ASSESSING THE IMPACT OF DROUGHT ON SHIFTS IN CROP PATTERNS IN GEORGIA

by

TOPE J. ARAYOMBO

(Under the Direction of GENTI KOSTANDINI)

ABSTRACT

This study examines the impact of drought conditions, specifically the Palmer Drought Severity Index (PDSI), on crop pattern shifts in rainfed agriculture Georgia between 2012 and 2023. We utilize panel data on Corn (*Zea mays L.*), Cotton (*Gossypium* spp.), Peanuts (*Arachis hypogaea*), and Soybeans (*Glycine max*) planted acreage, incorporating regression models to analyze the influence of drought severity, time trends, and market prices on planting decisions. Georgia's agricultural landscape, traditionally reliant on Cotton, has experienced shifts toward more drought-tolerant crops such as Peanuts and Soybeans, likely driven by increasing climate variability and fluctuating market conditions. The analysis of this study reveals heterogeneous crop-specific responses. Peanuts showed a significant negative relationship exists between lagged PDSI and acreage indicating that drought conditions reduce peanut planting area. Conversely, soybeans show a positive but modest effect, consistently with their relative drought tolerance. Cotton and corn acreage exhibit no statistically significant relationship with lagged PDSI values. Robustness tests adopted for this study include heteroscedasticity checks such as Hausman specification tests to affirm the suitability of the fixed effects model over random effects. Our findings suggest that while drought conditions using (PDSI) have a negative impact on Cotton acreage, they show minimal direct effect on Corn and Soybeans. This study concludes that the changing crop patterns in Georgia reflect both climate adaptation strategies and market-driven shifts. The findings of this study underscore the need for policy interventions that promote the adoption of drought-resistant crops and ensure agricultural sustainability in the face of climate change.

INDEX WORDS: Drought, Palmer Drought Severity Index (PDSI), Price, Climate Change, Planting Decision, Corn, Cotton, Peanuts, Soybeans

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TOPE J. ARAYOMBO

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TOPE J. ARAYOMBO

Major Professor: Genti Kostandini
Committee: Shankjuta Nath
Yangxuan Liu

Electronic Version submitted to:

Ron Walcott
Vice Provost for Graduate Education and Dean of the Graduate School
The University of Georgia
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DEDICATION

Firstly, this thesis is dedicated to the Almighty God who is the giver of life, knowledge and wisdom. Also, I am grateful to my parents and parents-in law for their prayers, words of encouragement, and continued support. I am always proud of you.

Importantly, I cease this medium to appreciate my dearly beloved and beautiful wife, Oluwafunmilayo Arayombo (nee Ajiferuke) for your persistent love, encouragement and highly impactful contribution towards the development of my thesis. You have proven consistent support all through the phases of the program without which it would have been more difficult to complete.

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CHAPTER ONE

INTRODUCTION

The problem of feeding a rising population in the face of climate change, two possibly substantial pressures to the global food system presents the entire planet in the next decades. Almost two decades ago, the study of Wilhite (2006) emphasizes that one of the most complicated natural events and one of the most detrimental ones for communities all throughout the world: drought. Like in many other countries across the world, the agriculture sector provides a significant contribution to the United States economy by enhancing food and energy security and generating jobs in rural areas (Kaygusuz, 2011). According to the 2013 United States Department of Agriculture (USDA), the current state of agriculture in the country is a dynamic, self-regulating system that reacts to changes in environmental conditions, corporate activity, policy, markets, and technology.

Among the most important problems the earth faces is climate change, which is obviously affecting the sector of agriculture (IPCC, 2014). Climate change is expected to affect comparative advantages in agriculture; however, the resulting crop reallocation might assist to minimize the overall effects of this shift (Candau *et al*., 2022). Among all the economic sectors, agriculture is more prone to drought.

Farms in 2015 created 2.6 million employment and $136.7 billion to the U.S. economy while about half of agricultural profits originate from animal output (Mackie & Kling, 2019). Other industries related to food and agriculture brought in another $855 billion and filled 21 million full- and part-time employment.

The third most major environmental phenomena linked with several billion-dollar weather occurrences since 1980 is drought after tropical cyclones and strong storms (Cammalleri, 2021). With agriculture especially vulnerable, drought is a very devastating natural calamity that may seriously affect the economy (World Meteorological Organization, 2021). Droughts cost an annual average of $6.4 billion (NCEI, 2022) in the United States and have been the main source of agriculture insurance indemnity payments paid recently (Perry *et al*., 2020). Droughts are predicted to be considerably more threatening to food security and agricultural output as climate change proceeds. Along with other extreme weather events, climate change has made droughts more common and severe throughout most major regions globally (Masson-Delmotte *et al*., 2021; UNCCD, 2022).

For example, Smith and & Matthews (2015) discovered that, with an annual expenditure of more than $6 billion, the United States' average yearly cost of drought occurrences is more than $9 billion. Drought is thus a major risk with major effects on the entire agricultural sector. Agricultural drought, maybe exacerbated by high temperatures, low humidity, and strong winds that raise evapotranspiration over an extended time, arises from a lack of precipitation all during the crop development season (Yao *et al*., 2022). Furthermore, accompanying dryness is decreased surface and subterranean water supplies as well as lower soil moisture (Apurv *et al*., 2017). Many research, like Su and Chen (2022), looked at how temperature variations affect agricultural output sensitivity.

United States cropping patterns have changed somewhat noticeably in recent times. Although many of these areas may be in marginal areas and need irrigation, some studies have projected that an expansion in cultivated areas will be required to raise productivity to satisfy rising food demands (Bruinsma 2009). While wheat acreage declined by 43.2% (Cui, 2020), the area set aside for maize (Zea mays L.), and soybeans (Glycine max) in the United States grew by 11.9% and 19.3%, respectively between 1980 and 2016. The Northern Plains and the Upper Midwest show clear shifts in acreage where both temperature and precipitation have risen (Derner *et al*., 2015). Farmers are utilizing adaptive methods, according to Mase *et al*., (2017), to reduce crop loss as changing climatic conditions and increasing frequency of extreme weather events demand more frequent reaction. Although good market circumstances and technical improvements, notably in biotechnology are regarded as significant factors affecting the shift of acreage (Olmstead and Rhode, 2011; Pates & Hendricks, 2018), the consequent effect of climate change remains little understood. Particularly in areas like California and the Midwest, Peña-Gallardo *et al*., (2019) discovered that droughts greatly affect cropping patterns all throughout the United States.

Rising water rates and agricultural prices have pushed California's Central Valley's conventional crops alfalfa and cereals from more water-efficient tree crops like almonds and walnuts. Changing precipitation patterns, typified by wet springs and drier summers, impact maize and soybean yields in the Midwest, Yang *et al*., (2022) indicate; drought conditions during critical development periods induce yield decreases of up to 7%. Reflecting changes to climatic and economic conditions, literature has indicated the overall shift of cropland generally in the United States defined by an increase in maize and soybean cultivation (Auch *et al*., 2018).

Dietz *et al*., (2021) define drought-related research as regionally specific as various regions produce different crops and experience different types of droughts. This study investigates the adaptive management technique by means of farmers' application against drought impacts to increase crop resilience in Southeast region's changing climatic circumstances by means of changes in crop shares. Although the Southeast area is generally seen as water rich (NIDIS, 2024), it is gradually suffering record-breaking droughts, therefore stressing contradicting water needs. Usually, the area gets somewhat high precipitation. Drought conditions particularly in the Southeast develop rapidly when little rainfall mixed with high temperatures increases evapotranspiration of water in the soils (Dai, 2011). Resilience depends on these adaptations, but they also highlight the ongoing challenges brought about by climatic unpredictability, which demands ongoing innovation in crop management and agricultural technologies.

Moreover, Raza *et al*. (2019) study indicates that awareness of its many consequences might drive improved management strategies and adaptation plans even if drought drastically affects agricultural productivity. Still, the variety in crop responses requires tailored plans for many different crops and regions. This study intends to especially add to the body of knowledge by providing significant analysis of the degree of changes in crop patterns in maize (Zea mays L.), cotton (Gossypium spp), peanuts and soybean based on county-specific data in Georgia owing of agricultural drought. The four crop selections are chosen with consideration for their varying water needs. More precisely, in this study, corn (Zea mays L.) and peanuts (Arachis hypogaea) have varied vulnerability to drought and economic relevance. Furthermore, maize remains a mainstay for cattle feed and biofuel; corn expected to outgrow wheat in terms of acreage by 2030 (Padhan *et al*., 2023).

In addition, based on Schnepf (2018), Georgia leads the United States in peanuts grown, accounting for about half of the national production. Both crops are quite susceptible to water scarcity, although their physiological reactions differ. While corn's water-intensive development periods (such as tasseling) heighten its vulnerability to yield losses under moisture stress, peanuts, being legumes, demonstrate considerable drought resistance through deep root systems.

Ranked among the top states in the United States for both crops, Georgia is a large soybean and cotton producer. According to FAOSTAT (2021), there were approximately 24.65 million tons of cotton fiber produced worldwide. 6.71 million tons were produced in the Americas, 0.38 million tons in Europe, 1.56 million tons in Africa, 0.95 million tons in Oceania, and 15.06 million tons in Asia at the end of 2018 (FAOSTAT, 2021). Approximately 3.52 million hectares of cotton were planted in the United States in 2020, with an anticipated 3.26 million tons of cotton produced nationwide (USDA, 2020). With over 35% of global cotton exports in recent years, the US is the world's top exporter of cotton.

After cotton and peanut, corn is still the third-largest row crop; based on Georgia AgSnapshots report (2021), its economic value was $321 million, making it the seventh largest agricultural product by economic value in Georgia. Additionally important for Georgia's ethanol and cattle sectors is its maize. A sizable share of Georgia's crop output is soybeans, which greatly impact the state's agricultural economy (USDA-NASS, 2023).

Georgia is also a major cotton producer, growing both upland and long-staple cotton types needed for the textile business (Scarpin *et al*., 2025).

Though they show different physiological reactions that affect their output under water-limited conditions, soybean (Glycine max) and cotton (Gossypium hirsutum) are quite vulnerable to drought stress. Because they can control stomatal closure and preserve water status, together with rather deep root systems that provide access to subsoil moisture, soybeans show some drought resistance (Manavalan *et al*., 2017). But water stress during important reproductive phases like pod filling and blooming can significantly reduce seed quantity and size, hence limiting output (Salem *et al*., 2017). Furthermore, dryness reduces soybean nitrogen fixation by compromising nodule function, therefore limiting nitrogen availability and hence restricting development under a moisture deficit (Cheng *et al*., 2019). During these delicate times, Georgia's sandy soils and often erratic rainfall aggravate drought risk, therefore water management is crucial for soybean output (Le *et al*., 2021).

Conversely, cotton, known for its rather deeper taproot and prudent water use strategy, can withstand short-term drought better than many crops, but extended moisture shortages during flowering and boll development can cause major bloom drop, reduced boll retention, and degraded fiber quality (Abid *et al*., 2016; Farooq *et al*., 2017). Closing stomata to minimize water loss helps cotton plants survive a drought; yet, this also limits photosynthesis, therefore influencing biomass growth (Mahajan & Tuteja, 2019). Drought stress during the fibre elongation phase might lower fibre length and strength, therefore affecting market value (Wang *et al*., 2020). Variations in rainfall and high evapotranspiration rates in Georgia pose challenges to cotton farmers that need for drought-resistant cultivar selection and irrigation techniques (Maher, 2021).

Although both crops show vulnerability to drought, their physiological reactions vary. While cotton uses drought tolerance mechanisms like stomatal closure and deep rooting but suffers yield losses if stress persists during reproductive development, soybeans rely on moderate drought avoidance via stomatal regulation and symbiotic nitrogen fixation, which is highly sensitive to moisture stress. Developing efficient water management strategies, drought-tolerant cultivars, and precision agriculture techniques catered to Georgia's agroecological circumstances depends on an awareness of these crop-specific reactions (Le *et al*., 2021; Wang *et al*., 2020). Combining such approaches helps to reduce crop losses brought on by drought and maintain Georgia's significant national soybean and cotton output.

Research on drought mostly has been on how it affects yield (Kuwayama *et al*., 2019; Lobell *et al*., 2014; Schmitt *et al*., 2022; Yu *et al*., 2022; Zipper *et al*., 2016). But drought also causes farmers all over the crop year to respond in terms of mitigating and adapting; this affects decisions on intended acres, avoided planting, and crop abandonment. Ignoring to replicate these adaptive responses leads to an inadequate knowledge of drought effects. This study will also help to understand how various drought intensities affect agricultural planted areas, thereby directing farmers and decision-makers toward suitable crop choice either now or in the future.

CHAPTER 2

BACKGROUND ON DROUGHT

Environmentally catastrophic drought has drawn the interest of environmental activists, ecological experts, hydrologists, meteorologists, geologists, and agricultural professionals (Mishra & Singh, 2024). Droughts, which usually coincide with a persistent decrease in precipitation over an extended time, almost all climatic zones including both high and low rainfall areas experience. Georgia's temperatures have risen by 0.8°F from the beginning of the 20th century, around half of what has been warming the contiguous United States. Still, Druckenmiller *et al*. (2021) found that 2016–2020 had the hottest continuous 5-year span. Edwards *et al*. (2013) claim that Georgia's temperatures peaked in the 1920s and 1930s preceding century: the 1960s experienced over 2°F decline. Temperatures have risen around 3°F since that cold time; consequently, the temperatures of the 1990s and 2000s mirrored those of the 1930s; nevertheless, the 2015–2020 period reached a record-high level significantly above the one noted during the 1930–1934 period.

Temperature, high winds, low relative humidity, timing and features of precipitation including the sequence of rainy days, intensity, length, commencement and cessation greatly affect the frequency of droughts (Kaygusuz, 2011). Droughts immediately cut the water flow, therefore influencing production. Less water and soil moisture available for agricultural development means that a significant drought can lower crop yields and crop hectarage. Farmers could think about cutting their cropping hectare and just growing drought-tolerant crops during a drought. To prepare and minimize its possible detrimental influence on agriculture, it is thus crucial to grasp the spatiotemporal variability of drought impact on crop output and cropping regions (Zipper *et al*., 2016). With climate change, projected to increase are extremes in temperature that could have detrimental effects on agricultural output (Troy *et al*., 2015).

According to Fukuoka (2023), severe drought in the southeast United States during important development years might result in yield losses of up to 42.7% for maize and soybeans. According to Eslamian *et al*., (2017) around two-thirds of American counties were declared disaster zones following a significant drought affecting 80% of the nation's agricultural acreage in 2012. Suppan (2020) noted across the Great Plains and Midwest that the drought impacted livestock and crop productivity, particularly wheat, corn, and soybeans, therefore generating $14.5 billion in federal crop insurance program payouts. With direct costs of $1.84 billion, drought effects on California's agriculture industry resulted in the loss of 10,100 seasonal employment and 8.7 million acre-feet of surface water shortages in 2015 (Smith, 2015).

Although short-term droughts contribute to as much as 13% of output variability nationwide, drought conditions, particularly during important growth periods, may cause considerable output losses in maize and Soybeans. In the Midwest, there has been an increasing trend of spring precipitation and decreasing summer rainfall, which could exacerbate drought effects (Elias *et al*., 2019). According to Oslo *et al*., (2019), total farmland acreage has decreased since the late 1970s, even though the percentage of corn and soybean acreage has increased. This implies that the replacement with other crops helps to partially explain how climate change influences soybean and corn land. Since, depending on their predicted impact on agricultural yield, climatic variations affect planting decisions assuming constant price, he also illustrated how closely the expected acreage trends are tied to the biophysical features of these crops.

Variations in precipitation have varying effects on agricultural profitability depending on the water requirements of various crops (Kukal & Irmak 2020). Usually using less water than most other crops in the United States, corn, soybeans, and barley usage are during a growing season (Wang *et al*, 2021). In dry climates, more rainfall increases the relative profit margins of maize and soybeans than it does barley and spring wheat. Furthermore, Sharma *et al*. (2022) claims that more soybean and maize cultivation benefits from higher precipitation in humid regions than from winter wheat and cotton. Still, these effects most usually come from several causes. Moreover, Mhawej *et al*., 2024 discovered that the greatest water consumption time for winter wheat partly matches with the developing season of maize and soybeans. Too much water at this time might offer more yield concerns for winter wheat than for maize and soybeans.

Driven by rising food prices and water expenses, drought in California's Central Valley has pushed a move from conventional crops like alfalfa and cereals to more drought-resistant tree crops like almonds and fruit trees (Hall *et al*l., 2015). With maize and soybean rising as key crops, historical data demonstrates a significant transfer of farmland from the Eastern U.S. to the Midwest, therefore demonstrating adaptive responses to changing climatic circumstances (Wang *et al*., 2015). Northern Great Plains farmers are steadily switching to pulse crops in response to water shortage, lowering fallow land by one-third, therefore signaling a change towards more sustainable practices (Banjara *et al*., 2022). Little is known, though, about how drought influences production and cropping patterns for important Southeastern US crops.

Using data from the U.S. Drought Monitor, Figure 1 shows the percent area of the United States impacted by different degrees of drought from 2000 to 2024. Understanding long-term trends in drought intensity and their spatial distribution which underpin changes in crop patterns in drought-sensitive areas like Georgia is especially important for this number. With many increases in extreme (D3) and exceptional (D4) drought conditions, the data reveal that droughts are not only recurrent but also progressively severe and extensive in certain years.

For Georgia, which is in the southeast of the United States, these national drought statistics are rather pertinent. Particularly for water-intensive crops like maize and peanuts, southeast agriculture is quite sensitive to water stress, according to research (Zipper *et al*., 2016). As this graph shows, protracted stretches of moderate to severe drought can lower crop yields, raise irrigation demand, and force farmers to rethink their planting choices. Past drought occurrences have seen, for instance, a shift from maize to more drought-resistant crops like peanuts or cotton (Mase & Prokopy, 2014). Furthermore, affecting long-term land use and agricultural diversification policies is the degree of drought. The repeated character of droughts shown in Figure 1 supports results by Brown *et al*. (2020), who observed that continuous drought conditions help to both cause temporary changes in crop portfolios at the county level in Georgia and cause permanent adaptations. This chart not only shows the rising unpredictability of climatic stresses but also establishes the environmental context for noted agricultural adjustments.

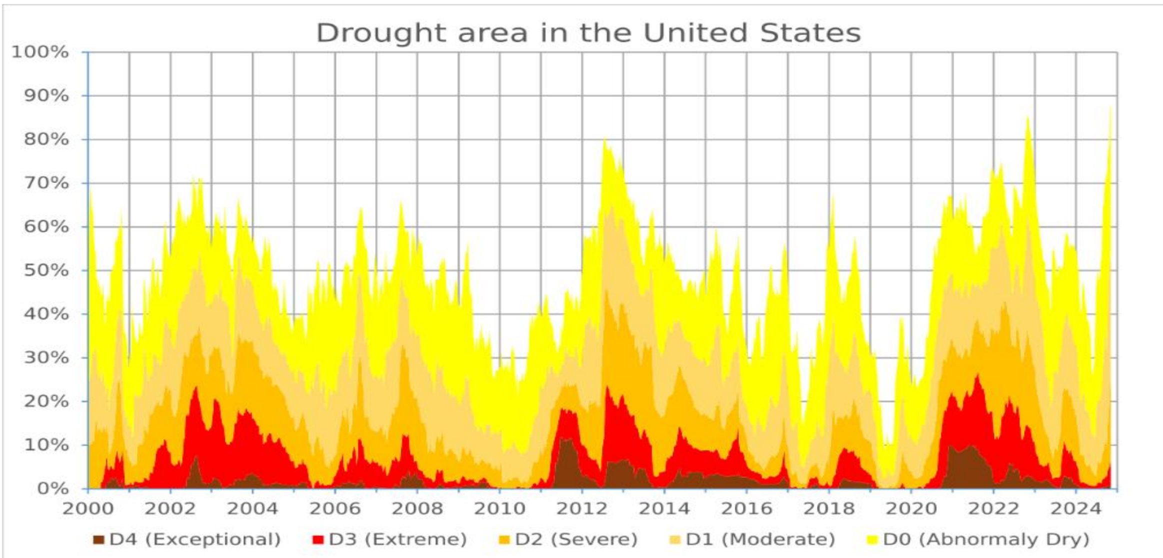


Figure 1: Percent Area in U.S. Drought Monitor Categories, United States Drought Monitor, 2024

CHAPTER 3

LITERATURE REVIEW

3.1 Drought Risk and Drought Related Damages in Southeast United States

In 1975, it was estimated that the average yearly crop losses in the United States (U.S.) Great Plains due to drought were US$700 million (White and Haas, 1975). US Federal Emergency Management Agency (FEMA) estimates of drought-related agricultural losses ranged from US$6–8 billion in 1995 (Wilhite, 2000) to US$10–14 billion in 2018 (Kuwayama, 2019). This highlights the concerning susceptibility of US agriculture to drought in spite of growing financial and technical investments.

Human actions (over-extraction of groundwater) and climatic variability (lower precipitation, greater temperatures) which affect ecological and socioeconomic systems cause a lengthy and abnormal water deficit known as a drought (Dai, 2011). Unlike short dry spells, droughts define their length, severity, spatial breadth and influence ecosystems, water supply, and agriculture among other areas (Crausbay *et al*., 2017).

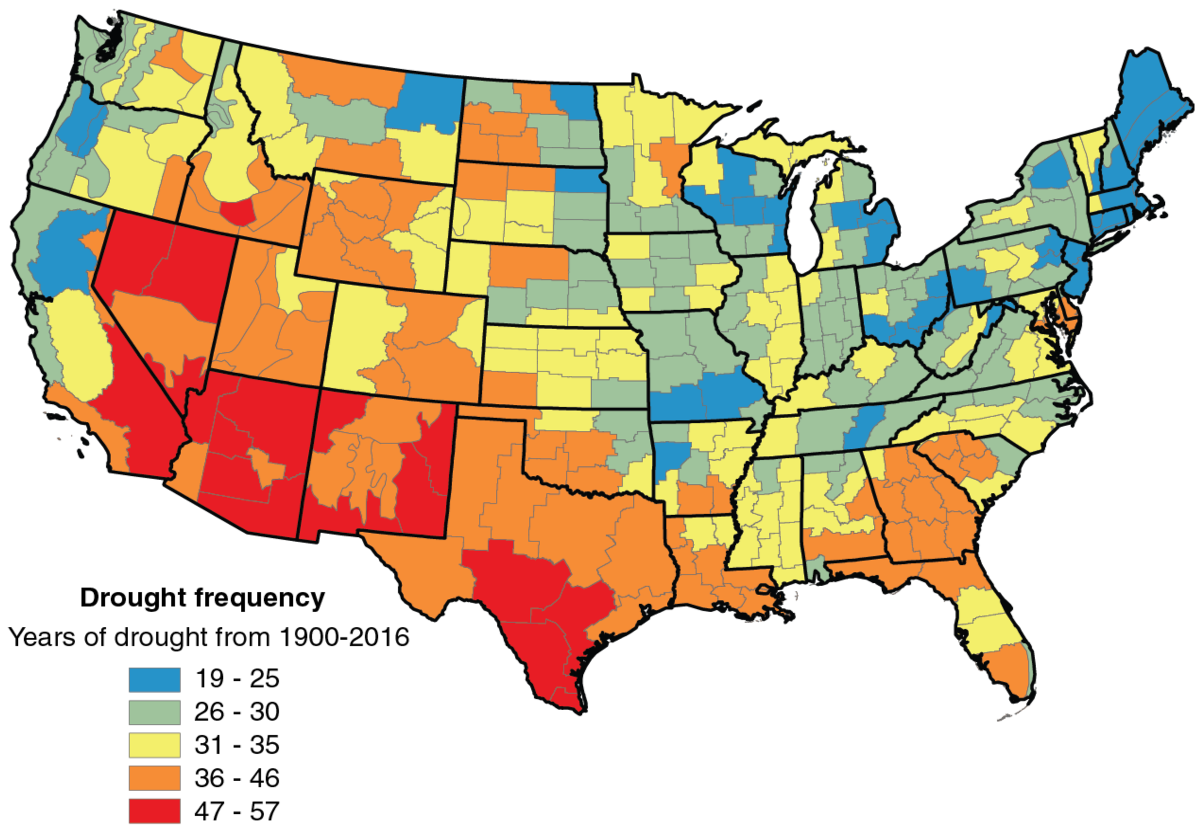
A recent study by Zhen *et al*. (2024) maintained that peanut (Arachis hypogaea L.) cultivation throughout the Southeastern United States (SEUS), which was defined by hot summers and moderate winters, faces significant problems due to rising temperatures and shifting patterns of precipitation in future climates. Also, the Southeastern Coastal Plains in the United States are the primary location for peanut production.

Due to the scarcity of supplies of water for farming, the primary abiotic stressor on peanut production in this region's dryland cropping systems is drought stress, which lowers yield (Ficklin and Novick, 2017; Pilon *et al*., 2018).

The Palmer Modified Drought Index (PMDI) operationalizes dryness by gathering precipitation, temperature, soil moisture, and evapotranspiration to classify events from "abnormally dry" to "exceptional drought," Keyantash & Dracup, 2002 notes. PMDI shows, for instance, droughts in the Southeast United States when persistent moisture shortages exceed area climatic norms, as in the 2006–2008 event when soil moisture deficits lasted for more than 18 months, severely harming crops (Li *et al*., 2020). Therefore, adaptive frameworks are required even if traditional criteria based on previous performance such as PMDI's reliance on baselines from the 20th century may not be able to detect new threats under climate change.

The Palmer Modified Drought Index (PMDI) allows one to see from figure 1 below the fluctuations in drought frequency throughout numerous areas of the United States between 1900 and 2016. The map lists the years in which at least one summer month {June, July, or August} had severe or worse drought conditions using distinct colors that is, color themes that denote varied frequency of drought occurrence.

Particularly California, Nevada, Arizona, New Mexico, and Texas, the western and southern portions of the United States have had more frequent droughts spanning 47 to 57 years. Representing vivid red, these areas have long gone through extended dry seasons and clear water deficit. Conversely, states in the middle and southeast of the country include Kansas, Oklahoma, Georgia, and Alabama show a moderate drought frequency between 31 and 46 years. These regions represented by tones of yellow and orange see regular droughts, albeit not as regularly as the Southwest. In the northern and upper Midwest states including New England, Michigan, Wisconsin, and Minnesota, droughts have been somewhat infrequent happening in just 19 to 30 years of the 116-year span. Emphasized in blue, these locations often get more consistent precipitation and have a more continuous water supply. Still, drought danger varies widely even inside different states. For example, certain areas of Colorado and Utah endure considerable frequency whereas others have either modest or low frequency of drought.



Note: Drought frequency is the number of years when at least one summer month (June, July, or August) had moderate or worse drought (PMDI ≤ -2.00).
Source: USDA, Economic Research Service using historical data by climate district from National Oceanic and Atmospheric Administration's Palmer Modified Drought Index (PMDI).

Figure 2: Drought frequency across the United States from 1900 - 2016

Especially for climate resilience, water management, and agriculture, these drought trends have major effects. To maintain output continuous in very drought-prone areas such as the Southwest, farmers must rely on large irrigation systems and drought-resistant crops. In these places also, water-saving methods are crucial to minimizing the effects of extended dry spells. Conversely, more regular water supply benefits the Midwest and Northeast, hence allowing more freedom in crop choice. As climate change continues to affect weather patterns, drought conditions in already vulnerable places may grow even more severe and persistent. Good adaptation strategies depend on knowledge of past drought patterns, particularly in relation to resource management and agriculture. In places like Georgia, where moderate drought frequency prevails, adjustments in crop patterns might be needed to assure long-term agricultural viability in reaction to changing climatic circumstances.

3.2 Drought Characteristics and Trends in Southeastern United States

Comprising 135 million hectares, the Southeast (SE) makes up 14.9% of the US geographical area overall. Although county-wide land use varies greatly throughout the Southeast, 60% (or more than 79 million hectares) is set up as forest, making about 30% of all forest acreage in the United States (Woodall *et al*., 2023). With cropland in the SE totaling around 21 million ha nearly 15.7% of the landmass of the region 13% of the overall cropland of the country interestingly noted (Johnson *et al*., 2021). Variations in critical climatic variables, like seasonal mean temperatures or precipitation patterns, can induce possibly significant changes in the mix of products produced inside an area and the methods and technology agricultural producers employ to create these items (Hatfield *et al*., 2020). Moreover, Dubey *et al*. (2020) contend that direct effects of changed temperature on crop and livestock growth and productivity expose agricultural output to susceptibility to climate change. Nonetheless, due of its flexibility to engage in adaptive behaviors, the U.S. agriculture industry is expected to be somewhat resilient to climate change in the near future (Holzkämper, 2017).

Talking about how drought affects Southeast American farmers first helps one to better understand the characteristics of the drought in the region. For farmers in the southeast of the United States, drought is posing serious difficulties that compromise crop productivity and farming profitability. According to historical statistics, drought events during pivotal periods of growth might result in losses of soybean output of 35% and maize output losses of up to 42.7%. Moreover, under extremely dry conditions there is a possibility of a yield decline of more than 80% (Meza *et al*., 2020).

Kim *et al*. (2023) contend that the change from rain-fed to irrigation-fed agriculture has made conditions more difficult as it can lessen precipitation in irrigated regions while nevertheless generating meteorological drought in planted areas. Apart from that, the financial weight of a drought might cause difficulties for farmers, which could influence their capacity to pay back loans and maintain a decent credit score (Cowley 2018). Especially in the Southeast, this is clearly true unlike in the Midwest. This is the reason the junction of climatic, financial, and agricultural aspects highlights the fragility of farmers in this area to drought conditions (Yagci *et al*., 2018).

Especially in view of climate change, Georgia's degree of drought frequency has grown increasingly severe. According to Hardy's (2013) research, both climatic and hydrological dryness have gotten more severe, significantly impacting water supply particularly in areas like Atlanta, where population expansion aggravates water scarcity issues. Using the Standard Precipitation Index (SPI) and Standard Precipitation Evapotranspiration Index (SPEI) demonstrates a notable rise in severe drought episodes, especially in eastern Georgia (Kim, 2023; Tatishvili *et al*., 2022).

3.3 Role of Irrigation, Drought Resilience and Adaptation Strategies in Drought Management

The Cotton Belt, which is the region of the U.S. southeastern and lower southern plains, accounts for over 17% of the world's upland cotton output, generating over $6 billion in total income and roughly 38% of worldwide raw cotton fiber exports (Nouri *et al*., 2021). Additionally, the Cotton Belt has more catastrophic weather catastrophes worth billions of dollars than the rest of the nation. Saini *et al*. (2023) also argued that in the great majority of the Cotton Belt, summer temperatures are also rising, particularly at night. Thus, irrigation is very important in the Southeastern United States' drought control if we are to increase agricultural resilience and output. Changing from rain-dependent to irrigation-dependent agriculture has been demonstrated to assist to lower crop sensitivity to drought, especially that of maize.

According to Fukuoka (2023), the yield loss in irrigation counties is significantly less than in non-irrigated ones. For crops like maize on the other hand, the effectiveness of irrigation may fluctuate; too much irrigation during years of great rainfall might result in financial penalties and reduced net returns (Liu *et al*., 2022). Furthermore, even if irrigation minimizes the negative consequences of drought, it may also change the local precipitation patterns for, so influencing the rainfall in several directions (Kim *et al*., 2023).

Under drought situations, irrigated crops usually show superior profitability; so, this underlines the significance of using effective irrigation management systems to optimize the economic benefits as well as the water usage (Pasaribu *et al*., 2021). Although irrigation is a required tool for the management of agricultural drought, Tang and McColl (2023) assert that it should be handled cautiously to achieve the most possible advantages while reducing the negative consequences. Drought resilience and adaptation plans are especially important in the Southeast United States given the rising frequency and intensity of drought pushed on by climate change. Studies reveal that if one wants to adequately adapt, one must be aware of the effects drought has on agricultural productivity. This is especially true for crops like soybean and maize, which can incur output losses of up to 42.7% and 25.4% respectively during significant growth years (Fukuoka, 2023). Furthermore, participatory methods in citizen science might improve community engagement and resilience programs, so promoting a cooperative approach to handle issues connected to drought (Vadjunec *et al*., 2022).

Mihunov, 2022 has found notable resilience components impacting community reactions to the drought. Among other elements, these variables address socioeconomic conditions and agricultural diversification. Finally, these discoveries may be used to create management plans combining local knowledge with scientific data, therefore promoting sustainable agricultural practices and raising community resilience against continuous drought circumstances by means of local knowledge mixed with scientific data (Bradford *et al*., 2022). The impacts of drought in the southeast United States are quite variable among locations depending on agriculture, hydrology, and forest ecosystems affected in a range of ways (Liu *et al*., 2081). With average yield declines projected to be between

31.9% and 42.7% for maize and between 23.4% and 25.4% for soybeans, extreme drought conditions have a significant influence on crop output (Nguyen *et al*., 2023). These losses may intensify significantly at crucial developmental phases; under extreme drought stress (Fukuoka, 2023), possible production drops exceed 80%. Low flow episodes brought on by summer expose some areas including the southeast of Mississippi and the central region of South Carolina that exhibit more susceptibility (Dyer *et al*., 2022; Raczyński & Dyer, 2022).

3.4 Change in Total Planted Acres for Field Crops in Georgia 2012-2023

Crop area is an important reference datum for irrigation water and land resources optimization. Efficient optimization of planning crop areas could help to decide how much water should be allocated to different cropped areas to achieve certain goals (Li and Guo 2015). The decline in the total planted area is significant as the area in 2013 for field crops stood at 3.863 million acres, but by 2023, this had decreased to 3.296 million acres. This reflects broader agricultural trends and the potential impact of climate variability, economic shifts, and agricultural policy changes over this period.

One contributing factor to this reduction in planted acreage is the increasing occurrence of drought events in Georgia. As illustrated by Wooldridge (2021), drought has a direct impact on farmers' decisions regarding crop planting. Droughts can limit water availability for irrigation and reduce soil moisture, making it more difficult for crops to grow, particularly water-intensive crops like corn (*Zea mays* L.) and soybeans. This leads to a reduction in planted acreage for these crops, as farmers may choose to plant more drought-resistant crops such as cotton or peanuts. The Palmer Drought Severity Index (PDSI), which measures drought severity, has shown increasing values during some of these years, indicating more frequent and prolonged drought conditions in the state (Higgins *et al*., 2019).

The shift in crop patterns driven by drought is also supported by Stoorvogel and Smaling (2020), who noted that agricultural shifts often occur in response to long-term environmental changes, such as drought. These changes are evident in the crops chosen for planting, as farmers adapt to environmental pressures and economic incentives. For instance, while corn (*Zea mays* L.) and soybeans have seen a decline in planted acreage, crops like cotton and peanuts, which are relatively more drought-resistant, have seen some stability or slight increases, reflecting an adaptation to changing climate conditions.

Additionally, economic factors, particularly crop prices, play a crucial role in determining planting decisions. Skees and Collier (2018) argue that crop prices significantly influence farmers' choices, even when faced with environmental challenges like drought. According to the study of Fischer *et al.* (2016), the study shows that higher prices for drought-resistant crops can encourage farmeffrs to continue planting them despite adverse conditions, whereas low prices for crops like soybeans and corn (*Zea mays* L.) could discourage planting, contributing to the observed decline in acreage for these crops in Georgia. Moreover, policy changes and market dynamics may have influenced these shifts. The Farm Bill and other agricultural policies can impact farmers' financial incentives, subsidies, and insurance coverage, which in turn affect their planting decisions. Smith *et al*. (2022) discuss how federal policies and market conditions, including subsidies for certain crops, can either mitigate or exacerbate the impacts of drought on planted acreage

CHAPTER 4

DATA AND METHODS

This study investigates the impact of drought on shifts in non-irrigated crop patterns across Georgia (USA) especially with respect to yield of corn (*Zea mays* L.), cotton, peanuts and soybeans utilizing two primary datasets: weather data and county-level agricultural acreage data. The weather data is sourced from the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information, specifically the Statewide Time Series dataset, Climate at a Glance, published in September 2024. The second dataset consists of county-level acreage data obtained from the Farm Service Agency (FSA) of the U.S. Department of Agriculture (USDA), covering the period from 2012 to 2023. This chapter outlines the variables used in this study and provides summary statistics.

The NOAA weather dataset provides monthly climate variables, including average temperature, total precipitation, and the Palmer Drought Severity Index (PDSI). PDSI is a widely used drought index in climate studies and agricultural impact assessments. For example, Yinpeng *et al*. (2009), examined the effect of climate change and drought on crop yields. PDSI values help quantify drought severity, where negative values indicate drought conditions, and positive values reflect wetter-than-average conditions. The second dataset, county-level crop acreage data, is obtained from the USDA's National Agricultural Statistics Service (NASS).

This dataset spans from 2012 to 2023 and includes acreage information for key crops such as corn (*Zea mays* L.) and peanuts. County-level crop yield data was extracted from NASS to examine spatial and temporal variations in agricultural production in response to drought conditions. The data provided from the USDA NASS (2025) as shown in figure 3 reveals a noticeable decline in the total planted area for field crops in Georgia over the past decade. In 2013, the total planted area for field crops stood at 3.863 million acres, but by 2023, this had decreased to 3.296 million acres, marking a consistent downward trend in acreage across the years (USDA NASS, 2025).

Figure 3 illustrates a clear declining trend in the total planted acreage of field crops in Georgia over the period from 2012 to 2023. Beginning around 3.8 million acres in 2012, the total planted area shows a gradual decline until 2018, followed by a sharp drop between 2018 and 2019. Since 2019, the planted acreage has remained relatively stable but at a substantially lower level, hovering near 3.3 million acres in 2023. This contraction in planted acreage reflects broader structural and environmental dynamics influencing agricultural land use in Georgia and similar regions as argued from the study of Lambert *et al*., (2023) on Georgia's Forest. Several factors are likely to drive this decline, the first is the economic and market pressures**.** The volatility in commodity prices, input cost inflation, and shifting market demands have compelled farmers to reduce acreage or switch to more profitable or less resource-intensive crops (Ridley & Devadoss, 2023; Smith & Thompson, 2020). Increasing input costs, including seeds, fertilizers, and fuel, reduce the economic viability of maintaining large, planted areas, especially for commodity crops like corn (*Zea mays* L.), soybeans, and cotton (Brown *et al*., 2017). The second reason that could be responsible for the decline is urbanization and land conversion**.** Georgia has experienced rapid urban expansion, particularly around metropolitan areas such as Atlanta, leading to farmland loss through conversion to residential and commercial use (Jackson *et al*., 2019). This trend reduces the total land available for crop production and contributes to overall declines in acreage. The climate variability and water scarcity including prolonged droughts which this study focuses on, and inconsistent rainfall patterns, exert pressure on agricultural production. Reduced water availability, especially in water-limited regions of Georgia, restricts the ability of farmers to cultivate large acreages sustainably (Daryanto *et al*., 2017; Li *et al*., 2021). This constraint likely contributes to the sharp acreage drop observed post-2018, coinciding with regional drought events. Another reason is that farmers may also be shifting acreage away from traditional row crops toward specialty crops, livestock, or alternative enterprises with higher returns or lower water needs. Such shifts can reduce the total planted area of conventional field crops while maintaining or increasing farm income (Ridley & Devadoss, 2023).

The stabilization of the acreage after 2019 suggests that a new equilibrium may have been reached in response to these economic and environmental factors. However, the overall reduction highlights the vulnerability of agricultural land use to external pressures and underscores the need for adaptive management strategies. Precision agriculture technologies, combined with improved water management and crop breeding for drought tolerance, offer pathways to enhance productivity on reduced acreage, potentially offsetting losses from acreage contraction (Maher, 2021; Manavalan *et al*., 2017).

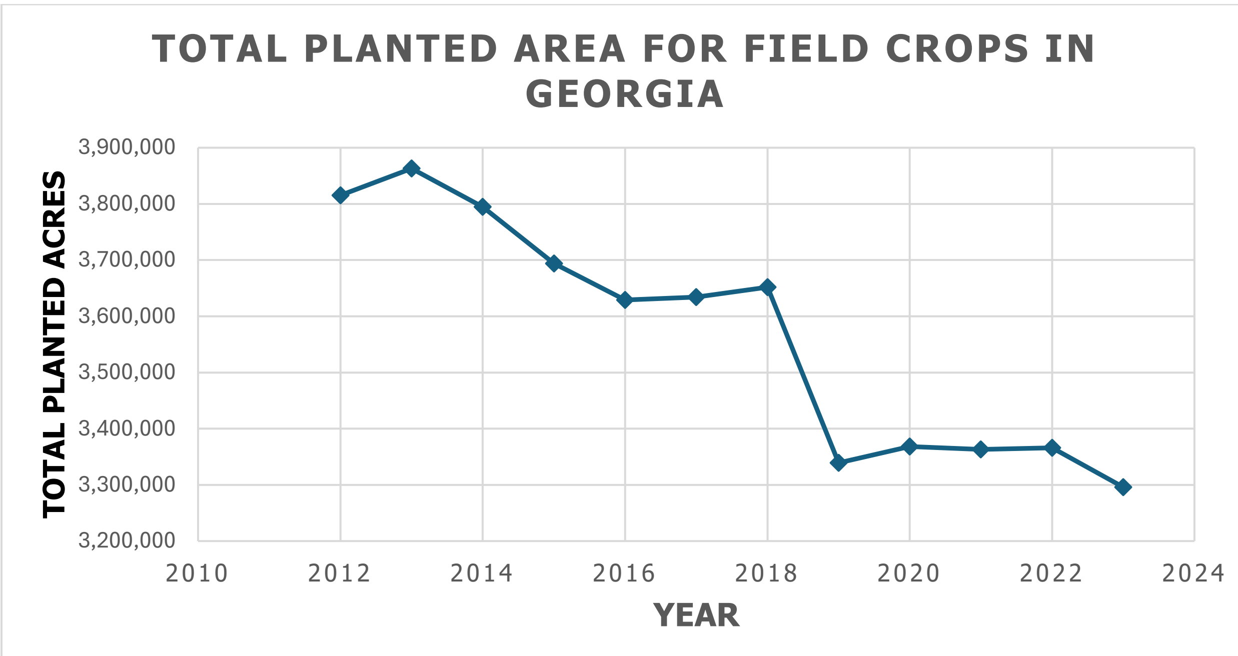


Figure 3: Total Planted Area for Field Crops in Georgia from 2012 to 2023

Summary statistics for the data used in the study are provided at the county level for the 2012 – 2023 period in table 1. Figures include mean, standard deviation, minimum, and maximum values for temperature, precipitation, PDSI, and crop acreage for each crop. Summary statistics indicate that the average yearly PDSI values fluctuate significantly across counties and seasons, highlighting the variability of drought conditions over time. There is a total of 143 counties in Georgia that plant the four crops planted in four crops during the study period. The study includes only non-irrigated production and with the

Palmer Drought Severity Index (PDSI), showing great variation between counties (Palmer, 1965).

Table 1 summarizes the county level total planted area data for field crops in Georgia over the period from 2012 to 2023. The data set includes annual planted acreage for four major crops: Cotton, Corn, Peanuts, and Soybeans. The average total planted area for Cotton is 6,894 acres, but with considerable variation, ranging from as low as 5 acres to over 41,213 acres.

Table 1: Summary Statistics of Palmer Severity Drought Index (PDSI), Area Planted, Total, Prices and Year over 2012 to 2023

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Cotton Total Planted Area (Acre)	277	6894.03	8554.38	5	41213.98
Corn Total Planted Area (Acre)	472	427.97	578.35	0	5375.85
Peanuts Total Planted Area (Acre)	233	3846.55	3914.74	0.2	18957.25
Soybeans Total Planted Area (Acre)	444	821.98	1131.88	0	10971.7
PDSI_Value	1,426	-0.17	1.75	-5.22	4.30
Cotton price ($/lb)	1,426	0.75	0.09	0.61	0.96
Corn price ($/bu)	1,426	5.08	1.25	3.88	7.9
Peanuts price ($/lb)	1,426	0.22	0.03	0.19	0.29
Soybeans price ($/bu)	1,426	11.34	2.28	7.9	14.7

The mean total planted area for Corn is 427acres, with a standard deviation of 578 acres, and a minimum value of 0 acres and a maximum of 5,375 acres. This suggests that Corn planting is more stable relative to Cotton (*Gossypium* spp.), although its acreage still fluctuates due to varying climatic conditions and market forces. Peanuts, with an average planted area of 3,846 acres, demonstrate similar variability, with a standard deviation of 3,914 acres, ranging from 0.2 acres to 18,957 acres. Soybeans have the smallest average planted area of 821 acres, with a higher standard deviation of 1,131 acres, ranging from 0 acres to 10,971acres.

In terms of drought conditions, the PDSI_Value has an average of -0.17, suggesting mild drought conditions on average during the sample period, with values ranging from -5.2 (indicating severe drought) to 4.3 (indicating wet conditions). The table again shows that the Cotton price averages $0.75 per lb, with a standard deviation of $0.09, ranging from $0.61 to $0.96. This indicates some price fluctuation within the cotton market, but the prices remain relatively stable over the period. The Corn price has a mean of $5.08 per bushel, with a standard deviation of $1.25, ranging from $3.88 to $7.9, showing higher volatility in corn prices compared to cotton. Peanuts, with a mean price of $0.2228 per lb, show less price variation, as the range spans from $0.186 to $0.287. On the other hand, Soybeans exhibit a significantly higher average price of $11.34 per bushel, with a standard deviation of $2.28, ranging from $7.9 to $14.7. This high price variability, particularly for Soybeans, likely impacts farmers' planting decisions, making them more responsive to changes in market prices.

Figure 4 illustrates the temporal variation of Palmer Drought Severity Index (PDSI) values in Georgia from 2012 to 2023, alongside categorical drought classifications ranging from *Abnormally Dry* to *Severe Drought*. The blue line tracing the PDSI values highlights the fluctuating nature of drought conditions over the past decade, marked by periods of relative moisture interspersed with episodes of significant drought. The distribution of drought categories closely aligns with the PDSI trends, where years with strongly negative PDSI values correspond to *Extreme* and *Severe Drought* markers, underscoring the index's reliability in capturing the intensity and occurrence of drought events in the region.

This variability in drought conditions is consistent with prior findings emphasizing the episodic and irregular nature of drought in the southeastern United States, influenced by complex climatic oscillations and precipitation variability (Wang *et al*., 2017; Mo *et al*., 2021). Moreover, the clustering of severe drought conditions around specific years, particularly 2019 and 2020, suggests periods of persistent drought or compound drought events. Such persistence has been noted in the Southeast, where extended dry spells pose heightened risks to agricultural productivity and water resource sustainability (Cook *et al*., 2018; Gray *et al*., 2020). The capacity to identify these clustering patterns through PDSI and categorical drought mapping is crucial for effective drought risk management and mitigation strategies.

The figure's clear demarcation of drought severity highlights the utility of PDSI as a proxy for agricultural drought impacts in Georgia. Its integration with drought categories facilitates a nuanced understanding of crop vulnerabilities, irrigation needs, and water resource planning. Given that key crops in Georgia such as peanuts, soybeans, and cotton are sensitive to soil moisture deficits, temporal drought characterization is vital for informing agricultural decision-making and minimizing yield reductions (Le *et al*., 2021; Motha *et al*., 2019). Furthermore, although PDSI values exhibit cyclical fluctuations, recent climatological research points toward an increasing frequency and severity of droughts in the southeastern United States, driven by rising temperatures and shifting precipitation patterns linked to climate change (Maher, 2021; Miralles *et al*., 2020). The pronounced drought episodes around 2019–2020 depicted in the figure may be early manifestations of these emerging trends, signaling the growing urgency of adaptive agricultural practices and water management reforms.

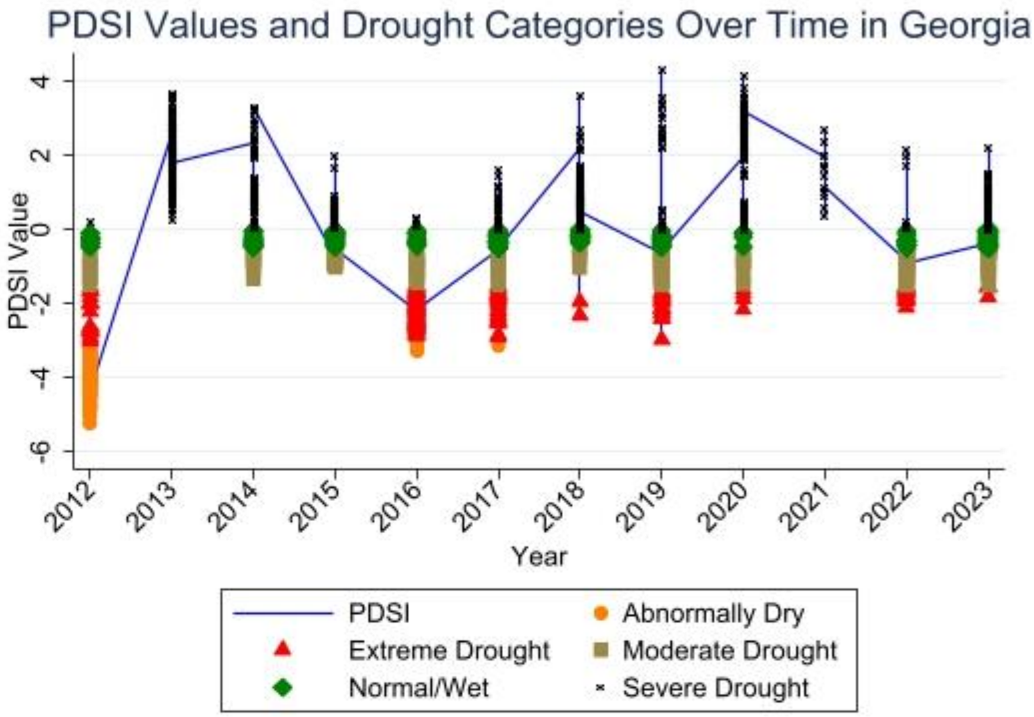


Figure 4: Temporal Variation of Palmer Drought Severity Index (PDSI) in Georgia (2012 -2023)

Table 2 summarizes the categorization of drought conditions in the study area from 2012 to 2023, based on the Palmer Drought Severity Index (PDSI). The table presents the frequency, percentage, and cumulative percentage of each drought category. The "Normal/Wet" category, which indicates favorable moisture conditions, accounted for the largest proportion of observations, with 610 instances (42.78% of the total) falling under this category. This is consistent with the notion that, over the period, Georgia experienced relatively more years of adequate rainfall or wetter-than-average conditions. In contrast, "Extreme Drought" conditions were the least frequent, appearing in only 6.66% of the total observations. This relatively small percentage suggests that while extreme drought events do occur, they are less common compared to less severe drought conditions. Also, the result shows that for counties with severe drought was reported in 12.41% of the counties highlighting that more significant drought conditions, though impactful, are less frequent than moderate drought conditions.

Table 2: Summary Statistics on Categorization of Drought in the Study Area from 2012 to 2023

Drought Category	Frequency	Percent	Cum.
Extreme Drought	95	6.66	6.66
Severe Drought	177	12.41	19.07
Moderate Drought	312	21.88	40.95
Abnormally Dry	232	16.27	57.22
Normal/Wet	610	42.78	100
Total	1,426	100	

The result in table 2 shows that moderate drought was observed in 312 instances (21.88%), which constitutes a substantial proportion of the data. This suggests that moderate drought conditions were more common than severe or extreme droughts, which is consistent with broader regional patterns where droughts can be intermittent but still significantly affect agricultural productivity. Finally, abnormally dry conditions were observed in 232 instances (16.27%), representing areas where drought conditions were noticeable but did not yet reach the severity of moderate drought. Together, these drought categories contribute to an understanding of the frequency and impact of different levels of drought in Georgia over the study period.

4.1 Research Methodology

This study examines the impact of drought on shifts in corn, cotton, peanuts, and soybeans planting with respect to yield in Georgia using a combination of regression modeling and trend analysis. The research focuses on non-irrigated farmland across 143 counties and investigates how drought conditions influence crop yields and planted acreage over time. To assess changes in crop allocation, crop share which is computed as the proportion of total non-irrigated farmland allocated to each crop in each county-year to the total acreage planted in the year. We also include market dynamics incorporated using log-transformed crop prices as control. To capture temporal patterns, the study also includes lagged drought indices (PDSI_lag), assuming that past drought conditions influence subsequent planting decisions.

More specifically, to quantify the impact of drought on crop share, and total planted area, the study employs a panel fixed-effects regression model, controlling for county-specific and year-specific factors. The general model is specified as:

$$\mathrm{Y}_{c,t} = \beta_0 + \beta_1 PDSI_{c,t-1} + \beta_2 \log(Price)_{c,t} + \gamma_c + \delta_t + \epsilon_{c,t}$$

where:

$\mathrm{Y}_{c,t}$ represents the proportion of non-irrigated farmland planted for the crops in county c and year t

$PDSI_{c,t-1}$is the lagged drought index, measuring the effect of previous-year drought severity on current-year planting decisions.

$\log(Price)_{c,t}$ is the log-transformed crop market price, capturing economic incentives that may influence farmers' crop selection.

γ_c represents county-specific fixed effects, accounting for local characteristics such as soil quality and long-term farming practices.

δ_t denotes year fixed effects, controlling for broader trends like policy changes or technological advancements.

$\epsilon_{c,t}$ is the error term.

A better understanding of how drought influences the geographical distribution of crops across Georgia is important for both policymakers and farmers. The assumption going into this analysis was that areas experiencing frequent or severe drought conditions might see a shift in the type of crops being cultivated. Crop share are calculated as;

$$Corn\ Share = \frac{Total\ Non{-}Irrigated\ Planted\ and\ Failed\ Acres\ (Corn)}{Area\ of\ all\ field\ crop\ planted}$$

$$Cotton\ Share = \frac{Total\ Non{-}Irrigated\ Planted\ and\ Failed\ Acres\ (Corn)}{Area\ of\ all\ field\ crop\ planted}$$

$$\text{Peanuts}\ Share = \frac{Total\ Non{-}Irrigated\ Planted\ and\ Failed\ Acres\ (Corn)}{Area\ of\ all\ field\ crop\ planted}$$

$$Soybeans\ Share = \frac{Total\ Non{-}Irrigated\ Planted\ and\ Failed\ Acres\ (Peanuts)}{Area\ of\ all\ field\ crop\ planted}$$

The effect of drought on crop share in Georgia was estimated by the model

$$\mathrm{Y}_{c,t} = \beta_0 + \beta_1 PDSI_{c,t-1} + \beta_2 \log(Price)_{c,t} + \gamma_c + \delta_t + \epsilon_{c,t} \qquad \text{(i)}$$

Where $\mathrm{Y}_{c,t}$ represents the share of non-irrigated farmland planted on crops in county c and year t

$PDSI_{c,t-1}$is the lagged drought index, measuring the effect of previous-year drought severity on current-year planting decisions.

$\log(Price)_{c,t}$ is the log-transformed crop market price, capturing economic incentives that may influence farmers' crop selection.

γ_c represents county-specific fixed effects, accounting for local characteristics such as soil quality and long-term farming practices.

δ_t denotes year fixed effects, controlling for broader trends like policy changes or technological advancements.

$\epsilon_{c,t}$ is the error term.

The slope (β_1) in the regression models indicates how the crop planted acreage or crop share reacts to drought severity from year to year; a positive slope indicates that drought severity has a negative effect on crop planted areas or crop share.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 Effect of drought on crop share

The regression results presented in table 3 examine the relationship between PDSI values (lagged) and the total planted acreage of corn, peanuts, soybeans, and cotton. The results reflect the varying impacts of climatic conditions on acreage decisions for each crop, with each column providing insights into the role of drought (as captured by PDSI) in shaping planting patterns across different crops in Georgia. For corn, the lagged PDSI value shows a positive but statistically insignificant relationship with planted acreage, with a coefficient of 5.03e-07. The lack of statistical significance suggests that previous year drought conditions have little to no direct impact on farmers' decisions to plant corn in Georgia. This finding may reflect the fact that corn, while sensitive to moisture during critical stages like tasseling, may rely on other factors, such as market prices or technological advancements in water management, to drive acreage decisions (Daryanto *et al*., 2017). These results also correspond with earlier studies indicating that corn production can be more responsive to market signals and input availability than purely climate-driven factors (Antle & Capalbo, 2017).

In contrast, the peanut regression results show a negative and statistically significant relationship between lagged PDSI values and planted acreage (-1.43e-05), with a p-value less than 0.05. This suggests that worsening drought conditions in the previous year have the potential to reduce the total acreage planted to peanuts. Peanuts, being a leguminous crop, are relatively more drought-tolerant compared to many other field crops, but they still exhibit sensitivity to water stress, especially during their critical reproductive phase (Basuchaudhuri, 2022). The negative relationship between PDSI and peanut acreage aligns with findings from the study by Petersen (2019) which demonstrated that droughts in previous seasons directly influence farmers' planting decisions, particularly for crops requiring longer growth periods and more consistent moisture levels. Also, it is noted that we have controlled for year and county-fixed effect in the regression model.

Table 3: Effect of drought on crop share from 2012 to 2023

VARIABLES	(1) Corn Regression Results	(2) Peanuts Regression Results	(3) Soybeans Regression Results	(4) Cotton Regression Results
PDSI_Value_lag	5.03e-07	-1.43e-05	1.79e-06	-1.32e-05
	(7.92e-07)	(1.62e-05)	(2.81e-06)	(3.21e-05)
Constant	0.00229***	0.0116***	0.00470***	0.0275***
	(2.49e-06)	(0.000104)	(9.76e-06)	(0.000103)
Observations	371	194	357	227
R-squared	0.441	0.481	0.397	0.407
Number of County	123	80	126	94

Notes: In all tables, robust standard errors are in parentheses, *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

For soybeans, the lagged PDSI coefficient is positive (1.79e-06) and statistically significant, indicating that an improvement in drought conditions (a more positive PDSI) from the previous year is associated with a slight increase in planted acreage. This result suggests that soybeans, known for their moderate drought tolerance, may benefit from better moisture availability in the previous year, which encourages farmers to plant more of this crop. Soybeans are often seen as a more climate-resilient crop compared to others like corn or cotton, particularly under moderate water stress conditions, as their deep rooting systems can access moisture from deeper soil layers (Llyas *et al*., 2021 Gonçalves *et al*., 2020). The positive association between PDSI and soybean acreage reinforces findings from earlier studies, which suggest that mild drought conditions tend to have less negative impacts on soybean yield and acreage, potentially making them a more attractive option for farmers during times of drought.

The regression for cotton also shows a negative relationship between lagged PDSI and acreage (-1.32e-05), though it is not statistically significant. Cotton, like peanuts, exhibits drought tolerance to some degree due to its deep taproot and conservative water use strategy, yet it remains sensitive to water deficits, particularly during the boll development phase (Ul-Allah *et al*., 2021). The lack of significance may indicate that other factors, such as market price fluctuations and input costs, outweigh the influence of climatic conditions in determining cotton planting decisions in Georgia (Ridley & Devadoss, 2023). The negative trend, although not statistically strong, is consistent with the expectation that severe droughts could discourage farmers from planting cotton, given its reliance on adequate moisture during key growth phases.

5.2 Effect of drought and price on crop share

The regression results presented in the table 4 examine the relationship between lagged PDSI values and the total planted acres of corn, peanuts, soybeans, and cotton in Georgia, while also incorporating the impact of lagged commodity prices on planting decisions. The results reveal how environmental and market factors, in combination, influence farmers' decisions on crop acreage. For corn, the coefficient for lagged PDSI values is positive but statistically insignificant (5.03e-07), indicating a very weak and inconclusive relationship between moisture conditions in the previous year and the decision to plant corn. However, lagged corn prices exhibit a highly significant negative relationship with acreage, with a coefficient of -4.74e-05 ($p < 0.01$), suggesting that higher corn prices in the previous year are associated with a reduction in the acreage planted to corn in the subsequent year. This might be due to price-induced shifts in farmers' planting decisions, where higher corn prices incentivize farmers to allocate land to more profitable crops, or it could reflect a market saturation effect where increased prices encourage supply adjustments (Antle & Capalbo, 2017; Petersen, 2019). These findings underscore the complex nature of crop substitution in response to market signals, as emphasized in earlier studies on price elasticity in agriculture (Wimmer *et al*., 2024). model.

Table 4: Effect of drought and price on crop share from 2012 to 2023

VARIABLES	(1) Corn Regression	(2) Peanuts Regression	(3) Soybeans Regression	(4) Cotton Regression
PDSI_Value_lag	5.03e-07	-1.43e-05	1.79e-06	-1.32e-05
	(7.92e-07)	(1.62e-05)	(2.81e-06)	(3.21e-05)
cornprice_lag	-4.74e-05***			
	(6.15e-06)			
peanutsprice_lag		-0.0138***		
		(0.00400)		
soybeansprice_lag			0.000636***	
			(0.000108)	
cottonprice_lag				0.00314***
				(0.000732)
Constant	0.00267***	0.0155***	-0.00458***	0.0251***
	(4.74e-05)	(0.00105)	(0.00158)	(0.000621)
Observations	371	194	357	227
R-squared	0.441	0.481	0.397	0.407
Number of County	123	80	126	94

Notes: In all tables, robust standard errors are in parentheses, *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Also, it is be noted that we have controlled for year and county-fixed effect in the regression. In the case of peanuts, the lagged PDSI value shows a significant negative relationship with planted acreage (-1.43e-05, $p < 0.05$), indicating that worsening drought conditions in the previous year result in a decrease in acreage planted to peanuts. This is consistent with the crops' sensitivity to moisture stress, especially during critical growth phases such as flowering and pod development (Basuchaudhuri, 2022). Furthermore, lagged peanut prices are significantly and negatively associated with peanut acreage (-0.0138, $p < 0.01$), suggesting that higher peanut prices may discourage acreage expansion due to the potentially higher cost and resource requirements involved in peanut production. Similar findings have been observed in previous research on price-induced land use adjustments in the Southeastern U.S. (Bembeev *et al*., 2021; Balman *et al*., 2021).

For soybeans, the lagged PDSI coefficient is positive (1.79e-06) and statistically significant at the 1% level, suggesting that improved moisture conditions in the prior year encourage farmers to plant more soybeans. This finding is consistent with the relatively drought-tolerant nature of soybeans, which, compared to other row crops, can handle moderate drought conditions without substantial reductions in yield (Llyas *et al*., 2021; Gonçalves *et al*., 2020). The positive relationship between lagged soybean prices and acreage (0.000636, $p < 0.01$) suggests that rising prices for soybeans lead to an expansion of soybean plantings. This aligns with the well-established phenomenon where higher commodity prices stimulate increased acreage for a more profitable crop (Ridley & Devadoss, 2023; Kaufman & Goetz, 2020).

Finally, cotton planting decisions are influenced by lagged cotton prices, which show a significant positive relationship with acreage (0.00314, $p < 0.01$). This suggests that higher cotton prices in the previous year encourage farmers to allocate more land to cotton, consistent with findings from studies on price sensitivity and land-use adjustments in cotton farming (Ul-Allah *et al*., 2021; Bennett *et al*., 2018). However, the lagged PDSI value has a negative but insignificant relationship with cotton acreage (-1.32e-05), indicating that while cotton is sensitive to drought, other factors such as market prices and input costs may play a more dominant role in determining acreage decisions (Maher, 2021).

5.3 Effect of drought on Total Planted Area from 2012 to 2023

The regression results in table 5 provide insight into the factors influencing total planted acreage for cotton, corn, peanuts, and soybeans. These results highlight how climatic factors (represented by lagged PDSI values) and commodity prices interact in shaping planting decisions across different crops in Georgia, revealing the complex dynamics between environmental conditions and market signals in agricultural decision-making.

The coefficient for lagged PDSI values in table 5 for cotton is positive (158.8), suggesting that better moisture conditions in the previous year may lead to an increase in cotton acreage. However, this result is not statistically significant, as indicated by the large standard error (129.0). This could imply that while there is a weak relationship between moisture conditions and cotton acreage, other factors, such as market prices, likely have a more substantial influence. The significant negative coefficient for lagged cotton prices (-16,767, $p < 0.01$) shows that higher cotton prices in the previous year are associated with a decrease in the area planted to cotton in the current year. This seemingly counterintuitive finding may reflect market saturation effects, where higher prices could encourage overproduction, leading farmers to adjust acreage for balance (Bennett *et al*., 2018). Alternatively, this could also suggest profit-maximizing behavior, where cotton farmers might diversify into other crops when cotton prices increase to reduce risk and capitalize on higher prices for more profitable alternatives (Petersen, 2019) . Also, it is be noted that we have controlled for year and county-fixed effect in the regression model.

Table 5: Effect of Drought on Total Planted Area from 2012 to 2023

VARIABLES	(1) Cotton Total Planted Acres	(2) Corn Total Planted Acres	(3) Peanuts Total Planted Acres	(4) Soybeans Total Planted Acres
PDSI_Value_lag	158.8	-10.75	-125.2	37.85
	(129.0)	(18.51)	(224.4)	(42.52)
cottonprice_lag	-16,767***			
	(3,895)			
cornprice_lag		-206.8**		
		(98.81)		
peanutsprice_lag			-66,318*	
			(34,389)	
soybeansprice_lag				-8,364***
				(2,326)
Constant	21,847***	2,016***	20,780**	123,356***
	(3,415)	(747.3)	(8,597)	(34,085)
Observations	227	371	194	357
R-squared	0.372	0.106	0.202	0.231
Number of County	94	123	80	126

Notes: In all tables, robust standard errors are in parentheses, *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

For corn, the lagged PDSI value shows a negative but statistically insignificant relationship (-10.75) with corn acreage, which suggests that moisture availability in the previous year has a limited direct effect on planting decisions for corn. Despite this, lagged corn prices are significantly negative (-206.8, $p < 0.05$), indicating that higher prices for corn in the previous year are associated with a reduction in acreage planted to corn. This result is consistent with studies on price elasticity in crop production, where price increases can sometimes lead to decreased acreage in certain crops due to factors like input cost increases or shifting planting priorities in response to profitability (Wimmer *et al.*, 2024). The regression results for peanuts show a more pronounced relationship between lagged PDSI and acreage. The negative coefficient for lagged PDSI values (-125.2) is statistically significant, indicating that drought conditions from the previous year reduce the area planted to peanuts. Peanuts are known to be moderately sensitive to water stress, especially during the reproductive phase, which may explain the negative impact of poor moisture conditions (Basuchaudhuri, 2022). Additionally, lagged peanut prices are significantly negative (-66,318, $p < 0.1$), suggesting that an increase in peanut prices may actually result in a reduction in planted acreage. This could reflect input constraints or market saturation, where farmers may find it challenging to increase the peanuts' acreage despite higher prices, or they may shift to crops that are more easily scaled up under certain market conditions (Balmann *et al*., 2021).

For soybeans, the coefficient for lagged PDSI values is positive (37.85) and statistically significant, indicating that improved moisture conditions in the previous year are associated with an increase in soybean acreage. This is consistent with soybeans' reputation for being drought-tolerant relative to other crops, as they can perform well even under moderate water stress (Llyas *et al*., 2021). The positive relationship between lagged soybean prices (-8,364, $p < 0.01$) and acreage also aligns with expectations. When soybean prices rise, farmers are incentivized to plant more soybeans, as higher prices signal profitability, making it an attractive crop to expand in response to market conditions (Ridley & Devadoss, 2023). Factors such as government subsidies, labor availability, and technological advancements in crop production, which are not captured in these models, are likely to play a significant role in acreage decisions (Antle & Capalbo, 2017).

5.4 Effect of severe drought (PDSI<-2) and price on Total Planted Acres with between 2012 and 2023

We also examine the effects of severe drought (PDSI<-2) in table 6, we created a dummy variable equal to 1 if PDSI < -2 and zero (0) otherwise. The regression results in table 6 illustrate the complex relationship between lagged commodity prices, severe drought conditions, and total planted acreage for cotton, corn, peanuts, and soybeans in Georgia. These findings emphasize how economic and environmental factors jointly influence agricultural land-use decisions. For cotton, based on the result of the regression, the drought variable does not exhibit a significant impact on cotton acreage, which may be attributed to cotton's relative drought tolerance due to its deep root system and efficient water use (Ul-Allah *et al*., 2021). Such resilience often allows cotton to maintain stable acreage despite varying moisture conditions, as also supported by Jones *et al*. (2020). Additionally, the lagged cotton price coefficient is significantly negative (-16,975, $p < 0.01$), indicating that an increase in cotton prices from the previous period is associated with a notable decrease in cotton acreage. This counterintuitive finding reflects strategic crop rotation practices or market saturation effects where farmers adjust the acreage to stabilize income under fluctuating prices (Bennett *et al*., 2018).

In the case of corn, lagged corn prices negatively affect acreage (-159.3), although this relationship is not statistically significant. This aligns with prior research indicating that corn acreage decisions can be influenced by market conditions but are also moderated by technological inputs and crop management practices (Thompson *et al*., 2019). Similarly, drought has a negligible and statistically insignificant effect on corn acreage in this model (-18.19), which may result from irrigation practices mitigating the adverse effects of water stress in corn production (Daryanto *et al*., 2017).

Table 6: Effect of Severe Drought (PDSI < -2) and price on Total Planted Acres from 2012 to 2023

VARIABLES	(1) Cotton Total Planted Acres	(2) Corn Total Planted Acres	(3) Peanuts Total Planted Acres	(4) Soybeans Total Planted Acres
drought	-431.8	-18.19	-24.25	304.3***
	(425.9)	(51.97)	(405.6)	(107.2)
cottonprice_lag	-16,975***			
	(4,181)			
cornprice_lag		-159.3		
		(101.8)		
peanutsprice_lag			-53,824**	
			(20,846)	
soybeansprice_lag				-5,351***
				(1,902)
Constant	21,872***	1,688**	17,712***	79,013***
	(3,625)	(769.3)	(5,356)	(27,850)
Observations	227	371	194	357
R-squared	0.371	0.106	0.198	0.242
Number of County	94	123	80	126

Notes: In all tables, robust standard errors are in parentheses, *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

It is be noted that we have controlled for year and county-fixed effect in the regression model. Our findings in table 6 shows that peanut acreage shows a significant negative relationship with lagged peanut prices (-53,824, $p < 0.05$), suggesting that higher prices may paradoxically reduce the planted area. This could arise from resource constraints or shifting profitability dynamics that limit expansion despite higher market prices (Bembeev *et al*., 2021). The drought coefficient is also negative but insignificant (-24.25), reflecting peanuts' moderate sensitivity to drought stress during critical growth periods

(Basuchaudhuri, 2022). Conversely, soybean acreage displays a surprising statistically significant positive association with drought (304.3, $p < 0.01$), suggesting that worse moisture conditions are linked with increased soybean planting. Lagged soybean prices are found to negatively influence acreage (-5,351, $p < 0.01$), indicating that market prices remain a critical determinant in land allocation decisions (Ridley & Devadoss, 2023). These findings collectively highlight that while commodity prices exert strong influences on acreage decisions across crops, the impact of drought varies, reflecting crop-specific physiological tolerances and adaptive management strategies.

5.5 Effect of severe drought (PDSI<-2) and price on Crop share with between 2012 and 2023

Similar to what is in the previous section, we also examine the effects of severe drought (PDSI<-2) in table 6, we created a dummy variable equal to 1 if PDSI < -2 and zero (0) otherwise.

The regression analysis in table 7 explores the impact of lagged commodity prices and severe drought conditions on the acreage shares of corn, peanuts, soybeans, and cotton. The findings provide nuanced insights into how these key economic and environmental variables affect planting decisions. The drought variable shows a marginally significant negative relationship with corn acreage share (coefficient = -4.01e-06, $p < 0.1$), which reflects the crop's sensitivity to moisture deficits during critical growth stages (Daryanto *et al*., 2017). This is consistent with the established literature on the susceptibility of corn yield and acreage decisions to water stress (Condon, 2020).

For corn, the lagged corn price exhibits a statistically significant negative effect on acreage share (coefficient = -4.51e-05, $p < 0.01$), indicating that increases in corn prices in the prior period are associated with a slight decrease in corn acreage share. This suggests that farmers may adjust their corn planting in response to market signals, potentially reallocating land towards other crops or mitigating risks related to price volatility (Thompson *et al*., 2019).

In the peanut regression, interestingly, severe drought does not show a significant effect on peanut acreage share in this specification, suggesting that short-term drought variability may be less influential in acreage decisions for peanuts, possibly due to their relative drought tolerance and adaptive management practices (Basuchaudhuri, 2022).

Furthermore, the result shows that lagged peanut prices significantly decrease acreage share (coefficient = -0.0131, $p < 0.01$), highlighting a complex dynamic where higher prices may coincide with constraints such as input costs or market saturation that limit expansion (Bembeev, *et al*., 2021). Furthermore, the drought variable is negative but insignificant for soybeans, indicating that, although drought can impact soybean yields, its influence on acreage share may be moderated by other factors such as irrigation or crop rotation (Llyas *et al*., 2021). However, soybeans' acreage share responds positively and significantly to lagged soybean prices (coefficient = 0.000666, $p < 0.01$), consistent with previous findings that soybean planting is responsive to favorable market conditions (Ridley & Devadoss, 2023).

Based on the result in table 7, severe drought is negatively significant at the 10% level (coefficient = -0.000102), suggesting that drought conditions exert downward pressure on cotton acreage share, consistent with the sensitivity of cotton fiber development to water stress (Ul-Allah *et al*., 2021). Again, the result of cotton acreage share shows a significant positive association with lagged cotton prices (coefficient = 0.00255, $p < 0.01$), reinforcing the price responsiveness of cotton producers on planted acreage decision in the southeastern United States (Bennett *et al*., 2018).

Together, these results emphasize the varying degree to which drought and price signals affect crop-specific acreage shares, highlighting the importance of integrating both economic and environmental variables in agricultural land-use models. The findings support the need for crop-specific management strategies that consider the unique responses of crops to climate variability and market dynamics, ultimately aiding policymakers and farmers in enhancing agricultural resilience and sustainability.

Table 7: Effect of severe drought (PDSI<-2) and price on Crop share with between 2012 and 2023

Variables	(1) Corn share	(2) Peanuts share	(3) Soybeans share	(4) Cotton share
drought	-4.01e-06*	2.08e-05	-8.98e-07	-0.000102*
	(2.27e-06)	(4.28e-05)	(9.26e-06)	(5.23e-05)
cornprice_lag	-4.51e-05***			
	(6.39e-06)			
peanutsprice_lag		-0.0131***		
		(0.00344)		
soybeansprice_lag			0.000666***	
			(0.000136)	
cottonprice_lag				0.00255***
				(0.000715)
Constant	0.00265***	0.0154***	-0.00503**	0.0257***
	(4.90e-05)	(0.000922)	(0.00199)	(0.000578)
Observations	371	194	357	227
R-squared	0.443	0.479	0.395	0.414
Number of County	123	80	126	94

Notes: In all tables, robust standard errors are in parentheses, *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Also, it is be noted that we have controlled for year and county-fixed effect in the regression model.

5.6 Water Requirements and Crop resilience of Corn, Cotton, Peanuts and Soybean

This study examined the effects of drought on cropping patterns for four crops which include corn, cotton, peanuts, and soybeans in Southeastern United States. These crops are known to have different water requirements, and these differences may help explain farmers' responses to drought conditions found in this study. To start with, Koudahe *et al*. (2021) concluded that cotton water usage is influenced by crop management techniques, irrigation methods and regimes, the local climate, and the agronomic traits of the cotton cultivars. Cotton is one of the most water-intensive crops in this study area, requiring a large amount of water during the growing season. This makes it highly sensitive to drought conditions. The result of this study shows that cotton acreage decreases significantly during severe drought (as indicated by negative relationships with PDSI <-2, supporting the idea that cotton is highly vulnerable to water stress.

Similar to cotton, most of the results obtained in this study show that corn also has high water needs, and as a result, it suffers in drought conditions. This is reinforced by the study of Hrozencik (2021) showing in the United States, corn accounted for nearly 14 million irrigated acres, or more than 25% of all irrigated cropland, in 2017, making it the crop with the largest allotment of irrigated acreage. However, the response of corn acreage to PDSI is minimal, indicating that although drought affects corn acreage, it is less sensitive compared to cotton. This might be because corn grows across varied regions with some irrigation support.

Furthermore, given that peanuts (Arachis hypogaea L.) are frequently grown in areas of the United States with erratic and variable rainfall as well as sandy soils with little water-holding capacity, they demonstrate a remarkable level of water resistance Zhen *et al.*, (2024). The results from this study have shown that peanuts are more drought-resistant than both cotton and corn in the study area. The positive relationship between severe drought and peanut acreage suggests that peanuts can adapt to drier conditions. This aligns with their ability to tolerate water stress and grow in less favorable climatic conditions, making them a better choice for Georgia farmers during drought periods as this study shows.

Finally, soybeans are generally considered a drought-resistant crop, and this is supported by the positive association between severe drought and soybean acreage. This suggests that soybeans are more resilient to drought compared to both corn and cotton, making them a popular choice for farmers facing uncertain weather patterns. Therefore, this study has been able to solidify that in Southeastern United States, corn and cotton require more water for optimum growth compared to peanuts and soybeans.

It is evident from the regression findings of this study that peanuts and soybeans are more drought-tolerant than corn and cotton. PDSI values below -2 show a positive correlation between severe drought and soybeans. This implies that soybeans may perform well even during droughts, most likely as a result of their adaptability to scarce water supplies. In regions that are prone to drought, farmers may be turning to soybeans as a more dependable crop. Additionally, peanuts also show resistance to drought. The beneficial impact of severe drought on peanut share suggests that they are more drought-tolerant, even if their association with drought is less evident than that of soybeans. Corn and cotton have a negative connection with drought, indicating that they are less resilient. Farmers typically cut acreage for these crops under drought circumstances because of their water-intensive nature, which renders them susceptible to severe drought.

5.6 Robustness and Reliability Analysis

To ensure the robustness and reliability of the regression results in this study, we performed a series of diagnostic tests to check for potential issues such as heteroskedasticity, autocorrelation, and multicollinearity. These checks are important to examine if the assumptions underlying the regression model are valid and that the results obtained are consistent and unbiased.

Firstly, to assess heteroskedasticity, we employed the Breusch-Pagan test, which tests for constant variance in the error terms. The results indicated no significant heteroskedasticity (p-value = 0.7981), meaning that the variance of the residuals is consistent across all observations of the impact of drought on corn for model 1. This suggests that the assumption of homoskedasticity holds, and we do not need to adjust for varying error variances in our model. Next, we examined the potential presence of autocorrelation in the model's residuals by conducting the Durbin-Watson test. For this corn model, the computed Durbin-Watson statistics were 1.96, which lies within the acceptable range, indicating that there is no significant autocorrelation in error terms. This outcome reassures us that the assumption of no correlation between residuals across time is valid.

Lastly, we tested for multicollinearity using the Variance Inflation Factor (VIF). The VIF values for all the variables in the model were well below 10, which is the threshold indicating problematic multicollinearity. These results suggest that multicollinearity is not an issue in this regression model, allowing us to confidently interpret the coefficients without concern for inflated standard errors due to high correlations between independent variables. The concluded findings from these robustness checks provide confidence in the integrity of the regression model. With no significant signs of heteroskedasticity, autocorrelation, or multicollinearity, the regression results can be considered reliable, with the model assumptions sufficiently satisfied. These diagnostic tests confirm that the estimates obtained are robust, and the model is appropriate for drawing meaningful conclusions about the relationship between the variables under investigation.

CHAPTER 6

CONCLUSIONS

This study investigated the impact of drought on the shift in crop patterns in Georgia from 2012 to 2023, focusing on four primary crops: Corn, Cotton, Peanuts, and Soybeans. The analysis employed summary statistics and regression models to explore how drought conditions measured through the Palmer Drought Severity Index (PDSI), and economic factors like crop prices influenced crop acreage over time. The findings presented in this study provide insights into how environmental stressors and market dynamics shape agricultural decisions, especially in the face of changing climate conditions and fluctuating crop prices.

The results from the summary statistics showed considerable variability in total planted acreage across the four crops (corn, cotton, peanuts, and soybeans), highlighting the responsive nature of farming practices to both climatic conditions and market forces. While Cotton experienced the largest fluctuation in acreage, Peanuts and Soybeans showed steady increases in planted area, reflecting their drought resilience and rising economic value. Corn, while remaining an important crop, showed more stability in its planted acreage but has also been subject to the declining effect of drought as seen in its minimal response to PDSI values in the regression results.

On the other hand, Soybeans demonstrated a positive relationship with wetter conditions, underscoring their drought resilience and adaptability in changing climate conditions. This finding is particularly important as it demonstrates the shifting preferences of farmers towards drought-resistant crops in response to changing climate patterns.

The regression analysis revealed that drought severity, as indicated by the PDSI, had significant impacts on crop shares for Cotton and Soybeans, but with differing responses. Cotton exhibited a negative and significant relationship with PDSI, suggesting that drought conditions significantly reduce Cotton acreage, which is consistent with its water-intensive nature. The year variable consistently showed a positive effect for Peanuts, Soybeans, and Corn, indicating a general trend toward diversification in Georgia’s agricultural landscape. This suggests that while drought conditions have shaped planting decisions, the long-term shift towards crops like Soybeans and Peanuts, which are more adaptable to variable weather, points to a larger structural transformation in Georgia's farming sector. However, the negative impact of year effects on Cotton acreage suggests that Cotton is becoming less competitive in the region, likely due to both environmental challenges and market shifts.

One of the key findings from this study is the role of market forces, such as crop prices, in influencing planting decisions. The lagged price effects observed for Cotton and Soybeans suggest that past price fluctuations play a significant role in shaping the current crop share, especially when combined with drought resilience factors. Higher prices for Soybeans and Cotton can incentivize farmers to plant more of these crops, even when drought conditions prevail, pointing to the interdependence between economic incentives and environmental factors (Smith *et al*., 2022).

It is important to mention that while drought has undoubtedly influenced planting patterns, the evolution of crop prices, along with market demands, appears to be just as significant in determining which crops are planted each season. The findings of this study are consistent with Wooldridge (2021), who highlighted the importance of economic signals in determining crop choices, especially when climatic variability intensifies. In addition, this study contributes to the broader understanding of the relationship between climate change and agricultural production, particularly in the Southeastern United States. It underscores the importance of adopting agricultural practices to changing climate patterns, suggesting that drought-resistant crops like Peanuts and Soybeans are becoming increasingly vital for farmers' long-term sustainability. The findings also align with Higgins *et al*. (2021), who argue that farmers' ability to adapt to climatic extremes is a key factor in ensuring agricultural productivity.

It is noteworthy to mention that the results of this study may provide insights important implications for policy decisions in the context of adaptation of climate change and agricultural sustainability in the southeast. The observed shifts in crop patterns, with a preference for drought-tolerant crops like Peanuts and Soybeans, point to the need for policies that support climate adaptation through the promotion of resilient crop varieties and water management techniques. Furthermore, as Cotton experiences a decline in acreage, it may be essential to explore market diversification strategies and provide financial support for farmers transitioning to more adaptable crops. Given the significant influence of market prices on planting decisions, policymakers should consider the development of crop insurance programs and price stabilization measures that can help farmers navigate the dual challenges of climate variability and market fluctuations. Government subsidies for drought-resistant crops could also incentivize farmers to adopt sustainable agricultural practices that help mitigate the risks associated with prolonged droughts.

While this study provides valuable insights into the impact of drought on crop patterns in Georgia, further research is needed to explore the long-term effects of climate change on agricultural production, especially concerning water scarcity and crop yield fluctuations. Future studies could also examine the economic effects of market shifts on crop selection and the viability of drought-tolerant technologies in improving the resilience of crops in Georgia. This study therefore offers crucial insights into the evolving relationship between drought conditions and crop patterns in Georgia, highlighting how environmental stressors and market dynamics influence agricultural decisions. The findings suggest that while drought has a measurable impact on Cotton acreage, the trend towards drought-resistant crops like Peanuts and Soybeans reflects adaptive strategies by farmers in response to both climate challenges and economic opportunities. Moving forward, it is essential for policymakers to create supportive environments for sustainable agriculture, ensuring that farmers can continue to adapt to changing climate patterns while maintaining economic viability.

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