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Original Article

Access to Credit as a Climate Change Adaptation Strategy for Cotton Farmers: Evidence from Aydın-Söke

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ABSTRACT

Adaptation strategies to climate change are important to manage the risks of climate change and to ensure the sustainability of agricultural production. This research was conducted in Türkiye to determine the adaptation strategies of cotton farmers in the Söke district of Aydın province, the first geographical indication registered by the European Union. A survey of 157 farmers was conducted using simple random sampling. After a comprehensive preliminary investigation of adaptation strategies, the chi-square test was used to test whether there was a significant difference between cotton farmers' access to credit, climate change adaptation strategies and other variables. Binary logistic regression analysis was used to determine the factors influencing farmers' access to credit. The binary logistic regression analysis revealed that social and economic factors such as land tenancy and union membership have a positive influence on access to credit. In addition, it was found that a change in irrigation method, a change in the timing of spraying and land management had a positive effect on access to credit, while changes in land ownership, favoring drought-resistant varieties and turning to non-agricultural activities had a negative effect on access to credit. According to the results of this study, the implementation of holistic adaptation strategies instead of partial adaptation strategies could be a solution for climate change adaptation in cotton farming.

Key words: Adaptation, Access to Credit, Cotton, Söke, Farmer, Strategy, Türkiye

Pamuk Çiftçilerinin İklim Değişikliğine Uyum Stratejisi Olarak Krediye Erişim: Aydın-Söke'den Kanıtlar

ÖZ

İklim değişikliği risklerini yönetmek ve tarımsal üretimin sürdürülebilirliğini sağlamak için iklim değişikliğine uyum stratejileri önemlidir. Bu araştırma, Avrupa Birliği tarafından coğrafi işaret tescili alan ilk pamuk ürünü olan söke pamuğunu incelemektedir. Araştırma Aydın ilinin Söke ilçesindeki pamuk çiftçilerinin uyum stratejilerini belirlemek amacıyla Türkiye'de gerçekleştirilmiştir. 157 çiftçiye basit rastgele örnekleme yöntemiyle anket uygulanmıştır. Uyum stratejilerinin kapsamlı bir ön incelemesinden sonra pamuk çiftçilerinin krediye erişimi, iklim değişikliğine uyum stratejileri ve diğer değişkenler arasında anlamlı bir fark olup olmadığını test etmek için ki-kare testi kullanılmıştır. Çiftçilerin krediye erişimini etkileyen faktörleri belirlemek için ikili lojistik regresyon analizi kullanılmıştır. İkili lojistik regresyon analizi, arazi kiracılığı ve sendika üyeliği gibi sosyal ve ekonomik faktörlerin krediye erişim üzerinde olumlu bir etkiye sahip olduğunu ortaya koymuştur. Ayrıca, sulama yönteminde değişiklik, ilaçlama zamanlamasında değişiklik ve arazi yönetiminde değişiklik krediye erişim üzerinde olumlu bir etkiye sahipken, arazi mülkiyetindeki değişiklik, kuraklığa dayanıklı çeşitlerin tercih edilmesi ve tarım dışı faaliyetlere yönelmenin krediye erişim üzerinde olumsuz bir etkiye sahip olduğu bulunmuştur. Bu çalışmanın sonuçlarına göre pamuk tarımında iklim değişikliğine uyum için kısmi uyum stratejileri yerine bütüncül uyum stratejilerinin uygulanması bir çözüm olabilir.

Anahtar kelimeler: Adaptasyon**,** Çiftçi, Krediye Erişim, Pamuk, Söke, Strateji, Türkiye

INTRODUCTION

In order to eliminate the negative effects of climate change today, the situation must first be determined with climate change scenarios. Then, these impacts should be minimized through the effective implementation of mitigation and adaptation strategies (Akalın, 2014). Adaptation can be explained as the process of strengthening and implementing policies and measures in this area to combat the effects of climate change and cope with its consequences. Adaptation to climate change is a dynamic process that involves many decision-making processes. In recent years, the focus has been on new approaches that have emerged in the face of increasing risk and unpredictability in the agricultural sector as a result of rapidly changing climatic factors, changes in the food sector and the situation of agricultural areas in the face of the reality of global warming. Then, the need for a climate change compatible and future-oriented plan aimed at the adequacy of food supply in agricultural production both globally and locally was revealed (Akalın, 2014). On September 14, 2023, a regulation for agricultural production planning was issued in Türkiye. The aim of agricultural production planning is to reduce unpredictability and ensure the sustainability of food supply. In order to achieve this goal, climate risks must be minimized and climate change adaptation strategies must be defined. The aim of this research was to determine the climate change adaptation strategies of cotton producing farmers.

Although the rise in temperature and the increased CO2 concentration due to climate change appear to have a positive effect on the quantity of agricultural produce in some regions in the short term, these components can lead to a decline in product quality and production quantity in the long term in Türkiye (Akalın, 2014). In Türkiye, the effects of drought and high temperatures on cotton yields in 2008 led to a decline in cotton yields (seed) of 8.7% in 2007 and 21.3% in 2008 compared to previous years (Gürkan et al., 2017). It is estimated that cotton production in Türkiye will decrease by 4.53% in 2050 as yields will decrease due to climate change (Dellal, 2012). Irrigation is an essential element in cotton cultivation. While water scarcity and drought have a negative impact on yield, drought, which is becoming more frequent due to climate change, also has a negative impact on cotton cultivation.

Climate change poses a complex threat to cotton production in Türkiye (Tokel et al., 2022), a global leader and exclusive producer of organic, non-transgenic cotton. As in Europe, extreme heat events are causing yield losses (Świąder et al., 2020). At the same time, the changing climate is negatively affecting fiber quality(Li et al., 2021), reducing market value and threatening the sustainability of farming by lowering farmer income (Tokel et al., 2022). Increased irrigation needs are also raising water demand, complicating essential water management (Bryan et al., 2009). Climate change increases the potential for the spread of diseases and pests, which increases the pressure on the cotton plant. In this case, farmers have been suggested to change their pest management strategy, i.e. to change the amount of pesticides used (Zhou et al., 2022). Irregular rainfall can lead to soil erosion and nutrient loss and reduce the productivity of cotton cultivation. Farmers should change the timing and amount of fertilization. Good soil management practices can help reduce the negative effects of climate change. Conservation practices such as reduced tillage and mulching have been shown to increase the resilience of cotton farmers in India to drought and flooding (Jat et al., 2020). Finally, farmers can diversify their income sources by growing crops other than cotton, such as vegetables and fruits, to protect themselves from climate risks. Growing different crops can help reduce economic losses during extreme weather conditions.

The importance of drought-tolerant and pest-resistant cotton varieties and genetically modified cotton in reducing climate risks for cotton farmers was emphasized (Ali & Erenstein, 2017). A study on water management has shown that drip irrigation systems significantly improve the water use efficiency and crop yields of small farmers in China (Wu et al., 2014). On the other hand, the high cost of the technologies purchased for the conversion of irrigation methods, which is one of the climate adaptation strategies, limits the strategy of converting irrigation methods in general.

Location, education and drought experience were identified as factors influencing farmers' access to credit in South Africa (Ojo et al., 2021). According to a study conducted in India, farmers need advanced technologies and new policy initiatives to cope with the effects of climate change. In the projected climate change scenarios, access to banking, microcredit and insurance services are considered necessary (Venkateswarlu & Shanker, 2009).

While some studies emphasize the positive relationship between access to credit and the adoption of adaptation strategies (Asfaw et al., 2013; Nhemachena et al., 2014), other studies report that the lack of access to credit services and financial resources hinders climate change adaptation strategies (Marie et al., 2020; Nhemachena et al., 2014). In addition, other variables such as previous experience with strategies, experience with extreme events, membership in a community organization, and access to credit and extension services were also found to be significantly associated with farmers' preferences for adaptation strategies (Budhathoki et al., 2020).

Although many studies have been conducted on cotton in the literature, there are very few studies that specifically address adaptation strategies and access to credit. Since credit support increases farmers' adaptive capacity and resilience to climate change risks, this study examines farmers' climate change adaptation strategies and access to credit. This study contributes to the literature by examining access to credit and climate adaptation strategies of cotton farmers in Türkiye.

MATERIALS AND METHODS

Söke is a district of the province of Aydın in the Aegean region, on the coast of the Aegean Sea. Söke is located between latitudes 37° and 45° north and longitudes 27° and 24° east. The average annual rainfall in Söke is 943 mm. The month with the most precipitation is January (118.5 mm). This is followed by May with 117.5 mm. The high amount of precipitation in Söke is due to its location. The average annual temperature in Söke is 17.4 °C. The average monthly temperature is 25.6 °C in summer and 9.5 °C in winter (Özay, 2006). The Söke plain is irrigated by the Menderes River. Black pines and stone pines grow in the high mountain areas, olives on the mountain slopes and figs and citrus fruits on the plains. The crops grown in the Söke plain are wheat, barley, oats, corn, etc. Industrial crops are cotton, sunflowers, sesame and rapeseed. Söke is one of the most important cotton growing areas in Türkiye (Söke Kaymakamlığı, 2025). The most important agricultural product in the Söke Plain is cotton, along with wheat, fodder crops, citrus fruits, fruit crops, figs and olives (STO, 2025).

In Türkiye, most cotton is produced in Şanlıurfa and Diyarbakır, followed by the Aydın-Söke district, which is in third place. Since cotton was registered as the 27th geographical indication with the European Union on September 11, 2024 (TOBB, 2024), the adaptation strategies of cotton producing farmers to climate change in Aydın-Söke province were investigated. Söke cotton farmers were selected as the population for the study. In this study, which aims to determine the climate change adaptation strategies of farmers registered in the Agriculture and Forestry Registration System (FRS) of Söke district in Aydın province and engaged in crop production, there are 2,578 farmers registered in the FRS who will benefit from agricultural subsidies in 2024. Since it is difficult, tedious and even unnecessary to reach the entire population, a sampling method was used. The following formula was used to determine the sample size (Arisoy et al., 2017).

$$n = \frac{N.p.q}{[(N-1).(D)^2]+p.q}$$

N: Universe (2,578 farmer)
p: Probability of occurrence of the examined unit in the population (0.5)
q: The probability that the unit under study is not present in the population (1-p)
D: d/t
e: Acceptable error
t: T-Table value
n: Sample volume

It was determined that a survey of at least 157 farmers should be conducted with a 90% confidence level and a margin of error of 10% using simple random sampling based on sample size. A survey was used as the data collection tool.

Adaptation strategies were identified using the Web of Science database and used in the survey. A sample of 157 producers was randomly selected and data was collected through face-to-face interviews. To test whether there was a difference between access to credit and certain variables, the following variables were used: changing seed variety, changing irrigation method, changing irrigation source, cotton land partnership, changing planting date, changing cultivated area size, changing crop pattern, changing land management, using meteorological information, purchasing crop insurance, cotton land rental, union membership, using Twitter, moving towards non-agricultural work, obtaining farm assistance, and participating in water channel maintenance. In the study, variables such as land leasing, union membership, changing spraying schedules, changing land management, changing irrigation method, changes in land assets, shifting to non-agricultural jobs, and drought-resistant varieties were used as factors affecting climate change adaptation. These explanatory variables were coded as 1 if there was a change, and 0 otherwise. The data obtained from the surveys was analyzed using the open source statistics program JAMOVI version 2.3.28. Normal distribution tests were used to determine whether the data in the study was normally distributed. According to the normal distribution test result, it was determined that the data were not distributed normally. A chi-square analysis was performed to determine the difference between the implementation of adaptation strategies and other variables.

After determining the difference between those who adopted the adaptation strategy and those who did not, the magnitude of this effect was interpreted. The magnitude of the effect is a measure of the difference between two groups (those who adopted the strategy and those who did not). In Söke district of Aydın province, according to the implementation status of the adaptation strategy was coded as 1 if farmers implement the adaptation strategy and 0 if they do not. Binary logistic regression is often used when the dependent variable has a binary value (Bryan et al., 2013; Stoltzfus, 2011). In this regard, the study can be expressed functionally as follows.

$$Ln(\frac{\gamma}{1-\gamma}) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \dots\dots\dots \beta_n X_n + \varepsilon$$

In the equation, γ is the dependent variable, α is the constant term, X_{1-n} is the independent variable, $\beta_{1-n,}$ is the coefficient of the independent variable and ε is the error term. The dependent variable in this study is access to credit (Asfaw et al., 2013; Nhemachena et al., 2014).

As independent variables: In addition to socio-economic variables such as income, age, land size, land ownership (Yegbemey et al., 2013), fertilizer quantity and timing adjustment, pesticide quantity and timing adjustment (Zhou et al., 2022), planting/harvest timing adjustment (Swami & Parthasarathy, 2022), preference for drought-resistant varieties (Ali & Erenstein, 2017), seasonal migration, crop diversification, crop insurance (Venkateswarlu & Shanker, 2009), good soil management, reduced tillage and mulching (Jat et al., 2020), irrigation management (Bryan et al., 2009), drip irrigation system (Wu et al., 2014), access to information and extension services (Hossain et al., 2022), strategies such as off-farm income (Hossain et al., 2022) were included in the research (Di Falco et al., 2011).

Logistic regression analysis is a method that allows classification according to probability rules by calculating the estimated values of the explained variable as probabilities. The explanatory power of the model was evaluated using McFadden's R2, Cox&Snell R2, and Nagelkerke R2 values. Among the R2 statistics, Cox-Snell R2 statistic and Nagelkerke R2 statistic are desired to be R2>0.2 (Kalaycı, 2010). Additionally, the decision was made by examining the significance level of the Chi-square value in the Hosmer and Lemeshow test (if p>0.05, the model's fit to the data is good). To test for multicollinearity among variables in the study, the Variance Inflation Factor (VIF) was used. It was calculated whether the VIF values were within the ranges (<5) suggested by Akinwande et al. (2015). In binary logistic regression analyses, the test performance is measured by the Receiver Operator Characteristic (AUC). The AUC takes values between 0 and 1 (Rosner, 2006). Here, an AUC value between 0.7 and 0.8 was considered acceptable, between 0.8 and 0.9 excellent, and above 0.9 outstanding (Hosmer Jr et al., 2013). The findings obtained as a result of the analysis were interpreted as Odds Ratio (OR).

RESULTS AND DISCUSSION

Results

This study, which was conducted in the Söke district of Aydın province, found that the average age of the participating farmers was 46.8 years. Of these participants, 98.09% were male and 1.91% were female. The farmers had an average education level of 9.37 years. Their educational background showed that 2.55% were illiterate, 43.94% had completed primary school (8 years), 37.57% had completed secondary school (12 years) and 15.92% had completed college (12 years or more). Cotton farmers in the Söke district of Aydın province have an average of 26.8 years of agricultural experience. The average family size is 4.10, and the number of people working in agriculture is 2.28. Of the farmers whose average annual income from animal production was $2,147, from crop production $32,963, from non-agricultural activities $2,634 and from agriculture $35,110, 61.8% were cooperative members and 65% were union members. The farmers' total holdings averaged 283 decares, with cotton cultivation totaling 261 decares. The survey found that 91.1% of farmers owned their land, 38.2% rented it and 19.1% shared it. To measure farmers' perceptions of climate change, one question was asked on a 5-point Likert scale (from very little to very much change), “Has rainfall changed recently?” the mean value for this statement was 3.77. This was interpreted as “significant changes in rainfall” (Table 1).

Table 1. Descriptive statistics

Variables	Mean	SD	Variables	Mean	SD
Gender (male %)	0.981	0.137	Internet Usage %	0.732	0.444
Age	46.8	12.2	Smartphone Usage %	0.968	0.287
Education (Years)	9.37	4.11	Facebook Usage %	0.815	0.389
Agricultural Experience (Years)	26.8	14.1	WhatsApp Usage %	0.847	0.361
Number of Family Members	4.10	1.39	Instagram Usage %	0.682	0.467
People Working in Agriculture	2.28	1.94	X-Twitter Usage %	0.242	0.430
Animal Production Income $	2147	6741	YouTube Usage %	0.554	0.499
Total Land Assets (da)	283	377	Agricultural Income ($)	35,110	45285
Cotton Planted Area (da)	261	360	Non-Agricultural Income ($)	2,634	8530
Cotton Planted Area Property (da)	0.911	0.286	Crop Production Income ($)	32,963	44040
Cotton Planted Area Rental (da)	0.382	0.487	Distance from Village to City (km)	18.4	8.27
Cotton Planted Area (da)	0.191	0.394	Cooperative Partnership	0.618	0.487
monthly communication costs ₺	914	952	Union Membership	0.650	0.479
Changes in Rainfall	3.77	1.39	Climate Change Information	0.822	0.400
Climate Change Damage $	9,965	17482	Water Resources Adequacy	2.89	0.408

Farmers who had experienced significant changes in rainfall in recent years also thought that “water resources were quite inadequate” (2.89). It was found that 82% of the farmers who participated in the study were aware of climate change and 86% were affected by it. Cotton farmers reported that climate change costs them an average of $9965 per year. Participating farmers' social media usage, internet access and smartphone ownership status were examined. It was found that 96.8% of farmers owned a smartphone and 73.2% used the internet. The average monthly communication expenditure of farmers was calculated to be about (₺914) $26 ($1 = ₺36). It was also found that 81.5% of farmers used Facebook, 84.7% used WhatsApp, 68.2% used Instagram, 24.2% used X-Twitter and 55.4% used YouTube (Table 1).

In order to select the appropriate method of analysis for the statistical analyses, a test for normal distribution was carried out for the variables. According to the results of the normal distribution, it was found that all variables were not normally distributed ($P<0.01$). Nonparametric chi-square test was used to determine whether there was a significant difference between categorical variables and farmers' access to credit.

Table 2. Chi-square test between farmers' access to credit and variables

Variables	X^2	P	Variables	X^2	P
Changing seed variety	4.225	0.030	Using meteorological information	10.825	< 0.001
Changing irrigation method	9.913	0.001	Purchasing crop insurance	4.383	0.027
Changing irrigation source	6,836	0.007	Cotton land rental	14.881	< 0.001
Cotton land partnership	4.667	0,023	Union membership	8.217	0,003
Changing planting date	17.258	< 0.001	X-Twitter	6.093	0,012
Changing cultivated area size	11.849	< 0.001	Moving towards non-agricultural work	17.358	< 0.001
Changing crop pattern	15.715	< 0.001	Obtaining farm assistance	3,835	0,038
Changing land management	7.785	< 0.001	Participating in water channel maintenance	4,367	0.027

The survey of participating farmers found that 40.76% had access to farmer credit while 59.24% had no access. A significant difference was found between access to farmer credit and adaptation strategies such as change in seed variety, irrigation method, irrigation source, participating in water channel maintenance, and change in planting date ($P<0.05$). A significant difference ($P<0.05$) was found between access to credit for farmers and adaptation strategies such as change in size of cultivated area, change in cropping pattern, change in land management, use of meteorological information and purchase of crop insurance (Table 2). According to the test results conducted between access to credit and socio-economic variables, significant differences were

determined in terms of co-owning cotton land, renting cotton land, being affected by climate change, union membership, X-Twitter usage, working in non-agricultural jobs, and obtaining farm assistance (Table 2).

No significant difference was found between cotton farmers' access to credit and adaptation strategies such as timing of pesticide application, pesticide application, timing of irrigation, amount of irrigation, timing of fertilization, amount of fertilization and changes in planting location. In addition, no significant difference was found between access to credit and soil analysis, sale of assets, praying for rainfall, migration, institutional support, resource allocation, stockpiling of grain and rainwater harvesting. In addition, no significant difference was found between access to credit and socio-economic variables such as co-operative membership, internet ownership, smartphone usage, Facebook account, WhatsApp usage, Instagram usage and YouTube usage.

The strength of the relationship between dependent and independent variables in logistic regression was evaluated using McFadden's R^2 (0.408), Cox & Snell R^2 (0.424), and Nagelkerke R^2 (0.572) values. The calculated R^2 values indicate that the model explains the dependent variable, which is the credit access strategy. According to the Hosmer and Lemeshow test result, it was determined that the model's fit to the data was good (Chi-square: 8.041 and P: 0.430). It was concluded that the VIF values were within the ranges suggested by Akinwande et al. (2015) VIF<5, and that there was no multicollinearity problem. According to the classification table in the model used in the study, the model correctly explains 89.2% of those without access to farmer credit and 75% of those with access to farmer credit. The entire model indicates that 82% of the factors affecting access to farmer credit, which is one of the climate change adaptation strategies, are correctly explained. In this study, the AUC value was calculated as 0.905 (Hosmer Jr et al., 2013; Rosner, 2006). In light of all these calculations, the binary logistic regression model results were interpreted (Hosmer Jr et al., 2013; Rosner, 2006).

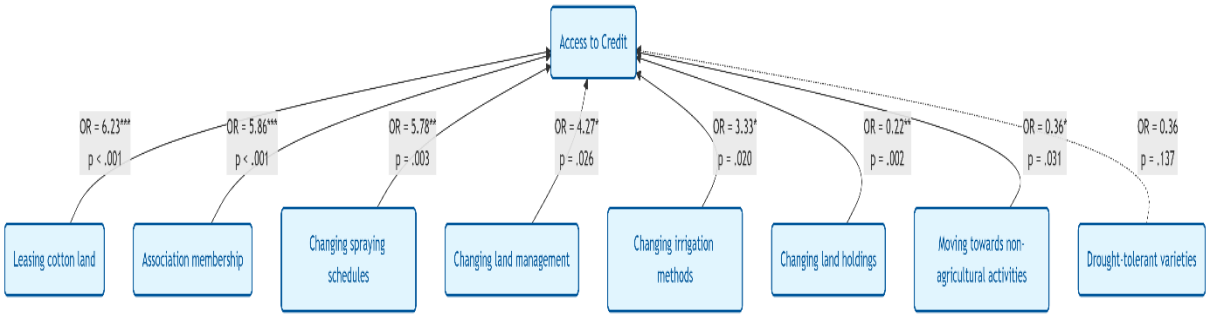


Figure 1. Factors affecting access to credit
Odds ratio (OR); statistically significant: *** P <0.001, **P <0.05, *P <0.10

As a result of the analysis, it was found that social and economic factors such as land leasing and union membership have a positive effect on access to credit. Since leasing cotton land is an economic activity, the need for credit is greater. In this study, land leasing was found to be the most influential factor on access to credit. It was determined that land leasing increases the probability of accessing credit by 6.2 times, and union membership increases the probability by 5.9 times. Additionally, while changing spraying schedules (OR: 5.86), modifying land management (OR: 4.27), and changing irrigation methods (OR: 3.33), positively affected access to credit, changes in land assets (OR: 0.21), and shifting to non-agricultural jobs (OR: 0.36), were found to negatively impact access to credit. Among these factors, preference for drought-resistant varieties was not found to have a significant effect on access to credit (Fig. 1).

Discussion

The general understanding in the literature is that access to credit and credit utilization, as an adaptation strategy, can be a proactive measure in agricultural production and contribute to the sustainability of agricultural production (Arunrat et al., 2017; Bryan et al., 2009). While some studies have emphasized the positive relationship between access to credit and the adoption of adaptation strategies (Asfaw et al., 2013; Nhemachena et al., 2014), other research has reported that the lack of access to credit services and financial resources hinders climate change adaptation strategies (Marie et al., 2020; Nhemachena et al., 2014). A study conducted in Ghana determined that access to credit was effective in implementing adaptation strategies (Acheampong et al., 2023). Similarly, according to a study conducted in India, access to credit was seen as a necessity for adapting to projected climate change scenarios (Venkateswarlu & Shanker, 2009).

According to the results of this study conducted in Türkiye, agricultural credit transactions and land management are generally carried out by male farmers. The proportion of men in the study was therefore 98%.

While about 51% of farmers in Nepal have access to credit (Budhathoki et al., 2020), this study in Türkiye found that 41% of cotton farmers use credit. In sub-Saharan Africa, where gender perceptions of climate change were studied, women were found to be more effective in accessing extension services, while men were more effective in accessing credit (Acheampong et al., 2023). If land cultivated using traditional methods is not managed according to changing climate conditions, there is a high likelihood of economic losses and leakages. Therefore, farmers may need access to credit to adapt to changing climate conditions and change their land management practices. Land management plays a crucial role in promoting integrated approaches to access to credit (Deressa et al., 2011). At the same time, farmers can improve their social capital by exchanging ideas with other farmers, non-governmental organizations, farmer groups and state organizations in the field of land management.

A farmer's membership in a cooperative increases the probability of accessing credit by about six times (Fig. 1). These results are consistent with studies in the existing literature (Budhathoki et al., 2020). From a social capital perspective, membership in farmer groups is an important determinant of adaptation strategies (Lambarraa-Lehnhardt et al., 2024). Membership in community-based organizations promotes farmers' social interaction, knowledge sharing, and the development of social networks for risk management, thereby strengthening their social capital (Paton, 2013). This social capital in turn facilitates access to credit markets (Deressa et al., 2009; Le Dang et al., 2014; Roco et al., 2015; Yaméogo et al., 2018).

Efficient water management is crucial for cotton cultivation in water-scarce regions. While a study conducted in China has shown that drip irrigation systems significantly improve water use efficiency and crop yields for cotton farmers, the high initial cost of such technologies was pointed out. The results of this study conducted in Türkiye show that changing irrigation methods to adapt to climate change has a positive impact on access to credit. Although a study conducted in China showed that drip irrigation systems significantly improve water use efficiency and crop yields for cotton farmers, the high initial cost of such technologies was highlighted (Xu et al., 2024). According to the results of this study conducted in Türkiye, access to credit is positively affected when farmers change their irrigation methods to adapt to climate change (Fig. 1).

Drought-resistant varieties (Chamberlin et al., 2020; Zhao et al., 2017), the cultivation of varieties with a short lifespan, efficient irrigation methods (Kisekka et al., 2019) and changes in land management (expansion of cultivated area) were among the important adaptation strategies (Swami & Parthasarathy, 2022). Switching to resistant varieties is not only a strategy that farmers use to address climate change, but also a method that they must use due to circumstances. For economic reasons, farmers are investing in new agricultural machinery and drought-resistant varieties (Alvi & Jamil, 2018; Mukherjee & Fransen, 2024). Every investment means a new expense. According to this study conducted in Söke, no statistically significant effect of switching to drought-resistant varieties on access to credit was found (Fig. 1).

According to Liu et al. (2025), “climate change exacerbates farmers' credit constraints”, which can lead them to turn to non-agricultural activities. Research in Söke has shown that turning to non-agricultural income/labor and switching to drought-resistant varieties negatively affects farmers' access to credit. One of the adaptation strategies of farmers in Bangladesh to climate change was off-farm income (Hossain et al., 2022). While the average age of farmers who resorted to off-farm labor was 44 years, the average age of those who did not resort to off-farm labor was estimated to be 50 years. Based on these results, it can be said that the relatively younger cotton farmers in Söke district are turning away from agriculture. Those who turn to off-farm labor may therefore be reluctant to access credit.

CONCLUSION

This study highlights the importance of climate change adaptation strategies for cotton farmers in the Söke district of Türkiye, the critical role of credit access in improving farmers' climate adaptation capacities, and the factors that influence credit access. Solutions for climate adaptation can be developed by considering the negative and positive impacts of these factors. Land tenancy and membership in agricultural organizations as indicators of farmers' desire and intention to continue agricultural production have a positive impact on farmers' access to credit. In this regard, it is beneficial to improve policies that provide subsidies, interest-free loans and technical assistance to encourage farmers to adopt sustainable adaptation practices.

As adaptation to climate change does not depend on a single strategy, the implementation of holistic strategies is crucial. This study concluded that changing irrigation practices, changing the timing of pesticide application, and changing land management practices have a positive impact on access to credit. Practices with positive effects, such as changes in land management and irrigation management, should be encouraged to ensure farmers' access to credit to increase agricultural production. The timing of pesticide applications should be adapted to the stage of crop development and pest population, and precision agriculture technologies such as digital tracking systems and smart spraying systems should be used in production processes. Cotton farmers can change their irrigation methods or use rainwater harvesting techniques. Agricultural advisors and decision-

makers have an important role to play, as changes in land ownership, the favoring of drought-resistant varieties and the shift to non-agricultural activities have a negative impact on access to credit. In the Turkish province of Aydın, for example, the governorate has decided to introduce a 50% dry farming practice for the 2025 irrigation season based on "Basin-Based Drought Analysis" studies. This decision aims to prevent or minimize potential damage to farmers who benefit from the reservoir irrigation systems built by the state waterworks due to the recent droughts. In parallel with this decision and irrigation restrictions, it is also important to choose drought-resistant cotton varieties and train farmers in holistic adaptation strategies.

Alternative credit and support programs should be developed to ensure the financial sustainability of farmers who switch to non-agricultural activities. In addition, improving infrastructure in rural areas, taking into account the push factors of rural areas and the attraction of urban centers, can reduce migration to non-agricultural occupations. Raising farmers' awareness of credit utilization and financial management can further facilitate their access to credit. Taking out insurance for agricultural products is a complementary strategy as it is an important factor in mitigating climate-related risks. Future research should focus on innovative financial solutions, policy interventions and integrated approaches to overcome challenges such as lower lending rates, lack of collateral, credit access constraints and limited financial infrastructure to improve the resilience of agricultural production systems to climate change.

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Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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