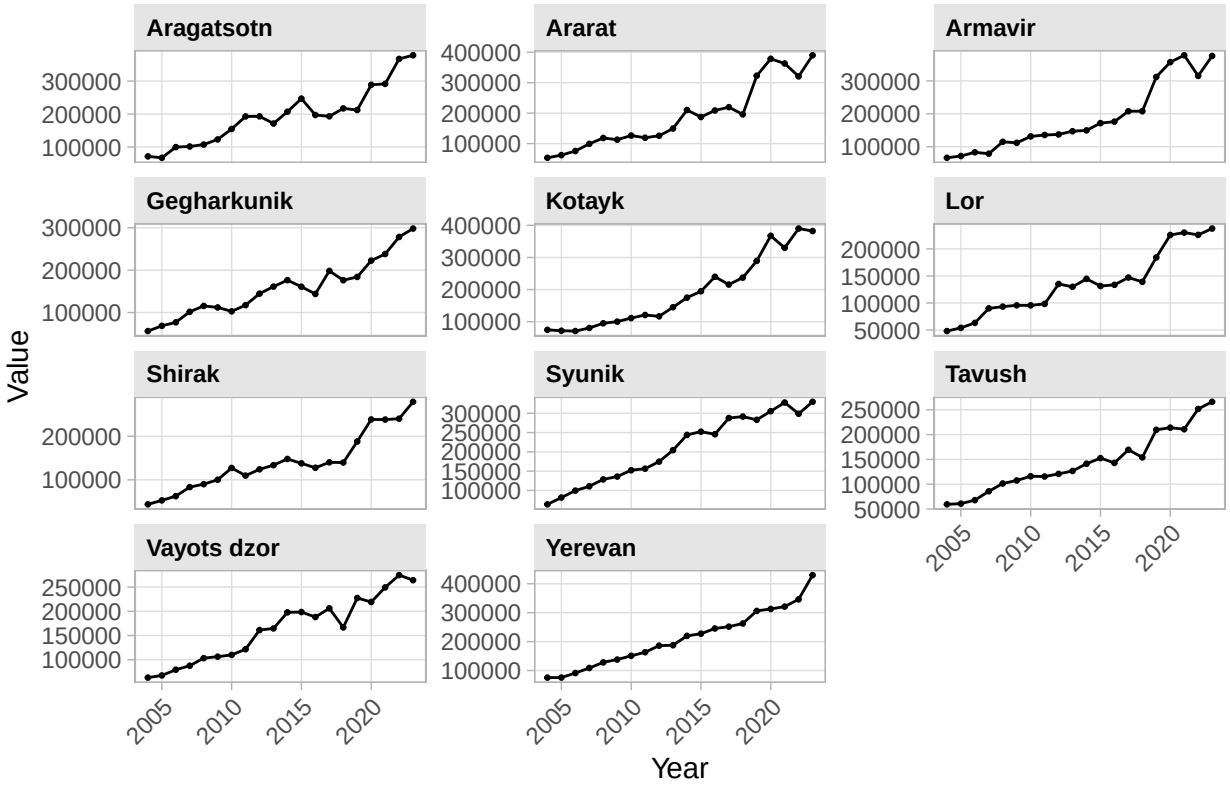
3.1 Summary Statistics

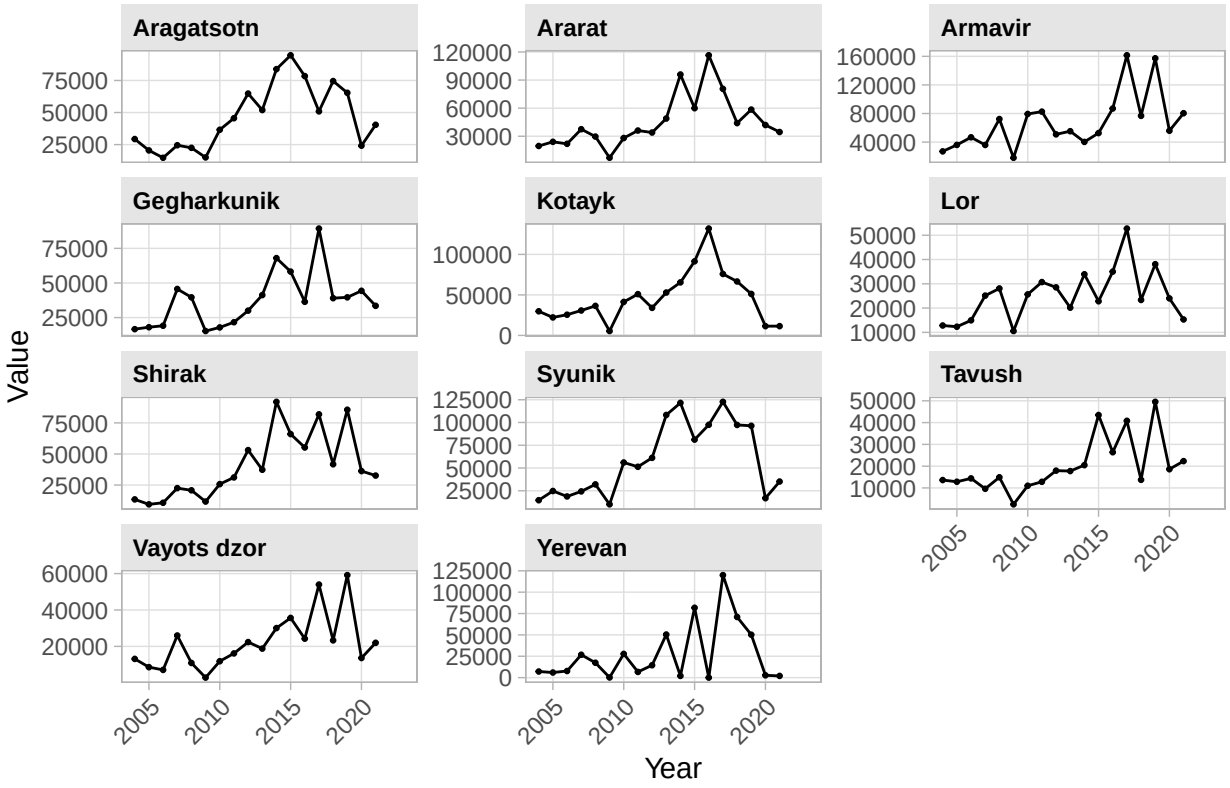
```
summary_stats_data <- dataset %>%
  pivot_longer(cols = c(income, agric_income, agric_output, fdcons, poverty,
                        urban, spei, share, agric_stress,
                        output_per_field_fruits, output_per_field_grains),
               names_to = "Variable",
               values_to = "value")

summary_stats_metric <- summary_stats_data %>%
  group_by(Variable) %>%
  summarize(Mean = mean(value, na.rm = TRUE),
            SD = sd(value, na.rm = TRUE),
            Median = median(value, na.rm = TRUE),
            Min = min(value, na.rm = TRUE),
            Max = max(value, na.rm = TRUE)) %>%
  ungroup()

if (latex_format) { format <- "latex"} else { format <- "html" }
summary_stats_metric %>%
  kableExtra::kable(format = format, digits = 2, caption = "Summary Statistics") %>%
  kableExtra::kable_styling(
    bootstrap_options = c("striped", "hover", "condensed"),
    full_width = FALSE  )
```

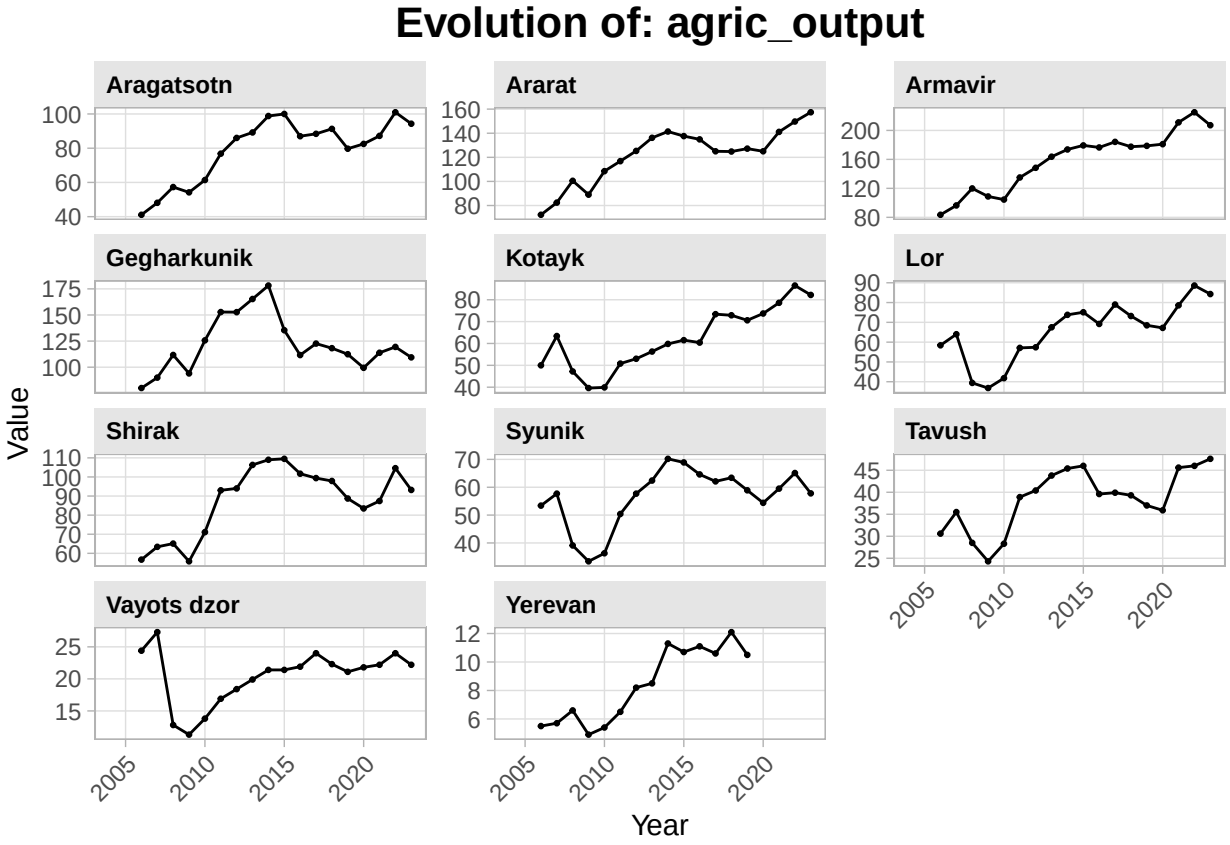
3.2 Raw Data Graphs

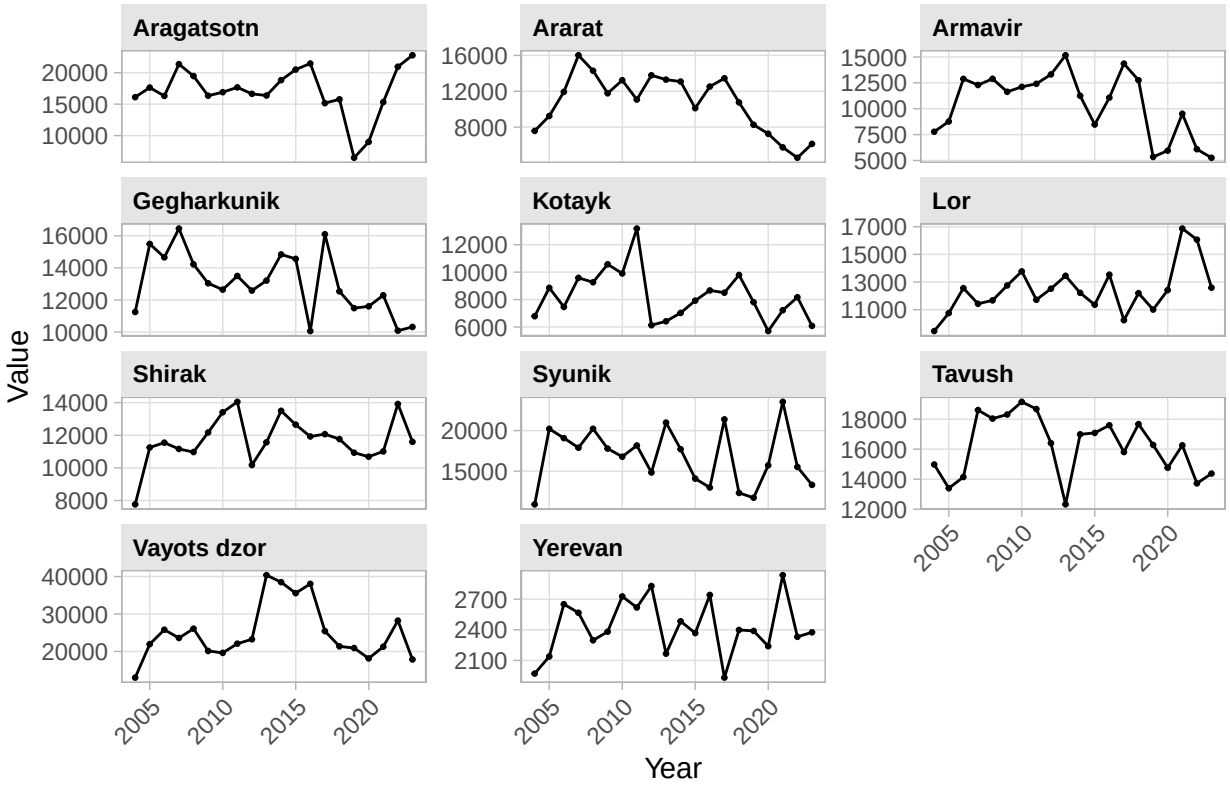
```
plot_data <- dataset %>%
  pivot_longer(cols = c(income, agric_income, agric_output, fdcons, poverty,
                        spei, share, agric_stress, Total_Rainfall,
                        output_per_field_fruits,output_per_field_grains),
```

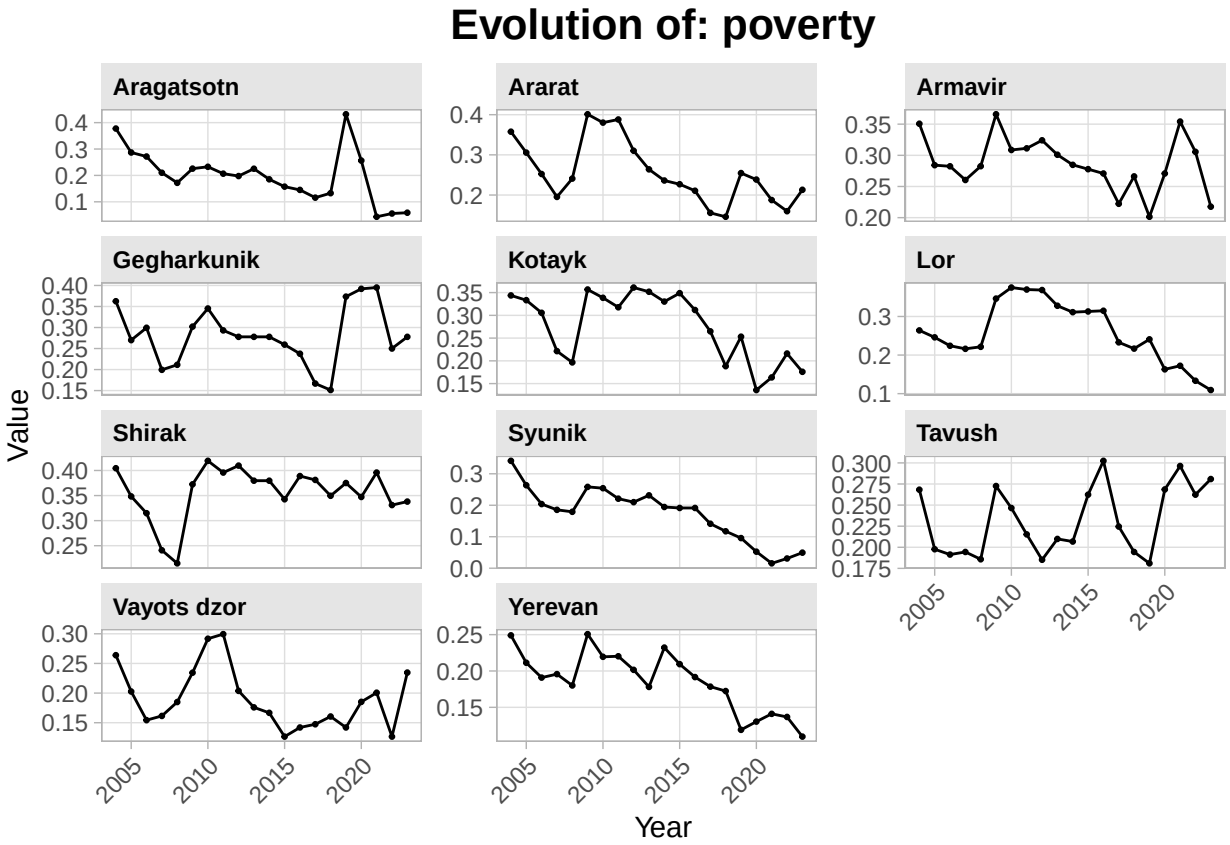
```r
    names_to = "metric",
    values_to = "value" )

all_metrics <- unique(plot_data$metric)

plot_list_by_metric <- map(all_metrics, function(met) {

  plot_data <- plot_data %>%
    filter(metric == met)
  p <- ggplot(plot_data, aes(x = year, y = value)) +
    geom_line() +
    geom_point(size = 0.5) +
    facet_wrap(~ district, scales = "free_y", ncol = 3) +
    labs(title = paste("Evolution of:", met),x = "Year",y = "Value") +
    theme_light() +
    theme(plot.title = element_text(face = "bold", size = 16, hjust = 0.5),
          plot.subtitle = element_text(size = 12, hjust = 0.5),
          plot.caption = element_text(color = "grey50", face = "italic"),
          strip.text = element_text(face = "bold", color = "black", hjust = 0),
          strip.background = element_rect(fill = "grey90", color = NA),
          axis.title = element_text(size = 11),
          axis.text.x = element_text(angle = 45, hjust = 1, size = 9),
          axis.text.y = element_text(size = 9),
          panel.grid.minor = element_blank() )
    print(p)
  #ggsave(filename = paste0("plot_", met, ".png"), plot = p, width = 12, height = 10)
  return(p) } )
```

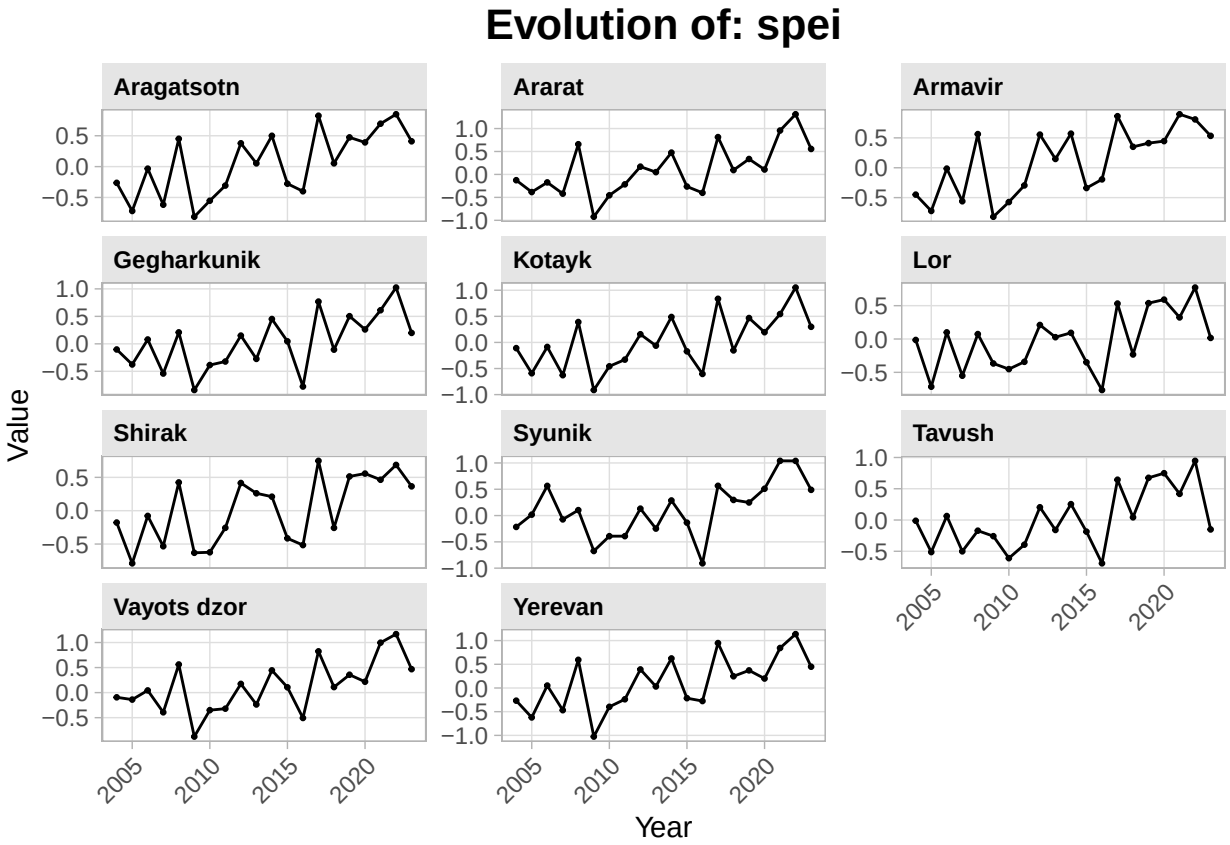

Evolution of: income
Aragatsotn
Ararat
Armavir
Gegharkunik
Kotayk
Lor
Shirak
Syunik
Tavush
Vayots dzor
Yerevan
Value
Year
2005
2010
2015
2020

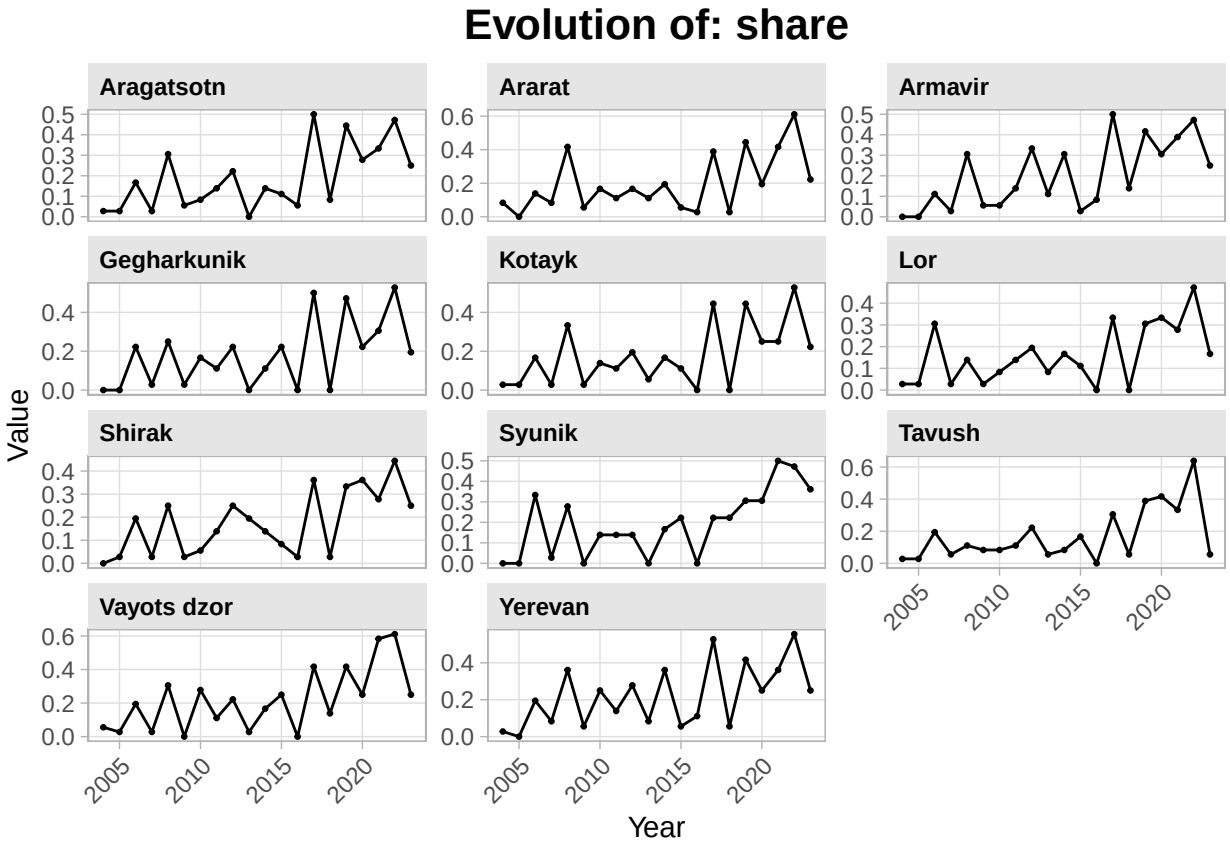

Evolution of: agric_income
Aragatsotn
Ararat
Armavir
Gegharkunik
Kotayk
Lor
Shirak
Syunik
Tavush
Vayots dzor
Yerevan
Value
Year
2005
2010
2015
2020

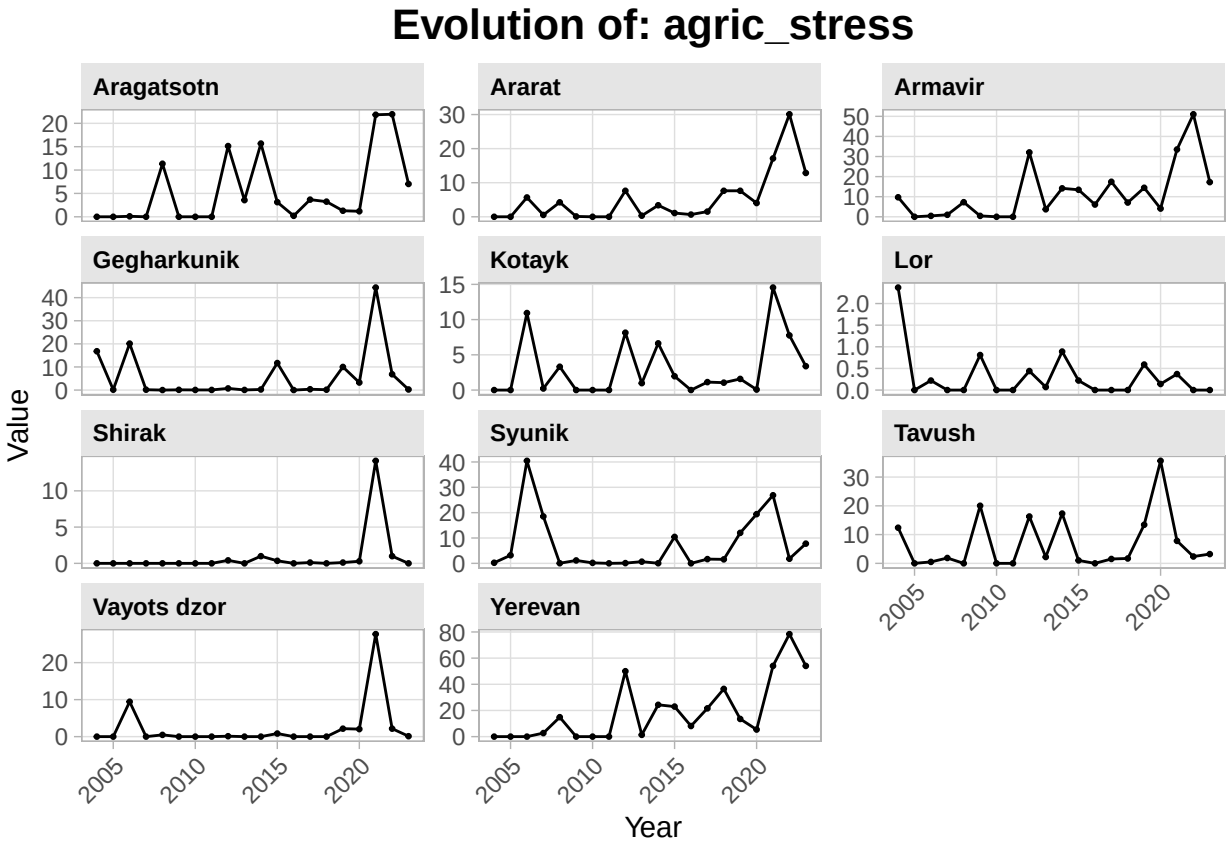

Evolution of: agric_output
Aragatsotn
Ararat
Armavir
Gegharkunik
Kotayk
Lor
Shirak
Syunik
Tavush
Vayots dzor
Yerevan
Value
Year
2005
2010
2015
2020

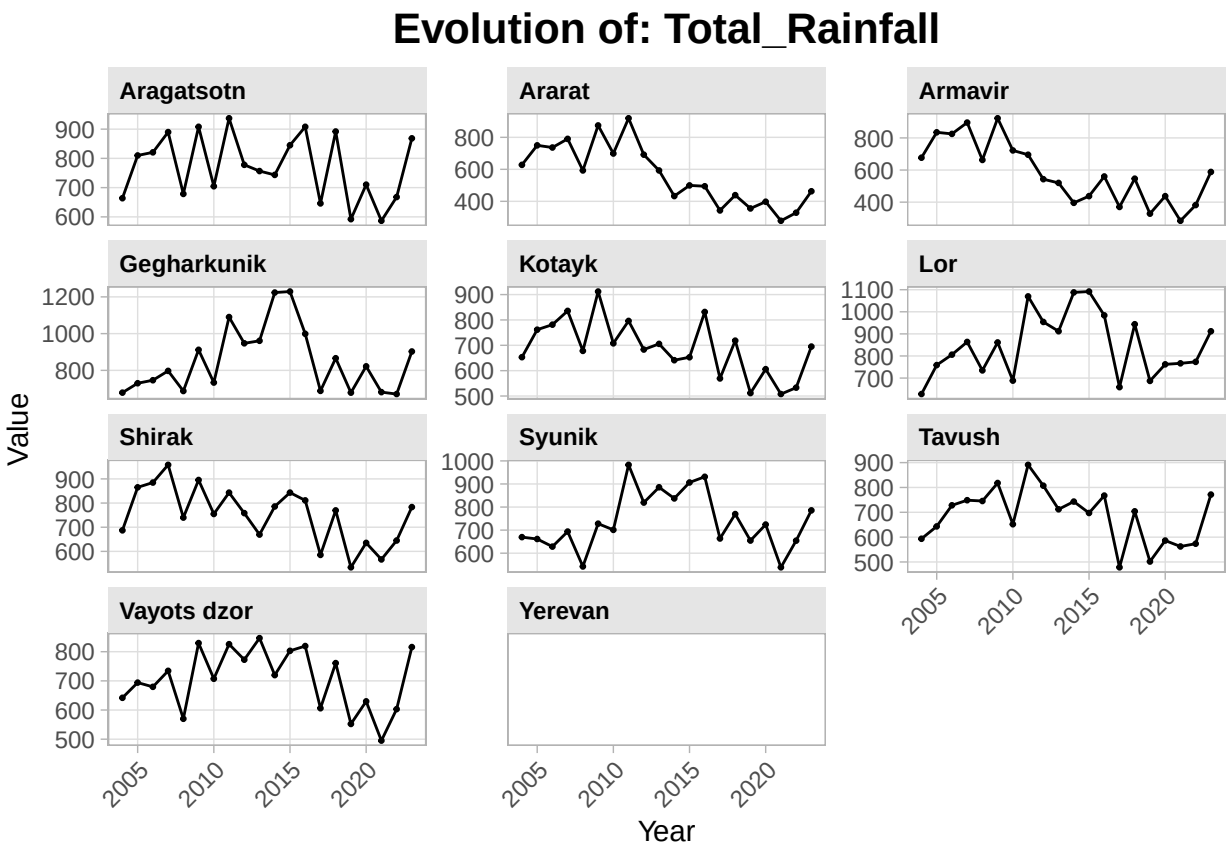

Evolution of: fdcons
Aragatsotn
Ararat
Armavir
Gegharkunik
Kotayk
Lor
Shirak
Syunik
Tavush
Vayots dzor
Yerevan
Value
Year
2005
2010
2015
2020

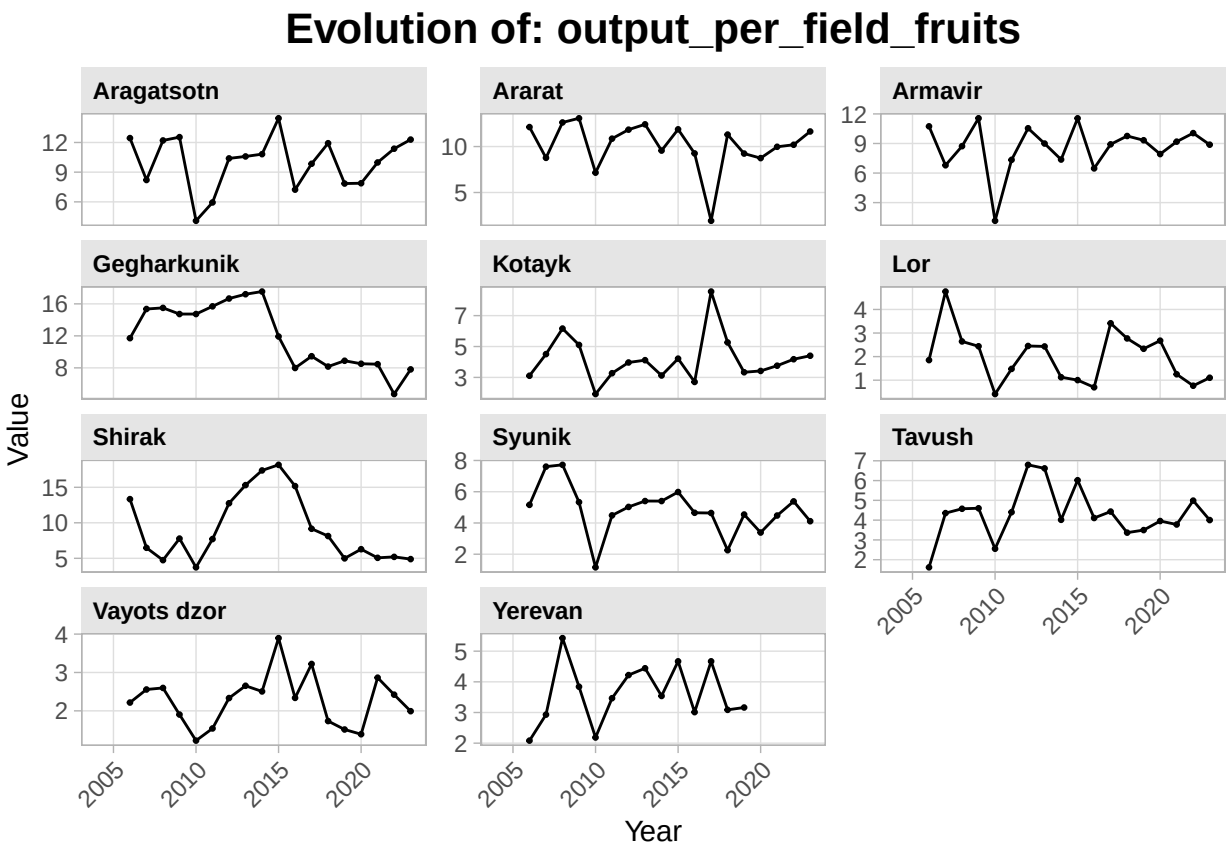

Evolution of: poverty
Aragatsotn
Ararat
Armavir
Gegharkunik
Kotayk
Lor
Shirak
Syunik
Tavush
Vayots dzor
Yerevan
Value
Year
2005
2010
2015
2020

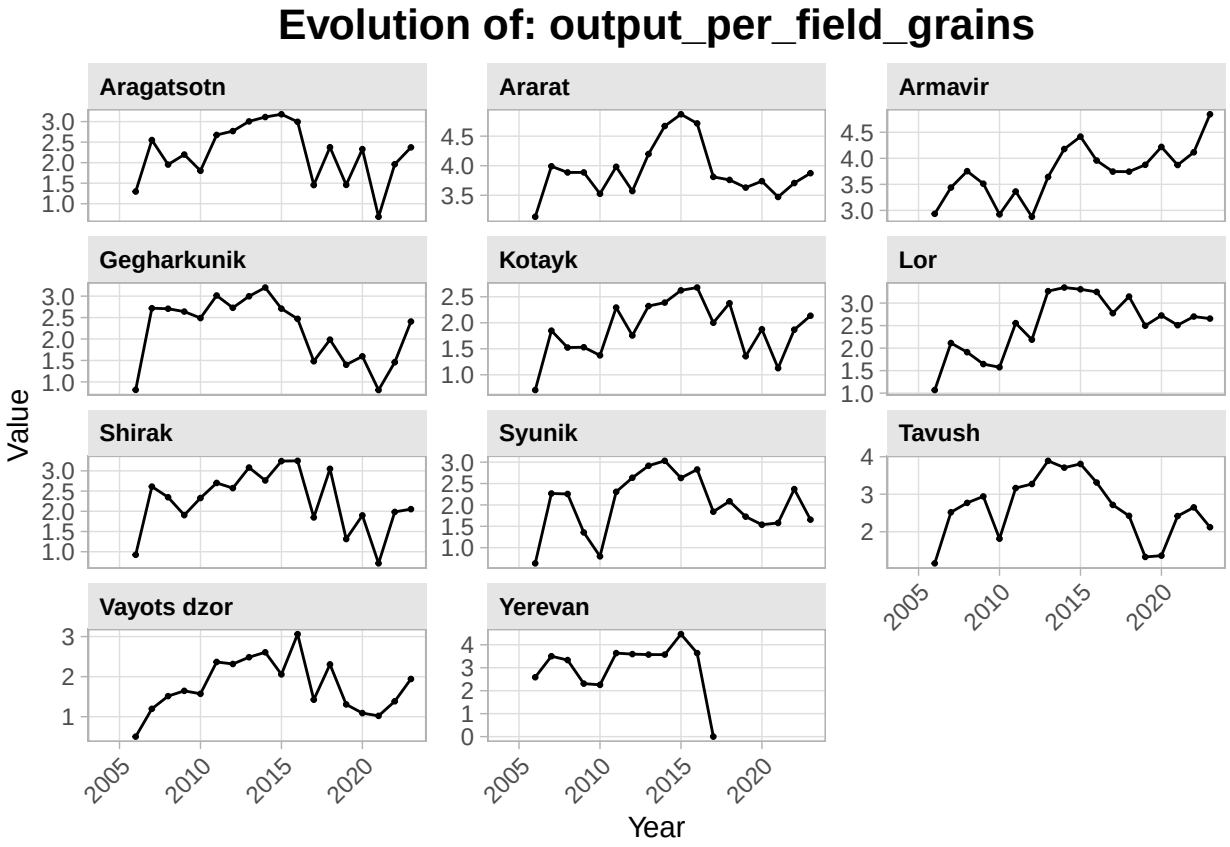

Evolution of: spei
Aragatsotn
Ararat
Armavir
Gegharkunik
Kotayk
Lor
Shirak
Syunik
Tavush
Vayots dzor
Yerevan
Value
Year
2005
2010
2015
2020


Evolution of: share
Aragatsotn
Ararat
Armavir
Gegharkunik
Kotayk
Lor
Shirak
Syunik
Tavush
Vayots dzor
Yerevan
Value
Year
2005
2010
2015
2020


Evolution of: agric_stress
Aragatsotn
Ararat
Armavir
Gegharkunik
Kotayk
Lor
Shirak
Syunik
Tavush
Vayots dzor
Yerevan
Value
Year


Evolution of: Total_Rainfall
Aragatsotn
Ararat
Armavir
Gegharkunik
Kotayk
Lor
Shirak
Syunik
Tavush
Vayots dzor
Yerevan
Value
Year
2005
2010
2015
2020

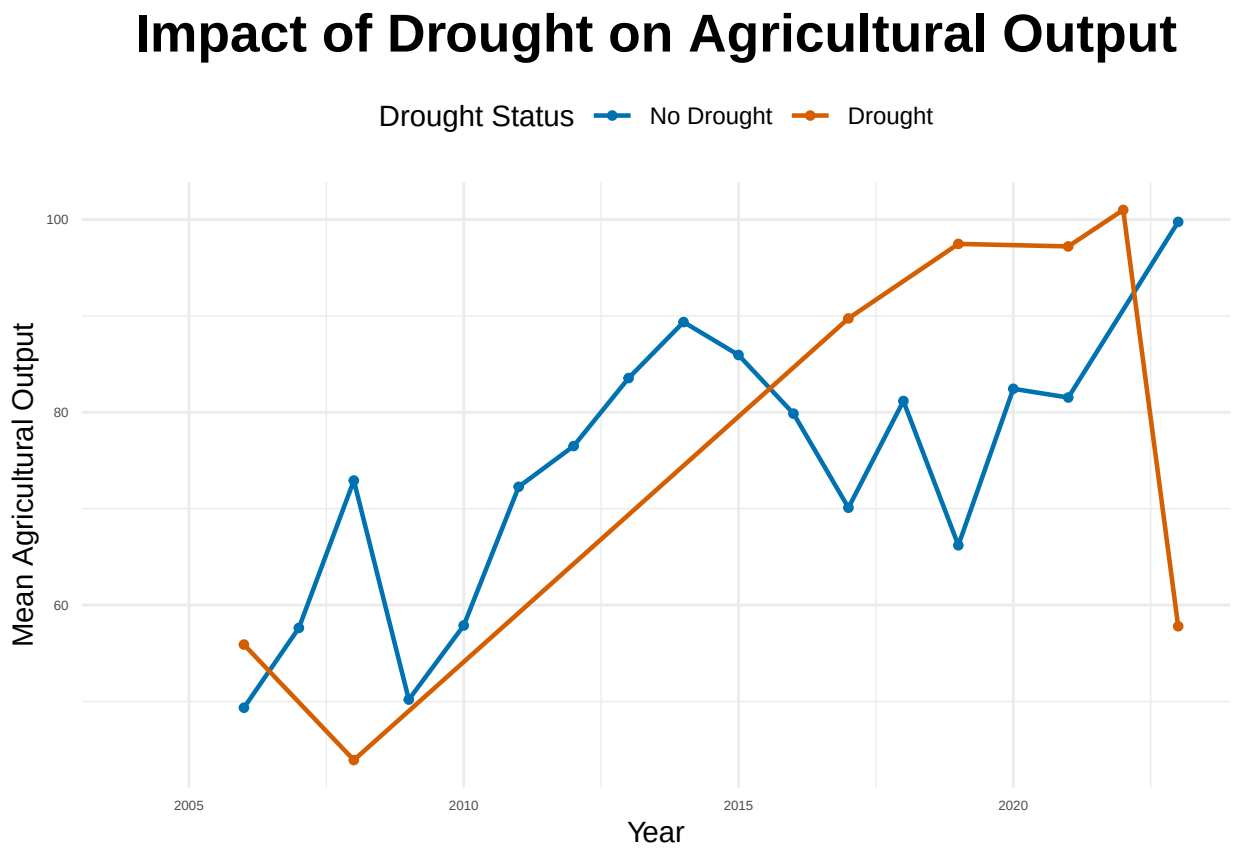

Evolution of: output_per_field_fruits
Aragatsotn
Ararat
Armavir
Gegharkunik
Kotayk
Lor
Shirak
Syunik
Tavush
Vayots dzor
Yerevan
Value
Year
2005
2010
2015
2020



3.3 Graphs with Drought Dummy

```
# Note: This graph should be interpreted with caution as the number of districts
#         is very low, meaning that any kind of visible relationship is very
#          likely due to confounding effects and between-district variation

# Compute, for each years, the mean of agricultural output between districts
#  that experience drought vs no drought
agric_plot <- dataset %>%
  group_by(year, drought_dummy) %>%
  summarise(mean_agric = mean(agric_output, na.rm = TRUE), n_district = n())

ggplot(agric_plot, aes(x = year, y = mean_agric,
                       color = factor(drought_dummy), group = factor(drought_dummy))) +
  geom_line(linewidth = 0.8) +
  geom_point(size = 1.2) +
  scale_color_manual(values = c("0" = "#0072B2", "1" = "#D55E00"),
                     labels = c("No Drought", "Drought")) +
  labs(x = "Year", y = "Mean Agricultural Output", color = "Drought Status",
       title = "Impact of Drought on Agricultural Output") +
  theme_minimal() +
  theme(legend.position = "top",
    axis.text.x = element_text(size = 5),
    axis.text.y = element_text(size = 5),
```

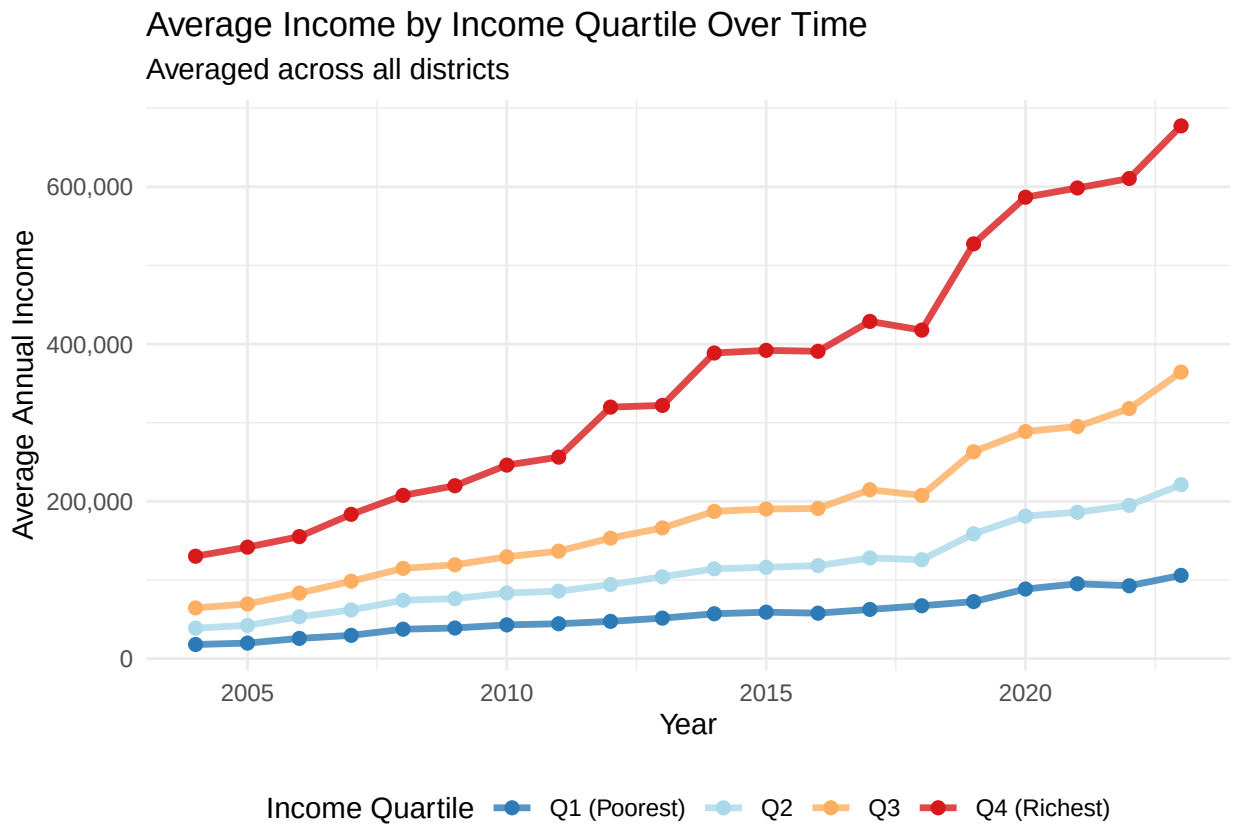
```
    plot.title = element_text(size = 20, face = "bold", hjust = 0.5),
    strip.text = element_text(size = 4, face = "bold"))
```



3.4 Graphs with Drought Dummy and Quartiles

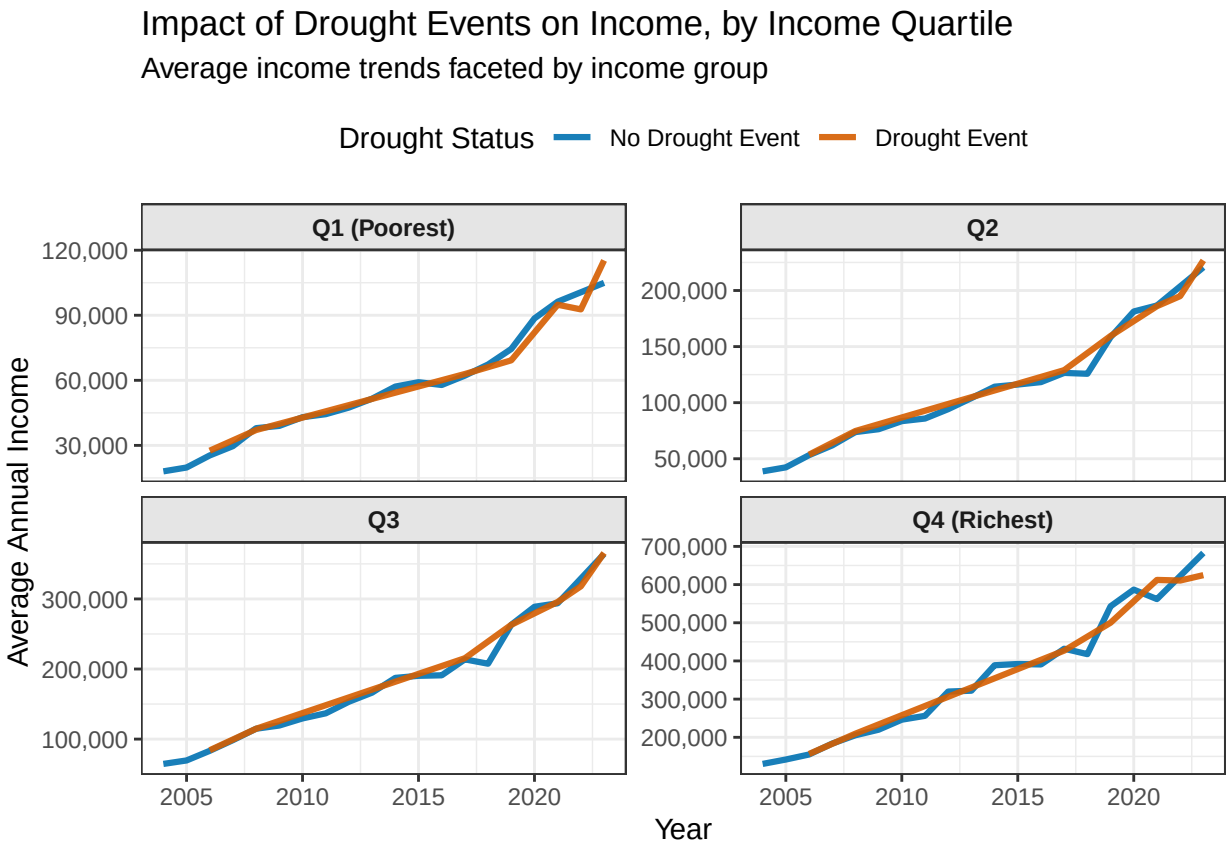
```
# Data Prep
dataset_prepped_q <- dataset_quartiles %>%
  mutate(drought_status = factor(drought_dummy,
                                 levels = c(0, 1),
                                 labels = c("No Drought Event", "Drought Event")),
         income_quartile = factor(national_quartile,
                                  levels = c(1, 2, 3, 4),
                                  labels = c("Q1 (Poorest)", "Q2", "Q3", "Q4 (Richest)")))

# A1. Aggregate the data: Find the mean income for each year and quartile
plot1_data_q <- dataset_prepped_q %>%
  group_by(year, income_quartile) %>%
  summarize(avg_income = mean(income, na.rm = TRUE),
            avg_agr_income = mean(agric_income, na.rm = TRUE), .groups = 'drop')


# A2. Create the plot q
ggplot(plot1_data_q, aes(x = year, y = avg_income, color = income_quartile, group = income_quartile)) +
```

```
  geom_line(linewidth = 1.2, alpha = 0.8) +
  geom_point(size = 2) +
  scale_y_continuous(labels = scales::comma) +
  scale_color_brewer(palette = "RdYlBu", direction = -1) +
  labs(title = "Average Income by Income Quartile Over Time",
       subtitle = "Averaged across all districts",
       x = "Year",
       y = "Average Annual Income",
       color = "Income Quartile") +
  theme_minimal() + theme(legend.position = "bottom")
```




```
# B1. Aggregate data: Mean income by year, quartile, AND drought status
plot2_data_q <- dataset_prepped_q %>%
  group_by(year, income_quartile, drought_status) %>%
  summarize(avg_income = mean(income, na.rm = TRUE),
            avg_agr_income = mean(agric_income, na.rm = TRUE), .groups = 'drop')


# B2. Create the faceted plot q
ggplot(plot2_data_q, aes(x = year, y = avg_income, color = drought_status, group = drought_status)) +
  geom_line(linewidth = 1.1, alpha = 0.9) +

  # Create 4 separate plots, one for each 'income_quartile'
  facet_wrap(~ income_quartile, scales = "free_y") +
  scale_y_continuous(labels = scales::comma) +
```

```
  scale_color_manual(values = c("No Drought Event" = "#0072B2", "Drought Event" = "#D55E00")) +
  labs(
    title = "Impact of Drought Events on Income, by Income Quartile",
    subtitle = "Average income trends faceted by income group",
    x = "Year",
    y = "Average Annual Income",
    color = "Drought Status") +
  theme_bw() +
  theme(legend.position = "top",
    strip.background = element_rect(fill = "grey90"),
    strip.text = element_text(face = "bold") )
```



4 TWFE Regressions

4.1 Data

4.1.1 Variables Units

- Armenian Dram (currency):
  - Income
  - Agriculture income
  - Agriculture output
  - Food consumption
- Tons (1000kg)
  - Grains harvest
  - Vegetables harvest
  - Fruits harvest
  - Potatoes harvest
- Tons per hectare (1000kg / 10000km2)
  - Grains output per field
  - Vegetables output per field
  - Fruits output per field
  - Potatoes output per field

4.1.2 Data Choice Selection

```
# Select TRUE for having dependent variables in logs
dependent_in_logs <- TRUE

# Select TRUE to exclude "Yerevan" district from analysis
exclude_yerevan <- FALSE

# Select TRUE to focus on, on average, more rural districts
more_rural <- FALSE

# Select TRUE to focus on, on average, districts with more poverty
more_poverty <- FALSE

# Select TRUE to have up to 10 lags for all independent variables
more_lags <- FALSE
```

```
# Base case
twfe_data = dataset

# Dependent variables
dependent_vars <- c("income", "agric_income", "agric_output", "fdcons",
                    "grains_harvest", "vegetables_harvest", "fruits_harvest",
                    "potatoes_harvest", "output_per_field_grains",
                    "output_per_field_vegetables", "output_per_field_fruits",
                    "output_per_field_potatoes")
```

```r
# Logs implementation
if (dependent_in_logs) {
  for (col in dependent_vars) {
    twfe_data[[col]] <- log(twfe_data[[col]]) }
  print("Dependent variables are in logs.") }
```

```
## [1] "Dependent variables are in logs."
```

```r
# Excluding Yerevan implementation
if (exclude_yerevan) {
  twfe_data = subset(twfe_data, district != "Yerevan")
  print("Excluding Yerevan district from sample.") }

# Selecting majority-rural districts implementation
if (more_rural) {
  twfe_data = subset(twfe_data, urban < 0.5)
  print("Focusing on districts with higher rural population, on average.")}

# Selecting poorer regions implementation
if (more_poverty) {
  twfe_data = subset(twfe_data, poverty > 0.3)
  print("Focusing on districts with higher rates of poverty, on average.") }

# Selecting a certain timeframe
#twfe_data = subset(twfe_data, year > 2015)

# Selecting the poorest income decile
#twfe_data = subset(dataset_deciles, national_decile == 1)

# Selecting the poorest income quartile
#twfe_data = subset(dataset_quartiles, national_quartile == 1)
```

4.2 Regression Loop

```r
# Define independent variables as a list of groups
if (more_lags) {
  iv_groups <- list(
    "SPEI" = c(
      "spei",
      "spei + spei_lag1",
      "spei + spei_lag1 + spei_lag2",
      "spei + spei_lag1 + spei_lag2 + spei_lag3",
      "spei + spei_lag1 + spei_lag2 + spei_lag3 + spei_lag4",
      "spei + spei_lag1 + spei_lag2 + spei_lag3 + spei_lag4 + spei_lag5",
      "spei + spei_lag1 + spei_lag2 + spei_lag3 + spei_lag4 + spei_lag5 + spei_lag6"),
    "Share" = c(
      "share",
      "share + share_lag1",
      "share + share_lag1 + share_lag2",
      "share + share_lag1 + share_lag2 + share_lag3",
      "share + share_lag1 + share_lag2 + share_lag3 + share_lag4",
```

```
      "share + share_lag1 + share_lag2 + share_lag3 + share_lag4 + share_lag5",
      "share + share_lag1 + share_lag2 + share_lag3 + share_lag4 + share_lag5 + share_lag6"),
    "AgricStress" = c(
      "agric_stress",
      "agric_stress + agric_stress_lag1",
      "agric_stress + agric_stress_lag1 + agric_stress_lag2",
      "agric_stress + agric_stress_lag1 + agric_stress_lag2 + agric_stress_lag3",
      "agric_stress + agric_stress_lag1 + agric_stress_lag2 + agric_stress_lag3 +
        agric_stress_lag4",
      "agric_stress + agric_stress_lag1 + agric_stress_lag2 + agric_stress_lag3 +
        agric_stress_lag4 + agric_stress_lag5",
      "agric_stress + agric_stress_lag1 + agric_stress_lag2 + agric_stress_lag3 +
        agric_stress_lag4 + agric_stress_lag5 + agric_stress_lag6") )
  model_names <- c(
  "Model 1: 0 Lags",
  "Model 2: 1 Lag",
  "Model 3: 2 Lags",
  "Model 4: 3 Lags",
  "Model 5: 4 Lags",
  "Model 6: 5 Lags",
  "Model 7: 6 Lags")
} else {
  iv_groups <- list(
    "SPEI" = c(
      "spei",
      "spei + spei_lag1",
      "spei + spei_lag1 + spei_lag2"),
    "Share" = c(
      "share",
      "share + share_lag1",
      "share + share_lag1 + share_lag2"),
    "AgricStress" = c(
      "agric_stress",
      "agric_stress + agric_stress_lag1",
      "agric_stress + agric_stress_lag1 + agric_stress_lag2") )
  model_names <- c(
  "Model 1: 0 Lags",
  "Model 2: 1 Lag",
  "Model 3: 2 Lags") }



# Loop for each dependent variable for each group of independent variables
for (dv in dependent_vars) {

  # Create a latex version of the dv name
  dv_safe <- gsub("_", "\\\\_", dv)
  cat(paste0("\n\n\\subsection{Dependent Variable: ", dv_safe, "}\n\n"))

  for (group_name in names(iv_groups)) {
    cat(paste0("\n\n\\subsubsection{Regressed on: ", group_name, "}\n\n"))
    models_list <- list()
    current_iv_formulas <- iv_groups[[group_name]]
```

```
  for (i in 1:length(current_iv_formulas)) {
        fml_string <- sprintf("%s ~ %s | district + year",
                              dv,
                              current_iv_formulas[i])
    models_list[[i]] <- feols(
      as.formula(fml_string),
      data = twfe_data,
      cluster = ~ district) }
    names(models_list) <- model_names
  print(etable(
    models_list,
    fixef_sizes = TRUE,
    fitstat = c("n", "r2"),
    tex = latex_format)) } }
```

4.3 Dependent Variable: income

4.3.1 Regressed on: SPEI

Dependent Variable:	income		
Model:	(1)	(2)	(3)
Variables			
spei	0.0260	0.0263	0.0254
	(0.0266)	(0.0252)	(0.0264)
spei_lag1		-0.0201	-0.0199
		(0.0505)	(0.0496)
spei_lag2			-0.0174
			(0.0522)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
Fit statistics			
Observations	220	220	220
R^2	0.95771	0.95775	0.95778

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.3.2 Regressed on: Share

Dependent Variable:	income		
Model:	(1)	(2)	(3)
Variables			
share	-0.1165	-0.1618	-0.1685
	(0.0908)	(0.1105)	(0.1155)
share_lag1		-0.2229	-0.2596
		(0.1517)	(0.1846)
share_lag2			-0.2104
			(0.1685)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
Fit statistics			
Observations	220	220	220
R^2	0.95781	0.95839	0.95888

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.3.3 Regressed on: AgricStress

Dependent Variable:	income		
Model:	(1)	(2)	(3)
Variables			
agric_stress	-4.75×10^{-5}	-0.0002	-0.0002
	(0.0007)	(0.0006)	(0.0006)
agric_stress_lag1		0.0007	0.0007
		(0.0008)	(0.0007)
agric_stress_lag2			-0.0002
			(0.0010)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
Fit statistics			
Observations	220	220	220
R^2	0.95764	0.95776	0.95777

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.4 Dependent Variable: agric_income

4.4.1 Regressed on: SPEI

Dependent Variable:	agric_income		
Model:	(1)	(2)	(3)
Variables			
spei	0.2773	0.2786	0.2814
	(0.2633)	(0.2720)	(0.2893)
spei_lag1		0.0586	0.0572
		(0.2790)	(0.2737)
spei_lag2			0.0400
			(0.2727)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	197	197	197
R^2	0.71669	0.71680	0.71685

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.4.2 Regressed on: Share

Dependent Variable:	agric_income		
Model:	(1)	(2)	(3)
Variables			
share	-0.3389	-0.3282	-0.3893
	(0.4318)	(0.4687)	(0.4920)
share_lag1		0.0552	-0.1080
		(0.7967)	(0.8750)
share_lag2			-0.8570*
			(0.4538)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	197	197	197
R^2	0.71444	0.71445	0.71667

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.4.3 Regressed on: AgricStress

Dependent Variable:	agric_income		
Model:	(1)	(2)	(3)
Variables			
agric_stress	-0.0020	-0.0020	-0.0014
	(0.0052)	(0.0055)	(0.0063)
agric_stress_lag1		0.0106	0.0119
		(0.0099)	(0.0099)
agric_stress_lag2			-0.0151
			(0.0088)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	197	197	197
R^2	0.71419	0.71963	0.72936

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.5 Dependent Variable: agric_output

4.5.1 Regressed on: SPEI

Dependent Variable:	agric_output		
Model:	(1)	(2)	(3)
Variables			
spei	0.0578	0.0597	0.0666
	(0.0556)	(0.0519)	(0.0544)
spei_lag1		0.0986	0.0994*
		(0.0580)	(0.0545)
spei_lag2			0.1435*
			(0.0744)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.97508	0.97550	0.97640

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.5.2 Regressed on: Share

Dependent Variable:	agric_output		
Model:	(1)	(2)	(3)
Variables			
share	0.1182	0.1643	0.1763
	(0.1120)	(0.1325)	(0.1352)
share_lag1		0.2021	0.2415
		(0.1329)	(0.1372)
share_lag2			0.1923
			(0.1527)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.97502	0.97522	0.97540

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.5.3 Regressed on: AgricStress

Dependent Variable:	agric_output		
Model:	(1)	(2)	(3)
Variables			
agric_stress	0.0031	0.0029	0.0029
	(0.0019)	(0.0017)	(0.0017)
agric_stress_lag1		0.0023	0.0023
		(0.0014)	(0.0014)
agric_stress_lag2			7.04×10^{-5}
			(0.0019)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.97572	0.97617	0.97617

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.6 Dependent Variable: fdcons

4.6.1 Regressed on: SPEI

Dependent Variable:	fdcons		
Model:	(1)	(2)	(3)
Variables			
spei	0.0400	0.0407	0.0393
	(0.0943)	(0.0950)	(0.0952)
spei_lag1		-0.0648	-0.0645
		(0.0517)	(0.0522)
spei_lag2			-0.0296
			(0.1102)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
Fit statistics			
Observations	220	220	220
R^2	0.90580	0.90611	0.90617

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.6.2 Regressed on: Share

Dependent Variable:	fdcons		
Model:	(1)	(2)	(3)
Variables			
share	-0.0860	-0.1811	-0.1932
	(0.1944)	(0.2304)	(0.2334)
share_lag1		-0.4673	-0.5340*
		(0.2695)	(0.2667)
share_lag2			-0.3819
			(0.3588)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
Fit statistics			
Observations	220	220	220
R^2	0.90574	0.90757	0.90875

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.6.3 Regressed on: AgricStress

Dependent Variable:	fdcons		
Model:	(1)	(2)	(3)
Variables			
agric_stress	-0.0002	8.21×10^{-5}	7.39×10^{-5}
	(0.0020)	(0.0018)	(0.0018)
agric_stress_lag1		-0.0012	-0.0012
		(0.0015)	(0.0013)
agric_stress_lag2			-0.0003
			(0.0020)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
Fit statistics			
Observations	220	220	220
R^2	0.90568	0.90593	0.90594

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.7 Dependent Variable: grains_harvest

4.7.1 Regressed on: SPEI

Dependent Variable:	grains_harvest		
Model:	(1)	(2)	(3)
Variables			
spei	-0.4503***	-0.4573***	-0.4691***
	(0.1064)	(0.1065)	(0.1071)
spei_lag1		-0.2992**	-0.3025**
		(0.1010)	(0.1207)
spei_lag2			-0.2425*
			(0.1214)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	191	191	191
R^2	0.94570	0.94719	0.94817

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.7.2 Regressed on: Share

Dependent Variable:	grains_harvest		
Model:	(1)	(2)	(3)
Variables			
share	-0.7772**	-0.9705***	-1.008***
	(0.2690)	(0.2807)	(0.2698)
share_lag1		-0.8358**	-1.012**
		(0.3403)	(0.3457)
share_lag2			-0.9098**
			(0.4027)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	191	191	191
R^2	0.94375	0.94509	0.94660

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.7.3 Regressed on: AgricStress

Dependent Variable:	grains_harvest		
Model:	(1)	(2)	(3)
Variables			
agric_stress	-0.0118***	-0.0113***	-0.0115***
	(0.0030)	(0.0028)	(0.0028)
agric_stress_lag1		-0.0080*	-0.0079*
		(0.0043)	(0.0043)
agric_stress_lag2			-0.0052
			(0.0044)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	191	191	191
R^2	0.94656	0.94848	0.94914

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.8 Dependent Variable: vegetables_harvest

4.8.1 Regressed on: SPEI

Dependent Variable:	vegetables_harvest		
Model:	(1)	(2)	(3)
Variables			
spei	-0.1150	-0.1191	-0.1240
	(0.0697)	(0.0697)	(0.0725)
spei_lag1		-0.2078	-0.2084
		(0.1572)	(0.1617)
spei_lag2			-0.1035
			(0.0929)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.95674	0.95738	0.95753

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.8.2 Regressed on: Share

Dependent Variable:	vegetables_harvest		
Model:	(1)	(2)	(3)
Variables			
share	-0.1733	-0.2713	-0.2927
	(0.1950)	(0.1901)	(0.1953)
share_lag1		-0.4297	-0.5002
		(0.3137)	(0.3758)
share_lag2			-0.3438
			(0.2918)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.95661	0.95693	0.95712

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.8.3 Regressed on: AgricStress

Dependent Variable:	vegetables_harvest		
Model:	(1)	(2)	(3)
Variables			
agric_stress	-0.0047	-0.0044	-0.0044
	(0.0048)	(0.0046)	(0.0046)
agric_stress_lag1		-0.0043	-0.0042
		(0.0052)	(0.0051)
agric_stress_lag2			-0.0014
			(0.0039)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.95716	0.95767	0.95771

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.9 Dependent Variable: fruits_harvest

4.9.1 Regressed on: SPEI

Dependent Variable:	fruits_harvest		
Model:	(1)	(2)	(3)
Variables			
spei	0.2105	0.2145	0.2239
	(0.1612)	(0.1631)	(0.1622)
spei_lag1		0.2010	0.2022*
		(0.1169)	(0.1042)
spei_lag2			0.1975
			(0.1402)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.91392	0.91480	0.91565

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.9.2 Regressed on: Share

Dependent Variable:	fruits_harvest		
Model:	(1)	(2)	(3)
Variables			
share	0.6161	0.8515**	0.8986**
	(0.3458)	(0.2807)	(0.2913)
share_lag1		1.033**	1.188**
		(0.3621)	(0.4138)
share_lag2			0.7552*
			(0.4113)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.91406	0.91675	0.91813

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.9.3 Regressed on: AgricStress

Dependent Variable:	fruits_harvest		
Model:	(1)	(2)	(3)
Variables			
agric_stress	0.0062**	0.0058***	0.0059**
	(0.0022)	(0.0018)	(0.0020)
agric_stress_lag1		0.0061*	0.0059*
		(0.0034)	(0.0030)
agric_stress_lag2			0.0043
			(0.0032)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.91457	0.91610	0.91670

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.10 Dependent Variable: potatoes_harvest

4.10.1 Regressed on: SPEI

Dependent Variable:	potatoes_harvest		
Model:	(1)	(2)	(3)
Variables			
spei	-0.0864	-0.0913	-0.0931
	(0.0585)	(0.0683)	(0.0699)
spei_lag1		-0.2477	-0.2479
		(0.1406)	(0.1438)
spei_lag2			-0.0391
			(0.0848)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.97357	0.97447	0.97449

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.10.2 Regressed on: Share

Dependent Variable:	potatoes_harvest		
Model:	(1)	(2)	(3)
Variables			
share	-0.3500	-0.5348*	-0.5406*
	(0.2041)	(0.2540)	(0.2604)
share_lag1		-0.8109**	-0.8300**
		(0.3189)	(0.3329)
share_lag2			-0.0928
			(0.2677)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.97369	0.97481	0.97482

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.10.3 Regressed on: AgricStress

Dependent Variable:	potatoes_harvest		
Model:	(1)	(2)	(3)
Variables			
agric_stress	-0.0005	-0.0002	-0.0002
	(0.0026)	(0.0025)	(0.0025)
agric_stress_lag1		-0.0042	-0.0041
		(0.0034)	(0.0033)
agric_stress_lag2			-0.0020
			(0.0016)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.97347	0.97395	0.97403

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.11 Dependent Variable: output_per_field_grains

4.11.1 Regressed on: SPEI

Dependent Variable:	output_per_field_grains		
Model:	(1)	(2)	(3)
Variables			
spei	-0.2324***	-0.2349***	-0.2379***
	(0.0584)	(0.0563)	(0.0524)
spei_lag1		-0.1082	-0.1090
		(0.0719)	(0.0768)
spei_lag2			-0.0598
			(0.0758)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	191	191	191
R^2	0.78380	0.78558	0.78612

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.11.2 Regressed on: Share

Dependent Variable:	output_per_field_grains		
Model:	(1)	(2)	(3)
Variables			
share	-0.4843**	-0.4983**	-0.5060**
	(0.2120)	(0.2098)	(0.2134)
share_lag1		-0.0607	-0.0972
		(0.2006)	(0.1848)
share_lag2			-0.1884
			(0.2824)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	191	191	191
R^2	0.78048	0.78055	0.78114

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.11.3 Regressed on: AgricStress

Dependent Variable:	output_per_field_grains		
Model:	(1)	(2)	(3)
Variables			
agric_stress	-0.0071**	-0.0071**	-0.0070**
	(0.0022)	(0.0023)	(0.0023)
agric_stress_lag1		0.0005	0.0004
		(0.0027)	(0.0026)
agric_stress_lag2			0.0013
			(0.0022)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	191	191	191
R^2	0.78933	0.78940	0.78977

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.12 Dependent Variable: output_per_field_vegetables

4.12.1 Regressed on: SPEI

Dependent Variable:	output_per_field_vegetables		
Model:	(1)	(2)	(3)
Variables			
spei	0.0175	0.0145	0.0092
	(0.0438)	(0.0492)	(0.0508)
spei_lag1		-0.1505	-0.1512
		(0.1425)	(0.1481)
spei_lag2			-0.1108
			(0.1046)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.81793	0.82015	0.82134

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.12.2 Regressed on: Share

Dependent Variable:	output_per_field_vegetables		
Model:	(1)	(2)	(3)
Variables			
share	0.0835	0.0650	0.0650
	(0.1599)	(0.1552)	(0.1582)
share_lag1		-0.0810	-0.0810
		(0.1714)	(0.2072)
share_lag2			-5.39×10^{-5}
			(0.2109)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.81799	0.81806	0.81806

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.12.3 Regressed on: AgricStress

Dependent Variable:	output_per_field_vegetables		
Model:	(1)	(2)	(3)
Variables			
agric_stress	-0.0033	-0.0030	-0.0030
	(0.0037)	(0.0035)	(0.0035)
agric_stress_lag1		-0.0037	-0.0037
		(0.0042)	(0.0041)
agric_stress_lag2			-0.0005
			(0.0023)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.81989	0.82240	0.82243

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.13 Dependent Variable: output_per_field_fruits

4.13.1 Regressed on: SPEI

Dependent Variable:	output_per_field_fruits		
Model:	(1)	(2)	(3)
Variables			
spei	0.1856	0.1887	0.1952
	(0.1434)	(0.1457)	(0.1438)
spei_lag1		0.1567	0.1575
		(0.1054)	(0.0973)
spei_lag2			0.1367
			(0.1568)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.79919	0.80052	0.80152

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.13.2 Regressed on: Share

Dependent Variable:	output_per_field_fruits		
Model:	(1)	(2)	(3)
Variables			
share	0.5624	0.7888**	0.8309**
	(0.3438)	(0.2894)	(0.3019)
share_lag1		0.9934**	1.132**
		(0.3737)	(0.4357)
share_lag2			0.6764
			(0.4382)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.79960	0.80578	0.80853

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.13.3 Regressed on: AgricStress

Dependent Variable:	output_per_field_fruits		
Model:	(1)	(2)	(3)
Variables			
agric_stress	0.0053***	0.0049***	0.0050***
	(0.0015)	(0.0012)	(0.0013)
agric_stress_lag1		0.0052*	0.0051*
		(0.0028)	(0.0025)
agric_stress_lag2			0.0034
			(0.0028)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.80018	0.80294	0.80384

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.14 Dependent Variable: output_per_field_potatoes

4.14.1 Regressed on: SPEI

Dependent Variable:	output_per_field_potatoes		
Model:	(1)	(2)	(3)
Variables			
spei	-0.0961*	-0.1006	-0.1018
	(0.0434)	(0.0607)	(0.0622)
spei_lag1		-0.2282	-0.2283
		(0.1451)	(0.1473)
spei_lag2			-0.0243
			(0.0680)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.80594	0.81511	0.81521

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.14.2 Regressed on: Share

Dependent Variable:	output_per_field_potatoes		
Model:	(1)	(2)	(3)
Variables			
share	-0.1459	-0.2399	-0.2216
	(0.1639)	(0.1776)	(0.1901)
share_lag1		-0.4124*	-0.3520*
		(0.2125)	(0.1922)
share_lag2			0.2948
			(0.2023)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.80487	0.80833	0.81003

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.14.3 Regressed on: AgricStress

Dependent Variable:	output_per_field_potatoes		
Model:	(1)	(2)	(3)
Variables			
agric_stress	-0.0021	-0.0017	-0.0017
	(0.0017)	(0.0016)	(0.0016)
agric_stress_lag1		-0.0051	-0.0050
		(0.0033)	(0.0033)
agric_stress_lag2			-0.0008
			(0.0011)
Fixed-effects			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
Fit statistics			
Observations	194	194	194
R^2	0.80581	0.81430	0.81445

Clustered (district) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*