

Armenia Drought Analysis

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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),
```

```

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

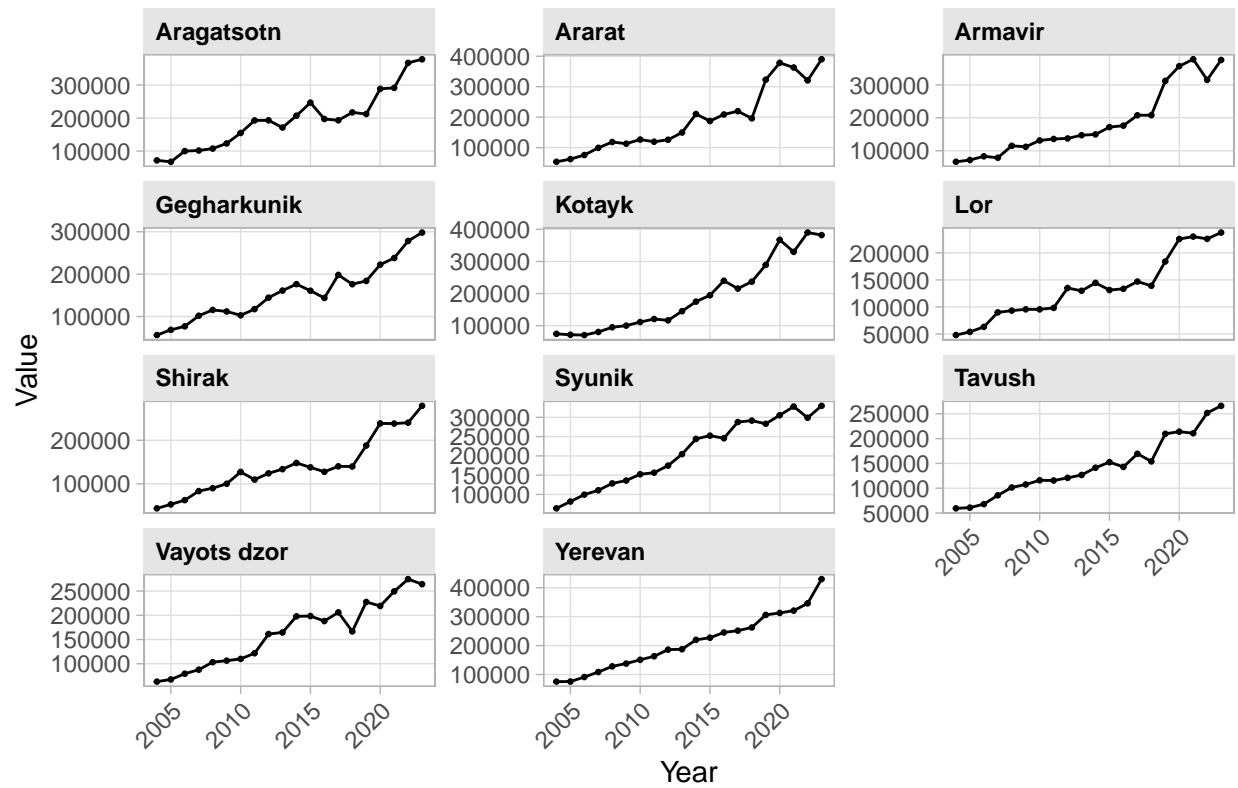
all_metrics <- unique(plot_data$metric)

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

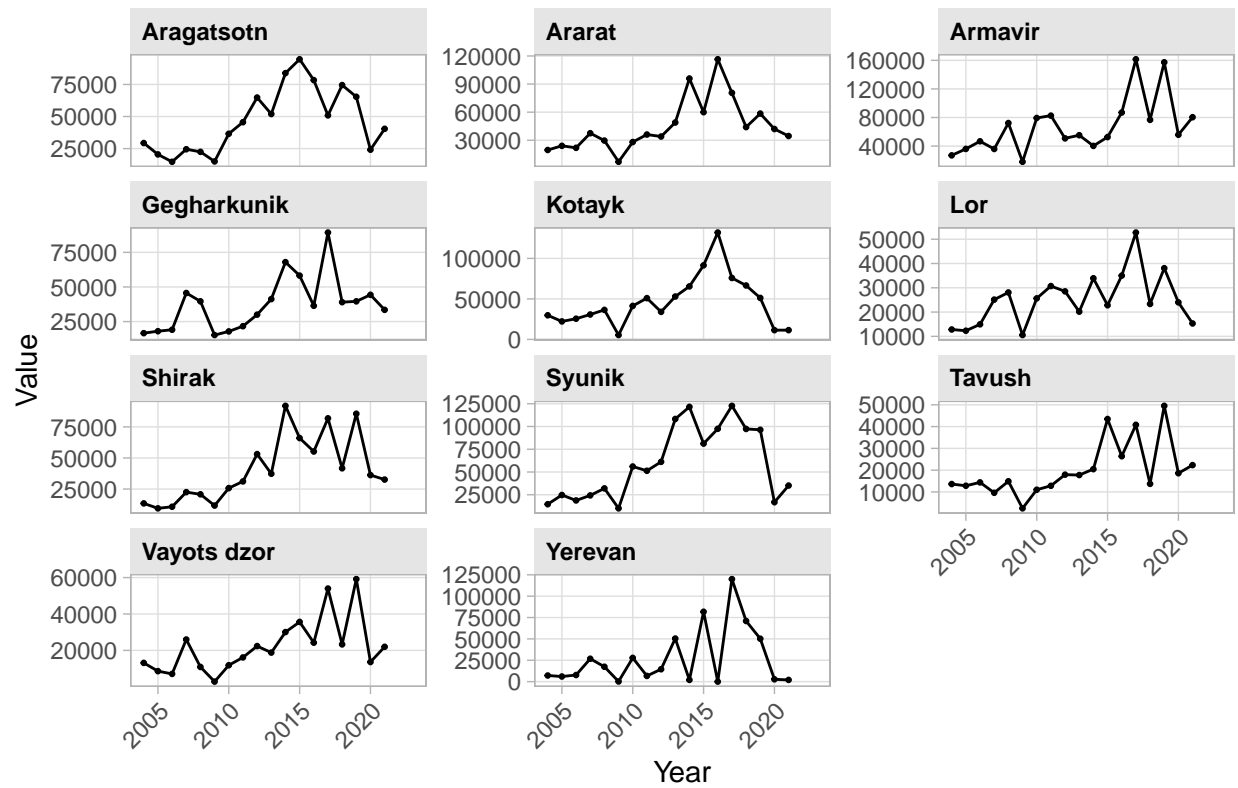
  plot_data <- plot_data %>%
    filter(metric == met)
  p <- ggplot(plot_data, aes(x = year, y = value)) +
    geom_line() +
    geom_point(size = 0.5) +
    facet_wrap(~ district, scales = "free_y", ncol = 3) +
    labs(title = paste("Evolution of:", met), x = "Year", y = "Value") +
    theme_light() +
    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) } )

```

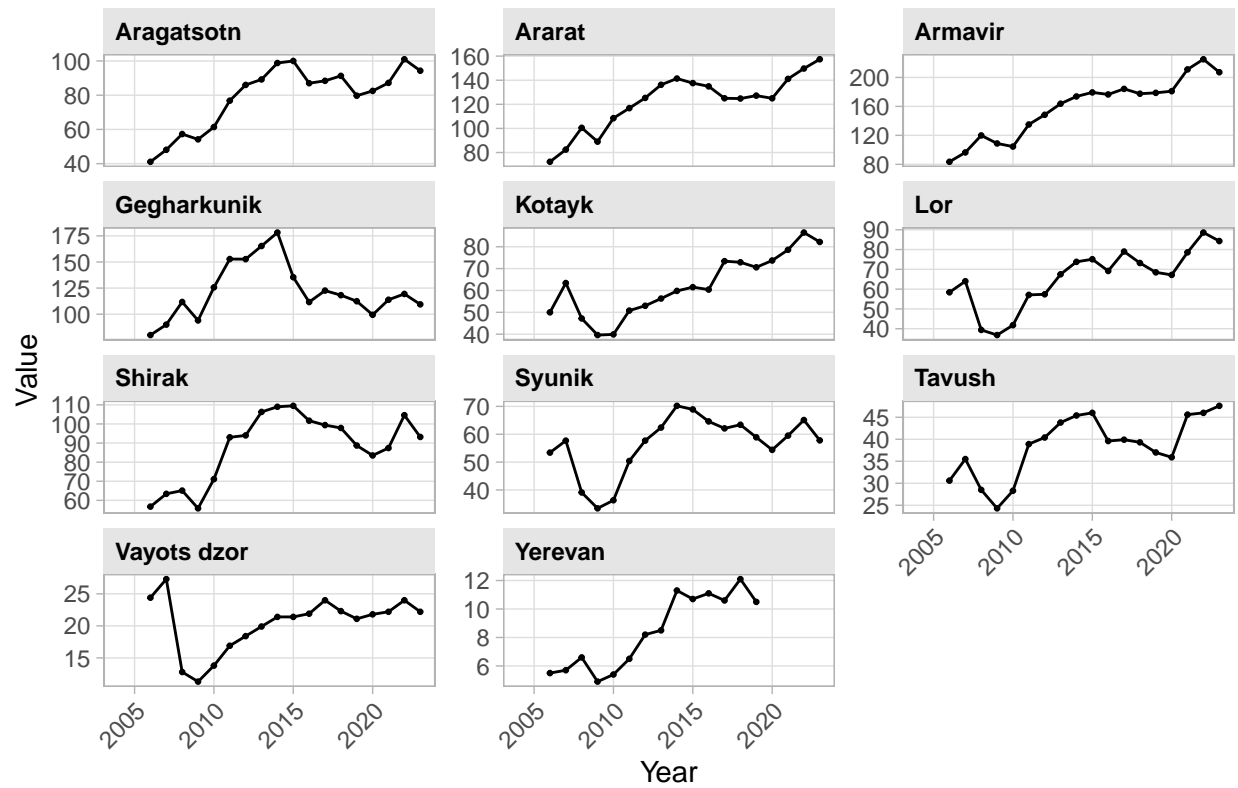
Evolution of: income



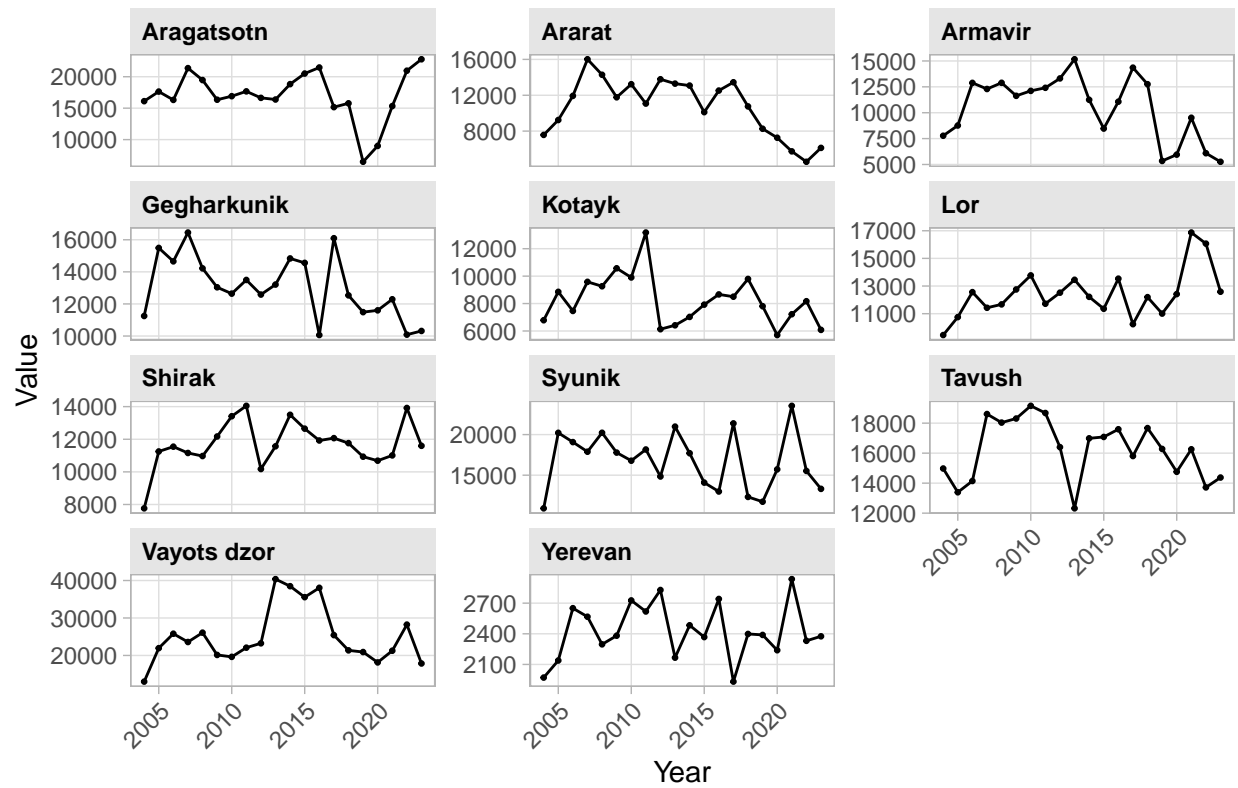
Evolution of: agric_income



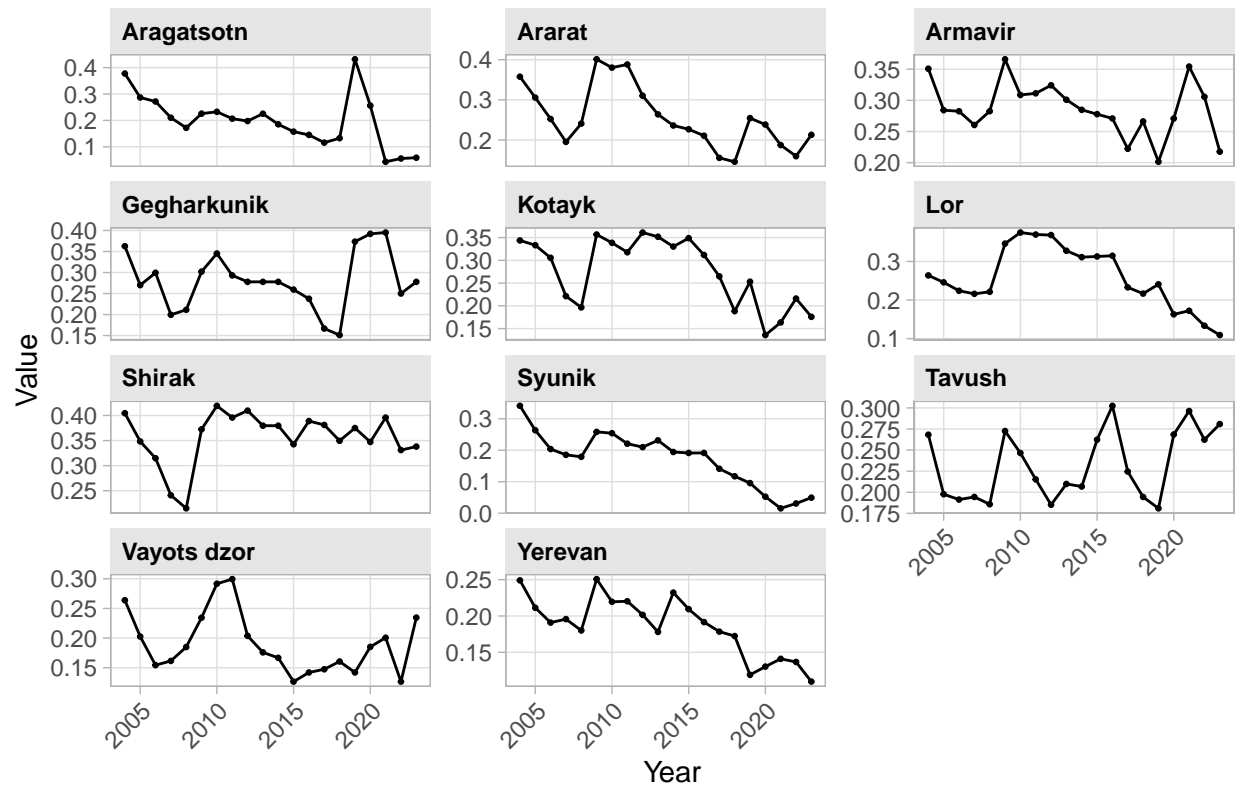
Evolution of: agric_output



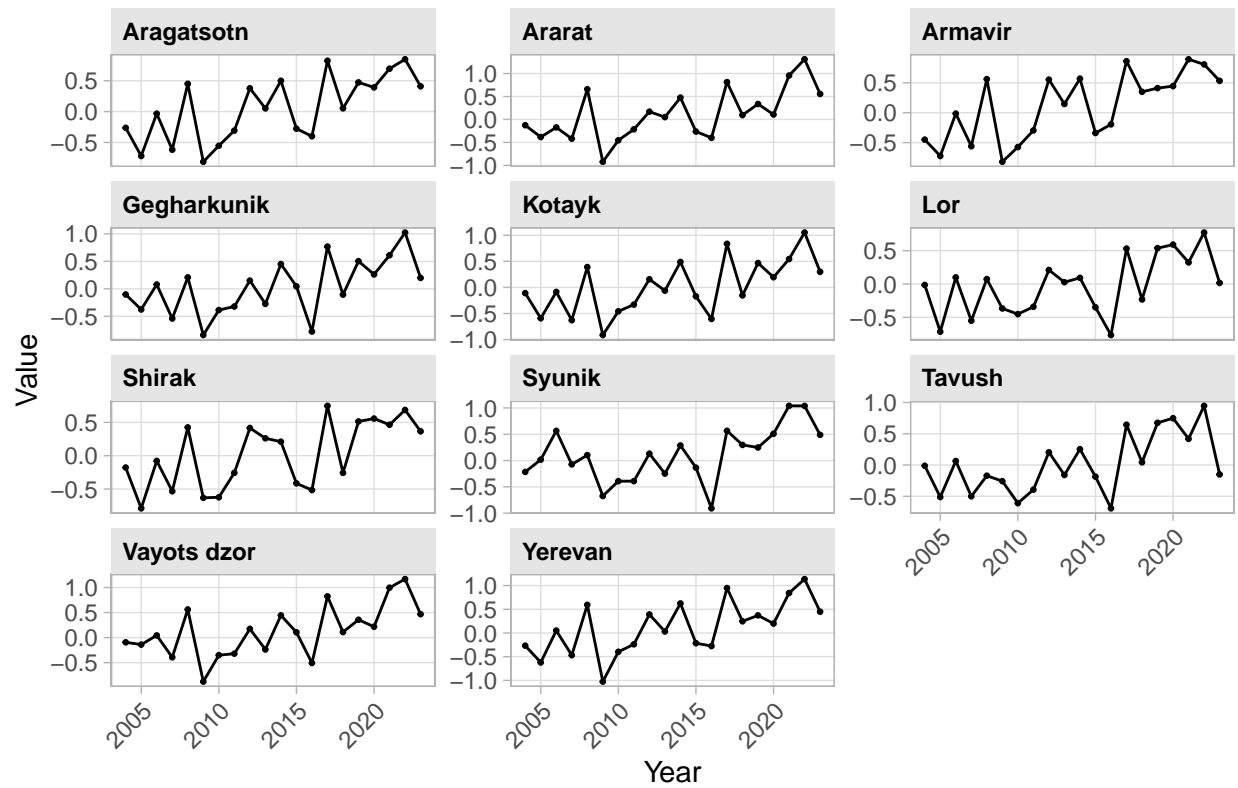
Evolution of: fdcons



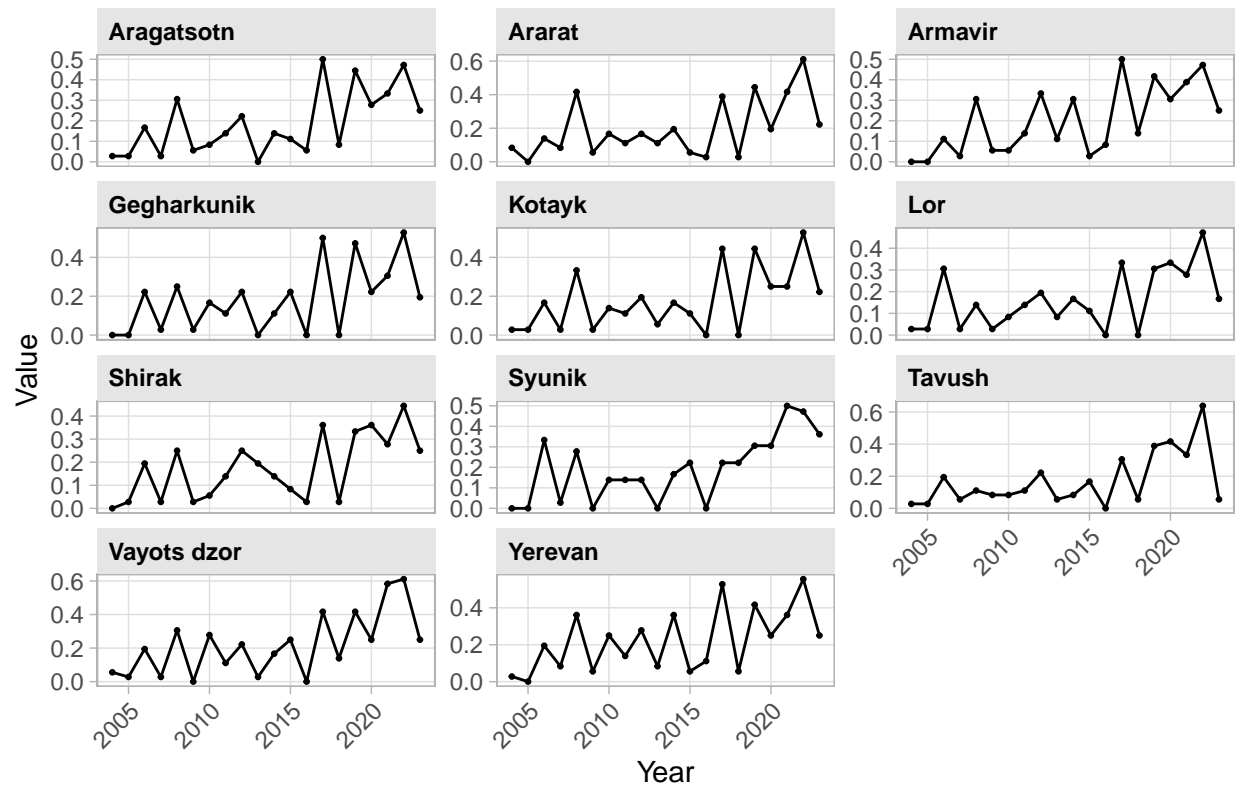
Evolution of: poverty



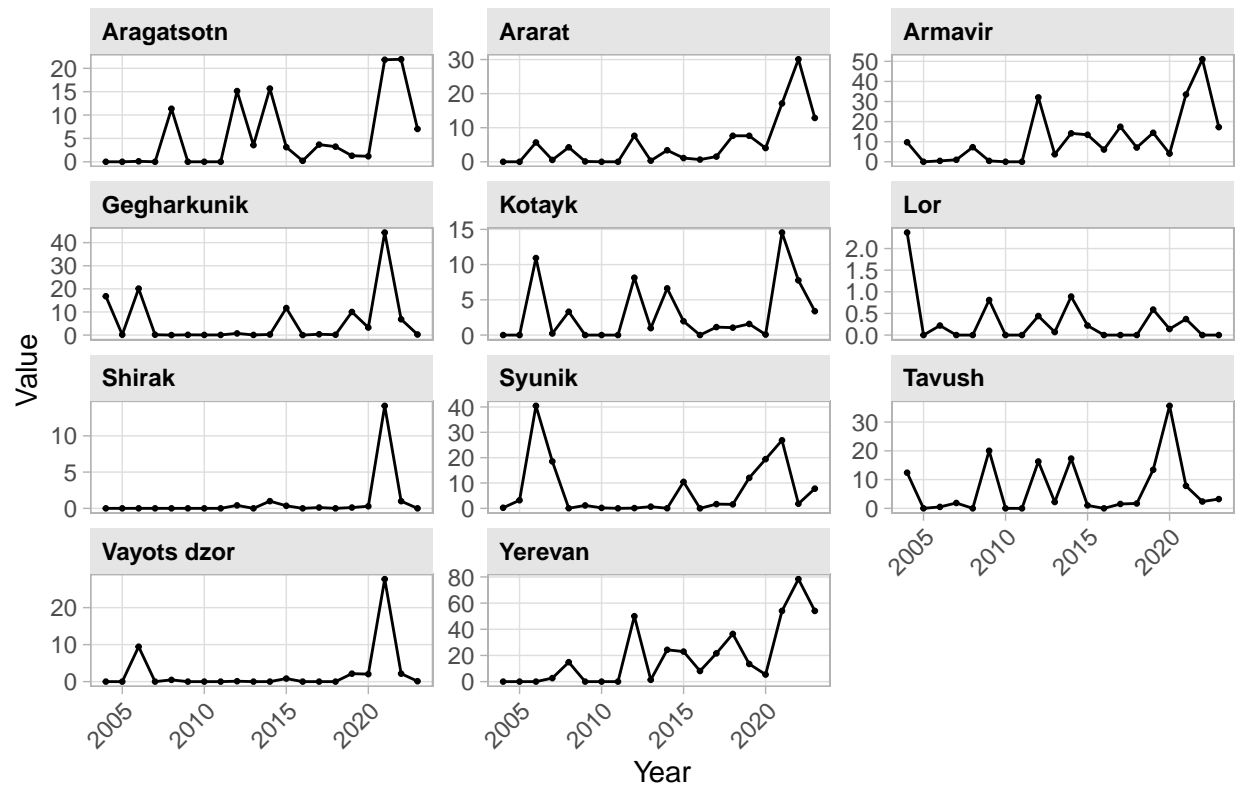
Evolution of: spei



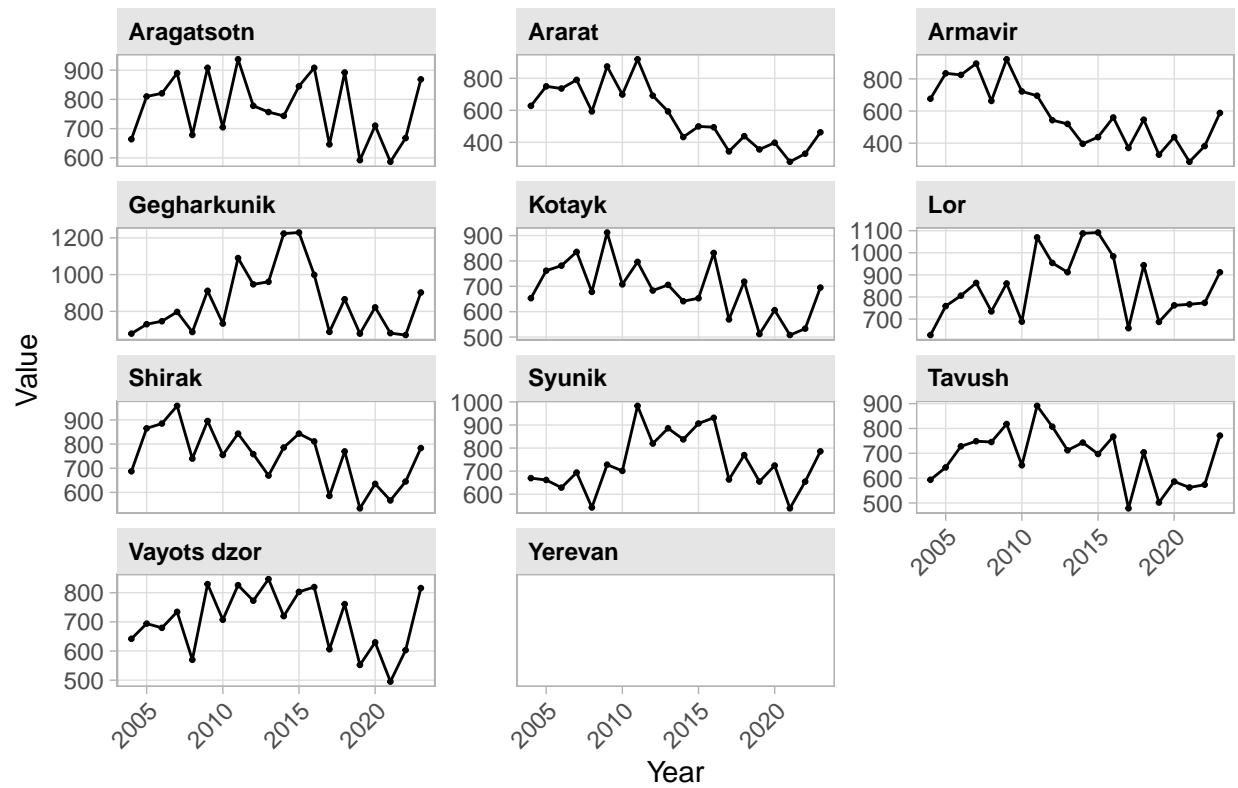
Evolution of: share



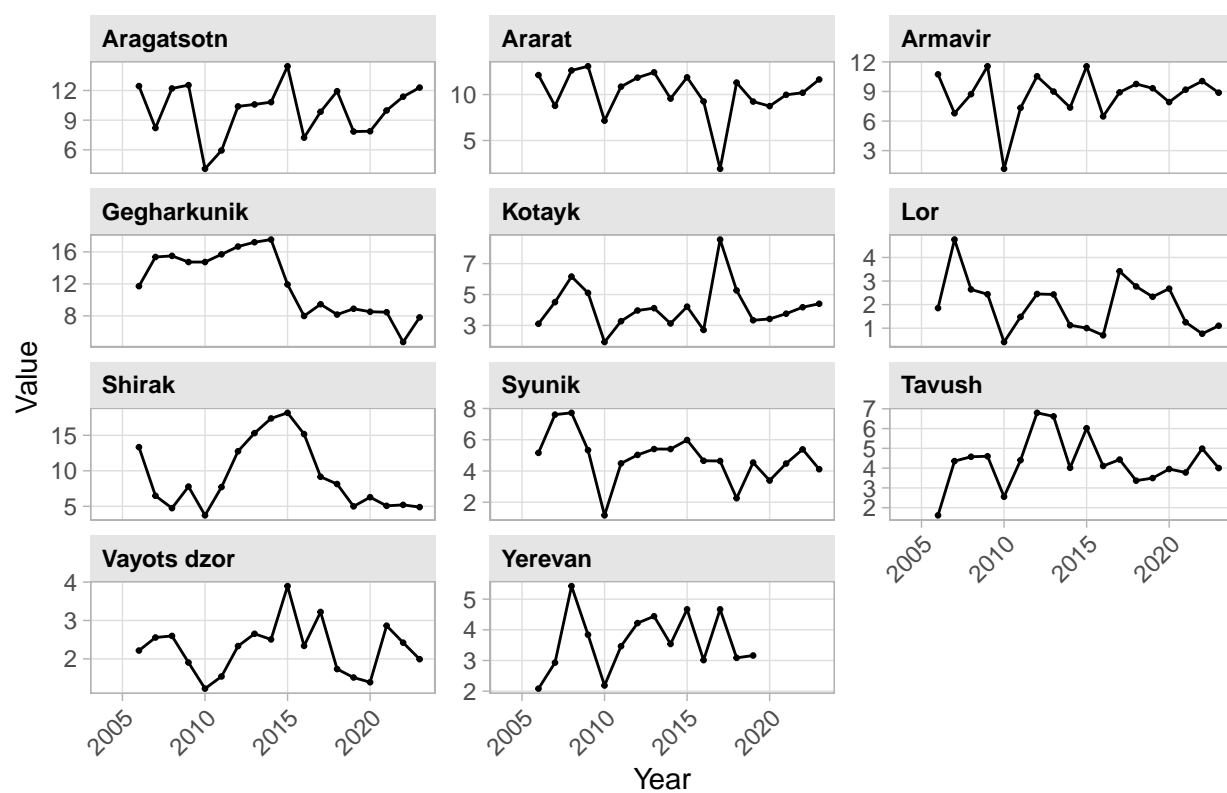
Evolution of: agric_stress



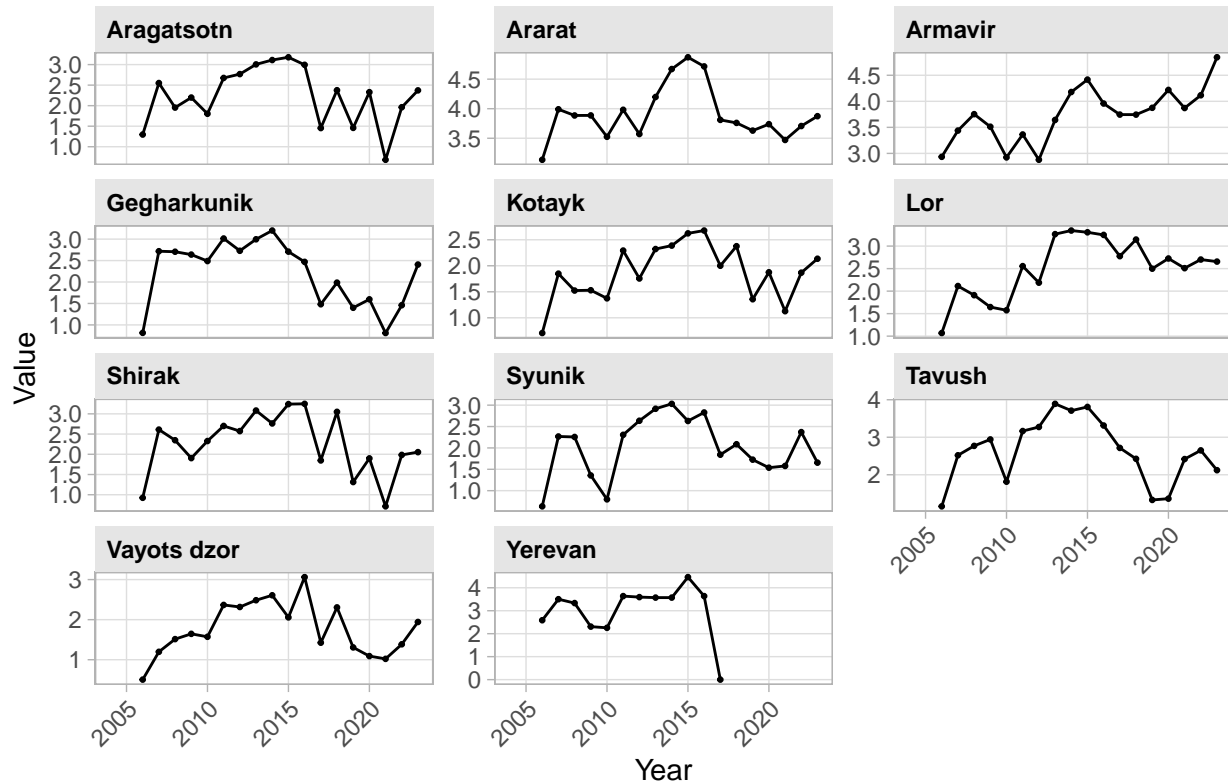
Evolution of: Total_Rainfall



Evolution of: output_per_field_fruits



Evolution of: output_per_field_grains



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

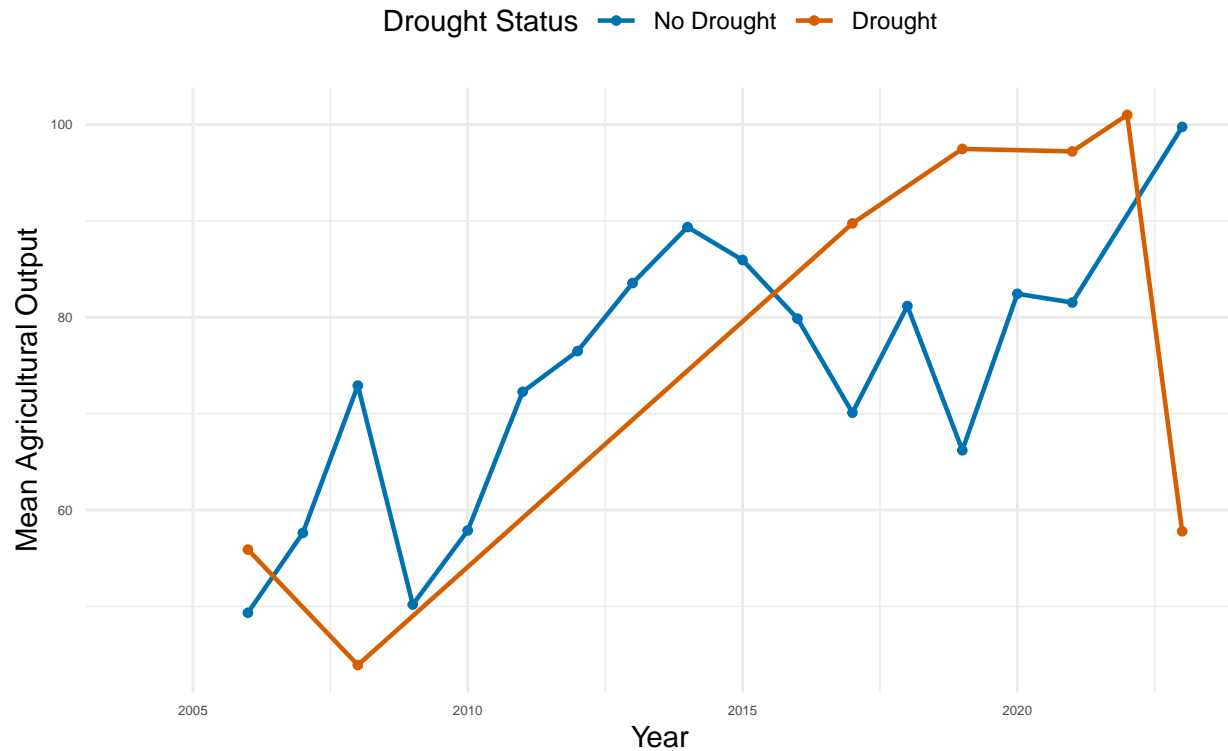
# Compute, for each years, the mean of agricultural output between districts
# that experience drought vs no drought
agric_plot <- dataset %>%
  group_by(year, drought_dummy) %>%
  summarise(mean_agric = mean(agric_output, na.rm = TRUE), n_district = n())

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"))
```

Impact of Drought on Agricultural Output



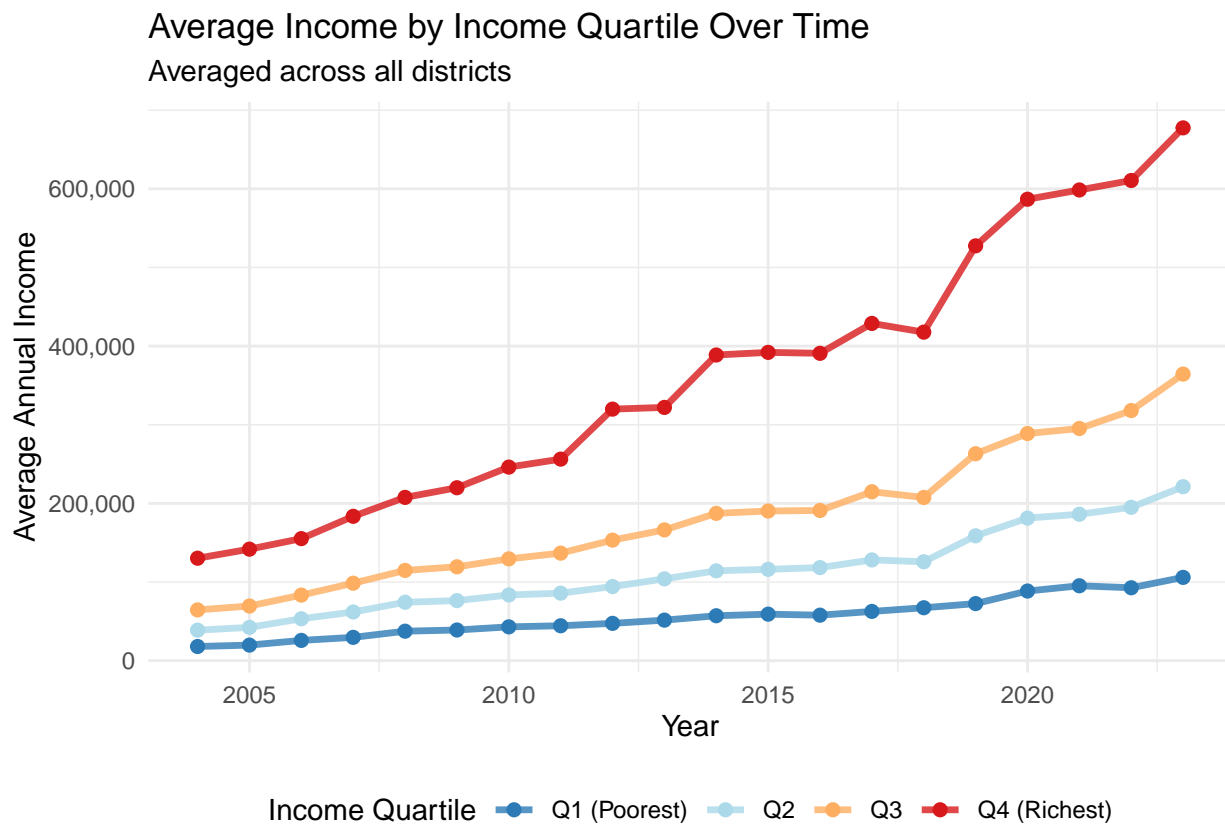
3.4 Graphs with Drought Dummy and Quartiles

```
# 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) +
```

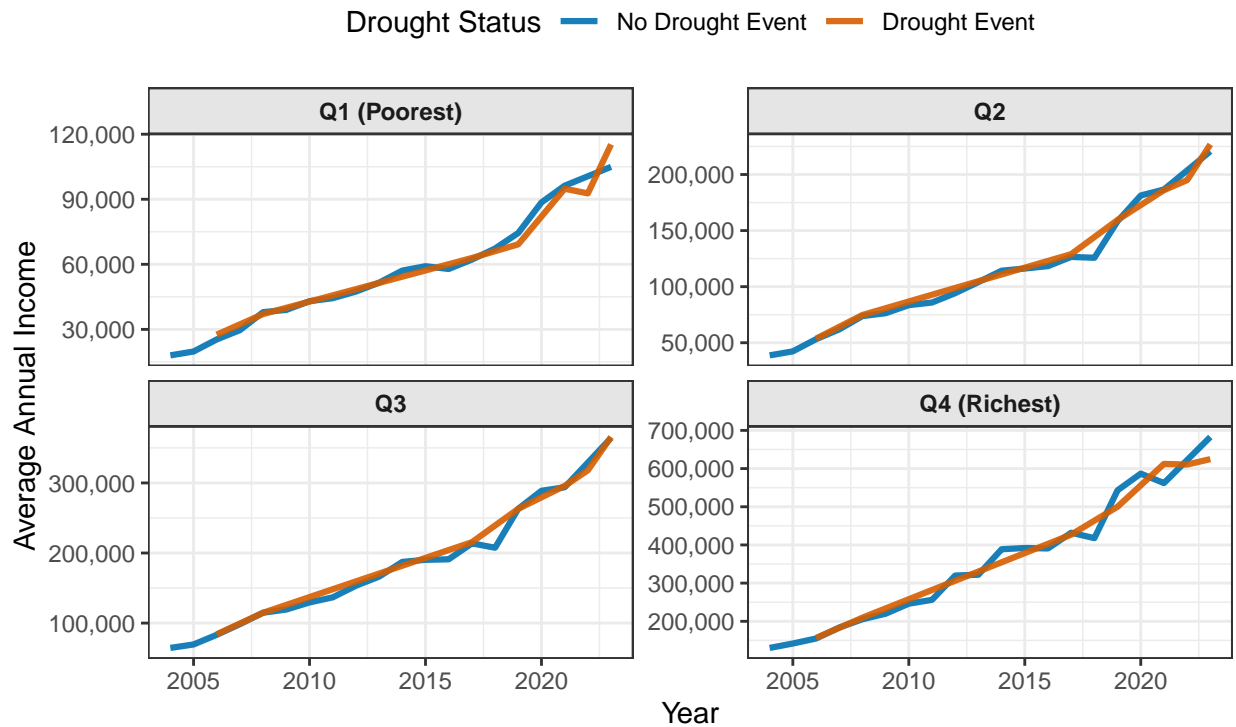
```

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") )

```

Impact of Drought Events on Income, by Income Quartile

Average income trends faceted by income group



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")
```

```

# 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."

# 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

```

# 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", "wr2"),
  tex = latex_format)) } }

```

4.3 Dependent Variable: income

4.3.1 Regressed on: SPEI

Dependent Variable:	income		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	0.0260 (0.0266)	0.0263 (0.0252)	0.0254 (0.0264)
spei_lag1		-0.0201 (0.0505)	-0.0199 (0.0496)
spei_lag2			-0.0174 (0.0522)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	220	220	220
R ²	0.95771	0.95775	0.95778
Within R ²	0.00175	0.00273	0.00344
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.3.2 Regressed on: Share

Dependent Variable:	income		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	-0.1165 (0.0908)	-0.1618 (0.1105)	-0.1685 (0.1155)
share_lag1		-0.2229 (0.1517)	-0.2596 (0.1846)
share_lag2			-0.2104 (0.1685)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	220	220	220
R ²	0.95781	0.95839	0.95888
Within R ²	0.00413	0.01776	0.02941
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.3.3 Regressed on: AgricStress

Dependent Variable:	income		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-4.75×10^{-5} (0.0007)	-0.0002 (0.0006)	-0.0002 (0.0006)
agric_stress_lag1		0.0007 (0.0008)	0.0007 (0.0007)
agric_stress_lag2			-0.0002 (0.0010)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	220	220	220
R ²	0.95764	0.95776	0.95777
Within R ²	1.42×10^{-5}	0.00285	0.00300
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.4 Dependent Variable: agric_income

4.4.1 Regressed on: SPEI

Dependent Variable:	agric_income		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	0.2773 (0.2633)	0.2786 (0.2720)	0.2814 (0.2893)
spei_lag1		0.0586 (0.2790)	0.0572 (0.2737)
spei_lag2			0.0400 (0.2727)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	197	197	197
R ²	0.71669	0.71680	0.71685
Within R ²	0.00952	0.00992	0.01009
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.4.2 Regressed on: Share

Dependent Variable:	agric_income		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	-0.3389 (0.4318)	-0.3282 (0.4687)	-0.3893 (0.4920)
share_lag1		0.0552 (0.7967)	-0.1080 (0.8750)
share_lag2			-0.8570* (0.4538)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	197	197	197
R ²	0.71444	0.71445	0.71667
Within R ²	0.00166	0.00170	0.00946
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.4.3 Regressed on: AgricStress

Dependent Variable:	agric_income		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0020 (0.0052)	-0.0020 (0.0055)	-0.0014 (0.0063)
agric_stress_lag1		0.0106 (0.0099)	0.0119 (0.0099)
agric_stress_lag2			-0.0151 (0.0088)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	197	197	197
R ²	0.71419	0.71963	0.72936
Within R ²	0.00080	0.01981	0.05383
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.5 Dependent Variable: agric_output

4.5.1 Regressed on: SPEI

Dependent Variable:	agric_output		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	0.0578 (0.0556)	0.0597 (0.0519)	0.0666 (0.0544)
spei_lag1		0.0986 (0.0580)	0.0994* (0.0545)
spei_lag2			0.1435* (0.0744)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.97508	0.97550	0.97640
Within R ²	0.00561	0.02268	0.05855
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.5.2 Regressed on: Share

Dependent Variable:	agric_output		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	0.1182 (0.1120)	0.1643 (0.1325)	0.1763 (0.1352)
share_lag1		0.2021 (0.1329)	0.2415 (0.1372)
share_lag2			0.1923 (0.1527)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.97502	0.97522	0.97540
Within R ²	0.00316	0.01144	0.01864
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.5.3 Regressed on: AgricStress

Dependent Variable:	agric_output		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	0.0031 (0.0019)	0.0029 (0.0017)	0.0029 (0.0017)
agric_stress_lag1		0.0023 (0.0014)	0.0023 (0.0014)
agric_stress_lag2			7.04×10^{-5} (0.0019)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.97572	0.97617	0.97617
Within R ²	0.03148	0.04908	0.04909
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.6 Dependent Variable: fdcons

4.6.1 Regressed on: SPEI

Dependent Variable:	fdcons		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	0.0400 (0.0943)	0.0407 (0.0950)	0.0393 (0.0952)
spei_lag1		-0.0648 (0.0517)	-0.0645 (0.0522)
spei_lag2			-0.0296 (0.1102)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	220	220	220
R ²	0.90580	0.90611	0.90617
Within R ²	0.00133	0.00465	0.00531
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.6.2 Regressed on: Share

Dependent Variable:	fdcons		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	-0.0860 (0.1944)	-0.1811 (0.2304)	-0.1932 (0.2334)
share_lag1		-0.4673 (0.2695)	-0.5340* (0.2667)
share_lag2			-0.3819 (0.3588)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	220	220	220
R ²	0.90574	0.90757	0.90875
Within R ²	0.00073	0.02016	0.03261
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.6.3 Regressed on: AgricStress

Dependent Variable:	fdcons		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0002 (0.0020)	8.21×10^{-5} (0.0018)	7.39×10^{-5} (0.0018)
agric_stress_lag1		-0.0012 (0.0015)	-0.0012 (0.0013)
agric_stress_lag2			-0.0003 (0.0020)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (20)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	220	220	220
R ²	0.90568	0.90593	0.90594
Within R ²	9.36×10^{-5}	0.00274	0.00283

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)
<i>Variables</i>			
spei	-0.4503*** (0.1064)	-0.4573*** (0.1065)	-0.4691*** (0.1071)
spei_lag1		-0.2992** (0.1010)	-0.3025** (0.1207)
spei_lag2			-0.2425* (0.1214)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	191	191	191
R ²	0.94570	0.94719	0.94817
Within R ²	0.05653	0.08245	0.09939

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)
<i>Variables</i>			
share	-0.7772** (0.2690)	-0.9705*** (0.2807)	-1.008*** (0.2698)
share_lag1		-0.8358** (0.3403)	-1.012** (0.3457)
share_lag2			-0.9098** (0.4027)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	191	191	191
R ²	0.94375	0.94509	0.94660
Within R ²	0.02257	0.04590	0.07212
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.7.3 Regressed on: AgricStress

Dependent Variable:	grains_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0118*** (0.0030)	-0.0113*** (0.0028)	-0.0115*** (0.0028)
agric_stress_lag1		-0.0080* (0.0043)	-0.0079* (0.0043)
agric_stress_lag2			-0.0052 (0.0044)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	191	191	191
R ²	0.94656	0.94848	0.94914
Within R ²	0.07144	0.10475	0.11627
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.8 Dependent Variable: vegetables_harvest

4.8.1 Regressed on: SPEI

Dependent Variable:	vegetables_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	-0.1150 (0.0697)	-0.1191 (0.0697)	-0.1240 (0.0725)
spei_lag1		-0.2078 (0.1572)	-0.2084 (0.1617)
spei_lag2			-0.1035 (0.0929)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.95674	0.95738	0.95753
Within R ²	0.00428	0.01891	0.02251
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.8.2 Regressed on: Share

Dependent Variable:	vegetables_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	-0.1733 (0.1950)	-0.2713 (0.1901)	-0.2927 (0.1953)
share_lag1		-0.4297 (0.3137)	-0.5002 (0.3758)
share_lag2			-0.3438 (0.2918)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.95661	0.95693	0.95712
Within R ²	0.00131	0.00854	0.01298
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.8.3 Regressed on: AgricStress

Dependent Variable:	vegetables_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0047 (0.0048)	-0.0044 (0.0046)	-0.0044 (0.0046)
agric_stress_lag1		-0.0043 (0.0052)	-0.0042 (0.0051)
agric_stress_lag2			-0.0014 (0.0039)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.95716	0.95767	0.95771
Within R ²	0.01401	0.02568	0.02661
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.9 Dependent Variable: fruits_harvest

4.9.1 Regressed on: SPEI

Dependent Variable:	fruits_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	0.2105 (0.1612)	0.2145 (0.1631)	0.2239 (0.1622)
spei_lag1		0.2010 (0.1169)	0.2022* (0.1042)
spei_lag2			0.1975 (0.1402)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.91392	0.91480	0.91565
Within R ²	0.01062	0.02073	0.03042
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.9.2 Regressed on: Share

Dependent Variable:	fruits_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	0.6161 (0.3458)	0.8515** (0.2807)	0.8986** (0.2913)
share_lag1		1.033** (0.3621)	1.188** (0.4138)
share_lag2			0.7552* (0.4113)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.91406	0.91675	0.91813
Within R ²	0.01223	0.04308	0.05892
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.9.3 Regressed on: AgricStress

Dependent Variable:	fruits_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	0.0062** (0.0022)	0.0058*** (0.0018)	0.0059** (0.0020)
agric_stress_lag1		0.0061* (0.0034)	0.0059* (0.0030)
agric_stress_lag2			0.0043 (0.0032)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.91457	0.91610	0.91670
Within R ²	0.01802	0.03561	0.04253
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.10 Dependent Variable: potatoes_harvest

4.10.1 Regressed on: SPEI

Dependent Variable:	potatoes_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	-0.0864 (0.0585)	-0.0913 (0.0683)	-0.0931 (0.0699)
spei_lag1		-0.2477 (0.1406)	-0.2479 (0.1438)
spei_lag2			-0.0391 (0.0848)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.97357	0.97447	0.97449
Within R ²	0.00395	0.03787	0.03871
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.10.2 Regressed on: Share

Dependent Variable:	potatoes_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	-0.3500 (0.2041)	-0.5348* (0.2540)	-0.5406* (0.2604)
share_lag1		-0.8109** (0.3189)	-0.8300** (0.3329)
share_lag2			-0.0928 (0.2677)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.97369	0.97481	0.97482
Within R ²	0.00872	0.05073	0.05126
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.10.3 Regressed on: AgricStress

Dependent Variable:	potatoes_harvest		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0005 (0.0026)	-0.0002 (0.0025)	-0.0002 (0.0025)
agric_stress_lag1		-0.0042 (0.0034)	-0.0041 (0.0033)
agric_stress_lag2			-0.0020 (0.0016)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.97347	0.97395	0.97403
Within R ²	0.00025	0.01831	0.02162
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.11 Dependent Variable: output_per_field_grains

4.11.1 Regressed on: SPEI

Dependent Variable:	output_per_field_grains		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	-0.2324*** (0.0584)	-0.2349*** (0.0563)	-0.2379*** (0.0524)
spei_lag1		-0.1082 (0.0719)	-0.1090 (0.0768)
spei_lag2			-0.0598 (0.0758)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	191	191	191
R ²	0.78380	0.78558	0.78612
Within R ²	0.03533	0.04328	0.04569
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.11.2 Regressed on: Share

Dependent Variable:	output_per_field_grains		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	-0.4843** (0.2120)	-0.4983** (0.2098)	-0.5060** (0.2134)
share_lag1		-0.0607 (0.2006)	-0.0972 (0.1848)
share_lag2			-0.1884 (0.2824)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	191	191	191
R ²	0.78048	0.78055	0.78114
Within R ²	0.02055	0.02084	0.02348
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.11.3 Regressed on: AgricStress

Dependent Variable:	output_per_field_grains		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0071** (0.0022)	-0.0071** (0.0023)	-0.0070** (0.0023)
agric_stress_lag1		0.0005 (0.0027)	0.0004 (0.0026)
agric_stress_lag2			0.0013 (0.0022)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	191	191	191
R ²	0.78933	0.78940	0.78977
Within R ²	0.06004	0.06032	0.06198
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.12 Dependent Variable: output_per_field_vegetables

4.12.1 Regressed on: SPEI

Dependent Variable:	output_per_field_vegetables		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	0.0175 (0.0438)	0.0145 (0.0492)	0.0092 (0.0508)
spei_lag1		-0.1505 (0.1425)	-0.1512 (0.1481)
spei_lag2			-0.1108 (0.1046)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.81793	0.82015	0.82134
Within R ²	0.00016	0.01235	0.01890
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.12.2 Regressed on: Share

Dependent Variable:	output_per_field_vegetables		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	0.0835 (0.1599)	0.0650 (0.1552)	0.0650 (0.1582)
share_lag1		-0.0810 (0.1714)	-0.0810 (0.2072)
share_lag2			-5.39×10^{-5} (0.2109)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.81799	0.81806	0.81806
Within R ²	0.00048	0.00089	0.00089
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.12.3 Regressed on: AgricStress

Dependent Variable:	output_per_field_vegetables		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0033 (0.0037)	-0.0030 (0.0035)	-0.0030 (0.0035)
agric_stress_lag1		-0.0037 (0.0042)	-0.0037 (0.0041)
agric_stress_lag2			-0.0005 (0.0023)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.81989	0.82240	0.82243
Within R ²	0.01094	0.02469	0.02487
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.13 Dependent Variable: output_per_field_fruits

4.13.1 Regressed on: SPEI

Dependent Variable:	output_per_field_fruits		
Model:	(1)	(2)	(3)
<i>Variables</i>			
spei	0.1856 (0.1434)	0.1887 (0.1457)	0.1952 (0.1438)
spei_lag1		0.1567 (0.1054)	0.1575 (0.0973)
spei_lag2			0.1367 (0.1568)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.79919	0.80052	0.80152
Within R ²	0.00881	0.01538	0.02034
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.13.2 Regressed on: Share

Dependent Variable:	output_per_field_fruits		
Model:	(1)	(2)	(3)
<i>Variables</i>			
share	0.5624 (0.3438)	0.7888** (0.2894)	0.8309** (0.3019)
share_lag1		0.9934** (0.3737)	1.132** (0.4357)
share_lag2			0.6764 (0.4382)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.79960	0.80578	0.80853
Within R ²	0.01088	0.04136	0.05493
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.13.3 Regressed on: AgricStress

Dependent Variable:	output_per_field_fruits		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	0.0053*** (0.0015)	0.0049*** (0.0012)	0.0050*** (0.0013)
agric_stress_lag1		0.0052* (0.0028)	0.0051* (0.0025)
agric_stress_lag2			0.0034 (0.0028)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.80018	0.80294	0.80384
Within R ²	0.01374	0.02737	0.03178
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.14 Dependent Variable: output_per_field_potatoes

4.14.1 Regressed on: SPEI

Dependent Variable:	output_per_field_potatoes		
Model:	(1)	(2)	(3)
<i>Variables</i>			
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)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.80594	0.81511	0.81521
Within R ²	0.00795	0.05479	0.05532
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.14.2 Regressed on: Share

Dependent Variable:	output_per_field_potatoes		
Model:	(1)	(2)	(3)
<i>Variables</i>			
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)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.80487	0.80833	0.81003
Within R ²	0.00247	0.02015	0.02882
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			

4.14.3 Regressed on: AgricStress

Dependent Variable:	output_per_field_potatoes		
Model:	(1)	(2)	(3)
<i>Variables</i>			
agric_stress	-0.0021 (0.0017)	-0.0017 (0.0016)	-0.0017 (0.0016)
agric_stress_lag1		-0.0051 (0.0033)	-0.0050 (0.0033)
agric_stress_lag2			-0.0008 (0.0011)
<i>Fixed-effects</i>			
district (11)	Yes	Yes	Yes
year (18)	Yes	Yes	Yes
<i>Fit statistics</i>			
Observations	194	194	194
R ²	0.80581	0.81430	0.81445
Within R ²	0.00730	0.05069	0.05145
<i>Clustered (district) standard-errors in parentheses</i>			
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>			