Hacettepe University Graduate School of Social Sciences

Department of Economics

FARMERS' PREFERENCES FOR DRIP IRRIGATION AND SOIL ANALYSIS: A DISCRETE CHOICE EXPERIMENT IN TÜRKİYE

Oğuzhan ÇELİK

Master's Thesis

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ACCEPTANCE AND APPROVAL

The jury finds that Oğuzhan Çelik has on the date of 06/07/2024 successfully passed the defense examination and approves his Master’s Thesis titled “Farmers’ Preferences for Drip Irrigation and Soil Analysis: A Discrete Choice Experiment in Türkiye”.

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Oğuzhan ÇELİK

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ÖZET

ÇELİK, Oğuzhan. *Çiftçilerin Damla Sulama ve Toprak Analizi Tercihleri: Türkiye'de Ayrık Seçim Deneyi*, Yüksek Lisans Tezi, Ankara, 2024.

Son yüzyılda, iklim değişikliği, dünyanın en önemli sorunlarından biri haline gelmiştir. Konumu itibariyle iklim değişikliğinden en çok etkilenecek ülkelerden biri Türkiye'dir. Tarım sektörü ise iklim değişikliğinden en çok etkilenecek sektörlerden biri olacaktır. Dolayısıyla, tarım sektöründe düşük miktarda enerji ve su tüketimi olan, yüksek verimliliklerin sağlandığı sürdürülebilir bir tarımsal üretim ekosistemi oluşturmak elzemdir. Ancak, Türkiye'deki tarımsal sisteme bakıldığında bunun tam tersi bir durumun söz konusu olduğu anlaşılmaktadır. Suyu daha az tüketen, bitki verimliliğine katkısı son derece yüksek olan damla sulama sistemlerinin kullanım oranı oldukça azdır. Damla sulama sistemi kullanımının yaygınlaştırılması amacıyla çeşitli hibe ve kredi desteği projeleri verilmektedir. Projeler incelendiğinde, damla sulama sistemi kullanımında birtakım artışların meydana geldiği tespit edilmiştir. Ancak, bu politikalar, araştırmacılar tarafından en kritik eksik olarak nitelenen danışmanlık desteği sağlamamaktadır. Tarımsal verimliliğin artmasına büyük katkı sağlayan bir diğer etken olan toprak analizinde de benzer senaryolar vardır. Damla sulama sisteminde olduğu gibi bu politikaların da yeterince etkin olmadığı görülmektedir. Çalışmalarda, bu uygulamaların yaygınlaştırılması hususunda çiftçi davranışlarının oldukça etkili olduğu tespit edilmiştir. Bu sebepten, bu çalışmada, uluslararası düzeyde hangi faktörlerin üreticilerin toprak analizi yaptırma, damla sulama sistemi kullanma gibi sürdürülebilir tarım teknolojilerine adaptasyon davranışlarını etkilediği araştırılmış ve bu faktörler kullanılarak seçim deneyi için gerekli alternatifler (damla sulama sistemi paketleri, verimde potansiyel artış, tarımsal danışman, kredi miktarı, kredi faizi, kredi geri ödemesinin başlama süresi ve kredi vadesi) oluşturulmuştur. Mixed logit model kullanılarak elde edilen araştırma bulgularında faiz oranının tüm illerdeki çiftçiler için en önemli alternatif olduğu tespit edilmiştir. Aynı zamanda, tüm alternatifler için ödeme istekliliği hesaplanmıştır. İl düzeyindeki analiz sonuçları incelendiğinde, faiz oranı dışındaki bütün alternatiflerin katsayı işaretlerinin ve/veya anlamlılık düzeyinin farklılık gösterdiği gözlemlenmiştir. Dolayısıyla, bazı politikaların Türkiye genelinde uygulanmasının uygun olmadığı, politikanın başarıya ulaşması için gerekirse il düzeyinde değişiklik gösteren politikalar üretilmesi gerektiği görülmektedir.

Anahtar Sözcükler: İklim Değişikliği, Toprak Analizi, Damla Sulama, Sürdürülebilir Tarım, Ayrık Seçim Deneyi, Çiftçi Tercihi, Mixed Logit Model

ABSTRACT

ÇELİK, Oğuzhan. *Farmers' Preferences for Drip Irrigation and Soil Analysis: A Discrete Choice Experiment in Türkiye*, Master's Thesis, Ankara, 2024.

Over the past century, climate change has become one of the most pressing global issues. Due to its geographical location, Türkiye is one of the countries most affected by climate change. The agricultural sector, in particular, will be significantly impacted. Therefore, it is crucial to establish a sustainable agricultural production ecosystem characterized by low energy and water consumption and high productivity in the agricultural sector. However, when examining the agricultural system in Türkiye, it becomes evident that the opposite is true. The use of drip irrigation systems, which consume less water and significantly enhance plant productivity, is relatively low. Various grant and credit support projects are being implemented to promote the use of drip irrigation systems. While these projects have led to some increases in the adoption of drip irrigation systems, they do not provide advisory support, which researchers identify as the most critical missing component. A similar scenario exists for soil analysis, another factor that significantly contributes to agricultural productivity. Like the policies for drip irrigation systems, those for soil analysis are also not sufficiently compelling. Studies have shown that farmer behavior plays a crucial role in the widespread adoption of these practices. Therefore, this study investigates the international factors influencing farmers' adaptation behaviors to sustainable agricultural technologies, such as soil analysis and drip irrigation systems. Using these factors, attributes for a discrete choice experiment (drip irrigation system packages, potential yield increase, agricultural advisor, credit amount, interest rate, repayment start time, and loan maturity) were developed. The research findings, obtained using the mixed logit model, indicate that the interest rate is the most crucial attribute for farmers in all provinces. Additionally, the willingness to pay for each attribute was calculated. When examining the results of provincial-level analyses, it was observed that the signs and significance levels of the coefficients for all attributes, except the interest rate, differed. Therefore, it is evident that implementing some policies nationwide may not be appropriate, and it may be necessary to develop policies that vary at the provincial level to achieve success.

Keywords: Climate Change, Soil Analysis, Drip Irrigation, Sustainable Agriculture, Discrete Choice Experiment, Farmer's Preference, Mixed Logit Model.

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LIST OF ABBREVIATIONS

DCE	: Discrete Choice Experiment
NOAA	: National Oceanic and Atmospheric Administration
TSMS	: Turkish State Meteorological Service
MAF	: Ministry of Agriculture and Forestry
MFAL	: Ministry of Food, Agriculture, and Livestock
FAO	: Food Agricultural Organization
IPCC	: Intergovernmental Panel on Climate Change
SPI	: Social Precipitation Index
MWTP	: Marginal Willingness to Pay
TurkStat	: Turkish Statistical Instute

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INTRODUCTION

The dramatic increase in industrialization and the use of high levels of fossil fuels, which started with the Industrial Revolution, became one of the most severe problems in today's agriculture. This problem is undoubtedly climate change. Climate change is the phenomenon of altering the world's climate due to the accumulation of greenhouse gases in the atmosphere, primarily as a result of various human activities, leading to global warming. These greenhouse gases trap heat and contribute to the greenhouse effect. The greenhouse effect occurs when short-wavelength rays from the sun penetrate the Earth's atmosphere. After these rays are absorbed and re-radiated by the Earth's surface, they are trapped by greenhouse gases in the atmosphere. This trapping causes long-wavelength heat rays to be retained. The primary greenhouse gases responsible for this effect include CO_2, CFC, N_2O, CH_4, and O_3. Among them, CO_2 has the highest effect; the contribution of CO_2 to the greenhouse effect is around 60 or 70% (Aksay, Ketenoğlu, & Kurt, 2005). From 1750 to 2021, the atmospheric CO_2 concentration increased from 200 ppm to 416 ppm (Mahato, 2014). In May 2023, a new record was recorded, and CO_2 concentration hit 424 ppm (National Oceanic and Atmospheric Administration [NOAA], 2023). Parallel to the rise in CO_2 concentration, the global surface temperature in 2021 also increased by 1,12 degrees Celsius compared to 1880-1920 due to the greenhouse effect (Hansen, Sato, & Ruedy, 2022). In 2081-2100, global surface temperature is expected to increase between 2.6 and 4.8 degrees Celsius compared to 1986-2005 (Allen et al., 2014). When the expected changes in global surface temperature are explicitly examined for Türkiye, it is observed that the expected increase will be 1.7 degrees Celsius in 2050 and 5.1 degrees Celsius in 2080 (Bozoğlu et al., 2019). The effects of climate change are not limited to temperature; the effects also include significant increases in the severity, duration, and frequency of extreme natural events (Öztürk et al., 2018). Changes in climate cause fluctuations in the hydrological cycle, which causes more considerable variability in precipitation and water flows. With the disruption of the balance in the hydrological cycle, the frequency and severity of extreme natural events rises. Another expected negative impact is a gradual decrease in the amount of precipitation from east to west after 2050 (Demir, Kılıç, & Coşkun, 2008). In the regional climate projections created by the Turkish State Meteorological Service (TSMS, 2015) using HadGEM2-ES global climate model data under the RCP4.5 scenario, it has been determined that precipitation will decrease by 20% in the spring months in the 2016-2040 period in most of the country, except eastern Anatolia and the Aegean coast. The findings of the project for the 2041-2070 period indicate that there will be a decrease in summer precipitation by around 30% in Eastern Anatolia. Additionally, winter precipitation is expected to decrease by approximately 20% in Southeastern and Eastern Anatolia and the Central and Eastern Mediterranean regions (Iglesias et al., 2009). Considering the review period as 2071-2099, it has been determined that there will be a 20% decrease in spring precipitation, excluding the Coastal Aegean, Northeastern Anatolia, and Central Black Sea regions. Moreover, summer precipitation will decrease by 40%, excluding the Black Sea, Marmara, and Aegean coasts. Climate change also causes a rise in sea level (Iglesias et al., 2009). From 1901 to 2018, there had been approximately a 0.20-meter increase in the global mean sea level (IPCC, 2021b). The global mean sea level increase in 2100 is expected to be between 0.28 and 1.01 m, depending on various greenhouse gas emission scenarios (IPCC, 2021a). This rise in global mean sea level will cause significant damage to coastal areas. According to estimates, a 0.75 m increase in global mean sea level compared to the 2020 level will result in an approximately 40% increase in the population potentially exposed to coastal floods (IPCC, 2022). Türkiye is faced with a high-risk category as it is surrounded by seas on three sides. It is expected that 4 million people will be affected by this danger (Ercanlı et al., 2019). In a study conducted specifically for the Mediterranean, it was determined that there would be a 44 cm to 102 cm increase in the sea level of the Mediterranean by the end of the 21st century, in parallel with the increase in the global mean sea level (Marcos et al., 2016).

The concepts of the studies are central to the fact that severe crises will occur in agricultural production in the future. Considering these scenarios, it is necessary to create a sustainable agricultural production ecosystem that requires low energy and uses water economically while also having high efficiencies. However, when we look at the agricultural system in Türkiye, it is accurate that the opposite situation exists. According to the 11th Development Plan of the Ministry of Development (2018), 74% of the annual water consumption in Türkiye is used for agricultural irrigation. According to 2021 values, 57.73 billion of the total water potential in the country was used for various purposes, 44 billion (77%) was used for irrigation, 13.73 billion (23%) was used for drinking use and industrial water (SHW, 2022). The annual amount of water per capita was 1322 m^3. These values imply that Türkiye is a country experiencing water scarcity (SHW, 2023a; SHW, 2023b; SHW,2023c). When we look at the reasons behind this high rate, we see that the surface irrigation system usage rate is around 70% (Kodal & Ahi, 2018). The surface irrigation technique has the highest water loss among irrigation techniques (water loss 35% - 60%). On the other hand, water loss in drip irrigation and sprinklers is significantly less (5% - 25%) (TAGEM, 2021). However, the drip irrigation system usage rate, which uses around 60-70% less water than surface irrigation methods, is only 17% (Suzan et al., 2023).

When we compare the surface and drip irrigation systems, it is evident that almost all of the water given to the field in the drip irrigation system, 90-95%, affects plant development. In comparison, in flood irrigation, this rate is only around 40% (Omrak, 2021). In addition, in surface irrigation methods, excessive water being applied to the land during irrigation can lead to the erosion of soil fertility elements and a portion of the soil itself being washed away. Consequently, soil erosion occurs, resulting in decreased productivity. Moreover, when the surface irrigation method is used, weed growth in the field significantly increases, leading to decreased soil fertility (Bayartan, 2012). With the implementation of a drip irrigation system, these issues are mitigated, resulting in increased product efficiency. Additionally, operational costs are reduced because fertilization and pesticide applications can be integrated into the drip irrigation system. To promote the adoption of these systems, which significantly enhance water conservation and product efficiency, various support programs for the utilization of pressurized irrigation systems have been established through grants since 2006. This initiative falls under the ‘Rural Development Investments Support Project’ as part of the modernization of irrigation projects (Çakmak & Avcı, 2017). In addition, Ziraat Bank has provided interest-free loans with a 5-year maturity since 2007 to be used in drip and sprinkler irrigation systems (Demircioğlu & Çakmak, 2016). In 2021, the maturity period has been increased to 7 years.

Accompanied by these policies, there have been some increases in the use of drip irrigation systems in recent years. While it was at 2% in 2001, it increased to 7% in 2014 and reached 17% by 2020. While the share of other pressurized irrigation systems is 21%, the share of surface irrigation is 62% (Suzan et al., 2023). However, this increase is entirely insufficient, and the rate of use of drip irrigation systems needs to accelerate rapidly. For instance, Israel, facing more challenging geographical conditions than Türkiye, exhibited a drip irrigation system usage rate of 75% in 2016 (Kaye, 2016). In countries of the European Continent, such as the Netherlands, Germany, and Italy, the use of pressurized irrigation systems is 100% (Zhang et al., 2022). Considering these statistics, we see that the agricultural policies established in Türkiye are not effective enough in popularizing the use of drip irrigation systems.

Analysis reveals that the agricultural policies established in Türkiye are inadequately effective in promoting the widespread use of drip irrigation systems. While these policies are implemented, producers lack consultancy support, with such assistance limited solely to financial provisions.

Researchers highlight this deficiency as the most critical issue in supporting policies. Surveys indicate that approximately 20% of farmers who received grants incorrectly installed drip systems due to the absence of agricultural consultancy services and consequently needed to modify the system (Nalbantoğlu, 2014). Moreover, all examined studies reveal farmers' insufficient knowledge regarding the quantity and timing of water required for fields in drip irrigation systems—the absence of technical support and training results in erroneous practices addressing potential issues. For instance, in the event of clogged pipes, the majority of farmers resort to increasing costs by replacing the pipes in that line or cause uncontrolled irrigation as a result of employing brushes and similar tools and disrupting the pressure and flow balance of the drippers (Yıldız & Yürdem, 2017).

Similar scenarios in soil analysis are another critical factor contributing significantly to increasing agricultural productivity. Through soil analysis, farmers can scientifically determine the nutrient needs of plants. Consequently, the correct amount of fertilizer the plants require can be applied to the soil (Bal & Özer, 2021). Given that fertilizer usage alone can boost productivity by approximately 50%, as indicated by analysis results, it becomes evident that accurate and effective fertilization stands as one of the cornerstones of high agricultural productivity (Şahinli, Özçelik, & Gürdal, 2016).

The Turkish government has established various political initiatives to promote soil analysis, which is recognized as one of the most critical factors in establishing a sustainable and highly productive agricultural ecosystem. The first breakthrough made in this context was providing soil support in 2005 by the Ministry of Food, Agriculture, and Livestock (MFAL) to encourage soil analysis. The Council of Ministers decided to introduce soil analysis support in addition to direct income support, as outlined in Article 1 of Decree No. 2005/8629 dated January 28, 2005. Further guidance on obtaining analysis support was provided in Article 11/b of Official Gazette Communiqué No. 2005/21 dated April 30, 2005. Following these decisions, soil analysis support of 2.5 TL per decare was initiated in 2006, with a maximum coverage of 60 decares per analysis. With the 2008/70 notification, the maximum support for each soil analysis was reduced to 50 decares (Küçükkaya & Özçelik, 2016). In 2014, another initiative was implemented to encourage soil analysis, mandating that enterprises with land holdings of 50 decares or more conduct soil analysis as a prerequisite for receiving fertilizer support. However, in 2016, soil analysis support was withdrawn entirely. In 2017, the support method was revised to provide 40 TL per analysis for agricultural lands of 50 decares and above, up to 50 decares of land, and was reinstated. This support, provided until 2022, was increased to 50 TL per analysis in 2022. In short, the implementation status and type of policies that encourage soil analysis fluctuate over time.

According to the research conducted on the effectiveness of incentives aimed at promoting soil analysis, it can be observed that these policies were not entirely successful in achieving the desired impact. One of the main reasons was farmers' reluctance to abandon traditional agricultural methods. Despite the partial contribution of the policies mentioned above to the rate of soil analysis, the rate of fertilization remains considerably low, according to analysis results. Surveys conducted across different regions of Türkiye revealed that, on average, 50-60% of farmers who had soil analyzed fertilized based on their knowledge and experience. Another significant factor is insufficient information dissemination activities, particularly in the eastern region. A considerable portion of enterprises in Tokat province, for instance, lack awareness of the importance and benefits of soil analysis, as well as the available support mechanisms (Yüzbasıoğlu, 2019; Altıntaş & Altıntaş, 2012). Similarly, it was found that a majority of farmers in Kahramanmaras lacked adequate information on soil analysis (Kızıloglu & Kızılaslan, 2017).

In line with these assessments, it has been identified that producer behavior plays a crucial role in the widespread adoption of drip irrigation systems and soil analysis. This issue was also highlighted in the Eleventh Development Plan of the Ministry of Development (2018), where the absence of a system capable of altering the traditional agricultural decisions of farmers was stated as a critical reason for the limited adoption of drip irrigation systems. Consequently, it is essential that support mechanisms are not limited to financial provisions but are also designed to affect farmer behavior. This study investigates the international factors affecting producers' adaptation to sustainable agricultural technologies, such as soil analysis and drip irrigation systems. Key factors impacting producer behavior include rational decision-making, access to credit opportunities, agricultural consultancy support, cognitive and psychological factors (such as awareness of climate change), educational status, age, and social pressure (Ali & Behera., 2016; Blasch et al., 2022; Burton, 2014; Carlisle, 2016; Dang et al., 2019; Daxini et al., 2018; Defrancesco et al., 2008; Dessart et al., 2019; Feola et al., 2015; Li et al., 2019; Huang & Karimanzira, 2018; Liu et al., 2018; Nejadrezaei et al., 2018; Obayelu et al., 2014; Qi et al., 2021; Prager & Posthumus, 2010; Rose et al., 2018).

In this study, the choice experiment method, one of the famous experimental economics methods, will be employed. This method has been widely used in various countries in the fields of health, tourism, transportation, and agricultural economics. The choice experiment method is one of the most well-used tools for assessing the experimental qualities policymakers should bring to the forefront when making policies. Unfortunately, this method, which is widely used in agriculture and many other areas worldwide, is rarely utilized in Türkiye.

Therefore, a discrete choice experiment was conducted based on the factors that may affect producer behavior decisions in many international studies mentioned above. Through face-to-face surveys with farmers, farmers’ willingness to adopt drip irrigation systems, as well as their preferences for specific indicators, such as interest rate, potential increase in yield, and credit amount, is elicited. In addition, throughout the survey, information is given about the impacts of climate change, current agricultural policies, the positive effects of using drip irrigation systems, and soil analysis (such as an increase in agricultural productivity, savings in water and electricity use, reduction in operating costs and increase in profitability). In this way, producers' awareness is increased. Moreover, recommendations are made on measures to protect producers against climate change and, consequently, against long-term severe drought. It is evident that in the long term, if farmers adopt drip irrigation systems and soil analysis, considering the increased productivity and limited water resources, the profitability of the producers will increase, and the food supply in Türkiye can be maintained by providing sufficient food to the consumers.

In this study, the current situation regarding farmers' use of drip irrigation and soil analysis, the problems they face on the farm, the issues caused by climate change, and the measures taken are analyzed. Most importantly, the study determines farmers' willingness to pay for various attributes, such as interest rates, in relation to the use of drip irrigation and soil analysis. The discrete choice experiment method, which is central to this research, is used to gather and analyze this information. In this sense, the policies that will be created in light of the findings obtained as a result of this study will be programs that farmers will voluntarily implement in order to maximize their profits from drip irrigation systems and soil analysis applications. Therefore, this study plays an essential role in ensuring a rapid and effective transition to a sustainable agricultural ecosystem. So far, since very little research has been utilized in choice experiment design, this thesis contributes to filling the gap in the literature.

The following section, Chapter 1, discusses the relationship between climate change and agriculture and the impact of climate change on agriculture. Chapter 2 includes a literature review on drip irrigation use and soil analysis conduction status in Türkiye, as well as the use of the discrete choice experiments method in the agricultural sector. Chapter 3 covers the methodology and model used for the analysis, as well as the survey design and the attributes and choice cards used for the discrete choice experiment. Chapter 4 describes the sample data collected by the survey and provides its description. The subsequent section, Chapter 5, presents the estimation results of the discrete choice experiment analysis, limitations of the study, and future works. Chapter 6 includes policy recommendations formulated based on the findings. Finally, the study was completed with the conclusion section.

CHAPTER 1
CLIMATE CHANGE AND AGRICULTURE

Climate is a dynamic component of agricultural production that plays an active role in many factors, from the quantity to the type of product to be grown (Akyüz, 2019). Since climate is a fundamental factor in agricultural production, agricultural product diversity differs and is shaped according to the climate of that region. However, unlike factors such as irrigation system and quantity, seed quality, sowing time, and frequency during agricultural activities, climate is a factor that cannot be intervened in and whose impact cannot be reduced. Therefore, even minimal changes in the climate will affect agricultural activity in that region. In this case, it is evident that agriculture is the most crucial sector most affected by climate change (Akyüz, 2019). Undoubtedly, this adverse impact on agriculture will manifest in several ways. Among these, the most significant and critical issue is malnutrition, which is one of the most common and significant problems in the entire world, even today. The Food and Agriculture Organization (FAO, 1999) states that in the 1990s, 800 million people in developing countries did not have sufficient food. Unfortunately, despite improved food technologies, more than one billion people are currently undernourished, and this situation is expected to worsen further. Therefore, food security is at extreme risk due to the adverse effects of climate change on agriculture. The World Agriculture Organization defines food security as the physical and economic access of all people to nutritious, healthy, and safe food so that they can lead active and healthy lives. (Akalın, 2014). Therefore, a possible food crisis and the endangerment of food security will create broader social, political, and economic problems on a global scale. Climate change scenarios provide us with foresight about possible agricultural impacts of climate change as well as food security. According to the climate change scenarios applied by experts, the increase in temperature and carbon dioxide caused by climate change will decrease the quality and quantity of agricultural yield in the long term. In addition, extreme natural events arise from climate change, which adversely affects agricultural yield. Therefore, to mitigate the possible decline in agricultural yield due to climate change, efficiency in agricultural production needs to be improved. Global projections suggest that developing countries will be affected adversely by the rise in temperature (Akalın, 2014).

1.2. CLIMATE CHANGE SCENARIOS

Ministry of Forestry and Water Affairs (MFWA, 2016) created climate projections for Türkiye using HadGEM2-ES, MPI-ESM-MR models, and CNRM-CM5.1 models. The projections were simulated for two climate change scenarios, RCP4.5 and RCP8.5. By using these models and both emission scenarios, MFWA (2016) found that there will be severe warming over Tukey in 2015-2100. In the years 2091-2100, under the RCP4.5 scenario, the temperature is expected to increase at 3.4°C, 2°C, and 2.5° for the three models mentioned above, respectively. For higher emission rates, RCP8.5 scenario, the increases are observed as 5.9°C, 4.5°C, and 4.3°C. When examined regionally, it is evident that the highest temperature increase will be in the Southern parts. For example, temperature increases in the east and southeast are expected to reach 4-6°C by 2100 (MFWA, 2016). Due to the rise in temperature, precipitation in the winter months will occur as rain instead of snow so that the snow-covered areas will decrease, and the snowmelt in the spring will occur earlier than usual. On the other hand, ten years of average precipitation are expected to vary between -50 mm to 40 mm and -60 mm to 20 mm for RCP4.5 and RCP8.5 scenarios (MFWA, 2016). In regional matters, the major decline in precipitation is predicted to be in the East Mediterranean, West Mediterranean, and Ceyhan basin. For the RCP4.5 scenario, expected variations in precipitation are found as %12 for the HadGEM2-ES model and %15 for the MPI-ESM-MR model (MFWA, 2016).

Demir et al. (2008) investigated the climate projections for Türkiye by using the PRECIS model. They used the data of the 1961-1990 period as a reference period to forecast the 2071-20100 period. The simulation results show that Türkiye's mean temperature, except in coastal regions, will be increased by 5-6 °C in the A2 scenario. The rise in the winter season was projected as 4-6°C in the Eastern region and 6-7°C in the Western region. In the summer season, a generally dramatic increase in temperature is expected, up to 8°C. Simulations about precipitation also indicate lousy news, the decline in precipitation was found to be 40%. In the western regions, precipitation rates are expected to decrease more compared to the eastern regions of Türkiye.

It is crucial to subsidize pressurized irrigation systems to have efficient and sustainable irrigation systems. So, the government has a critical role in this situation (Çetin, Doğanay, and Bezdan, 2023). The rise in drought and insufficiency of water results in a decrease in agricultural productivity, which may cause price increases of up to 85% in the food sector all over the world (IPPC, 2022). Chandio, Gokmenoglu, and Ahmad (2021) state that an increase in temperature level is expected to cause a decrease in cereal yields in Türkiye.[1] Using IPCC climate change projections (projected for 2050 for Türkiye's regions by HADCM), estimations have found that crop yields (wheat, barley, corn, sunflower, and cotton) are expected to decrease by 3.8% to 10.1% across all regions (Dellal, McCarl, & Butt, 2011). Agricultural authorities also state that agricultural productivity will decrease by approximately 25% over the next three decades (MAF, 2021). In this sense, adaptation, and mitigation are the two essential headings of the practices in the fight against climate change. Adaptation and mitigation are evaluated as two inseparable parts, like peanut butter and jelly, to have results-oriented work. The Ministry of Agriculture and Forestry (MAF) has been organizing “Climate Change and Agriculture Workshops” since 2021. The aim of the workshops is to raise the awareness of the entire agricultural sector against climate change's effects on agricultural enterprises and natural resources, to analyze the current situation, and to identify the necessary practices to create a sustainable agricultural production system and to offer solutions. The content of the solution suggestions in these region-based workshops is specific to the geographical structure of the region and the agricultural products planted. However, the widespread use of modern pressurized irrigation systems, especially the drip irrigation system, is an issue that was agreed upon and particularly emphasized in all workshops.

Nuri Balov and Altunkaynak (2019) investigated the future variations in extreme precipitation rates by using precipitation data from the 1971-2000 period and daily precipitation obtained from three GCMs’ daily downscaled outputs. The core location of the study was nine meteorological stations in the western Black Sea basin of Türkiye. The used GCMs are HadGEM2-ES, GFDL-ESM2M, and MPI-ESM-MR. The result of the estimations under emission scenarios of RCP4.5 and RCP8.5 for the years 2070-2099 shows that total precipitation will not change, but there will be a severe rise in the

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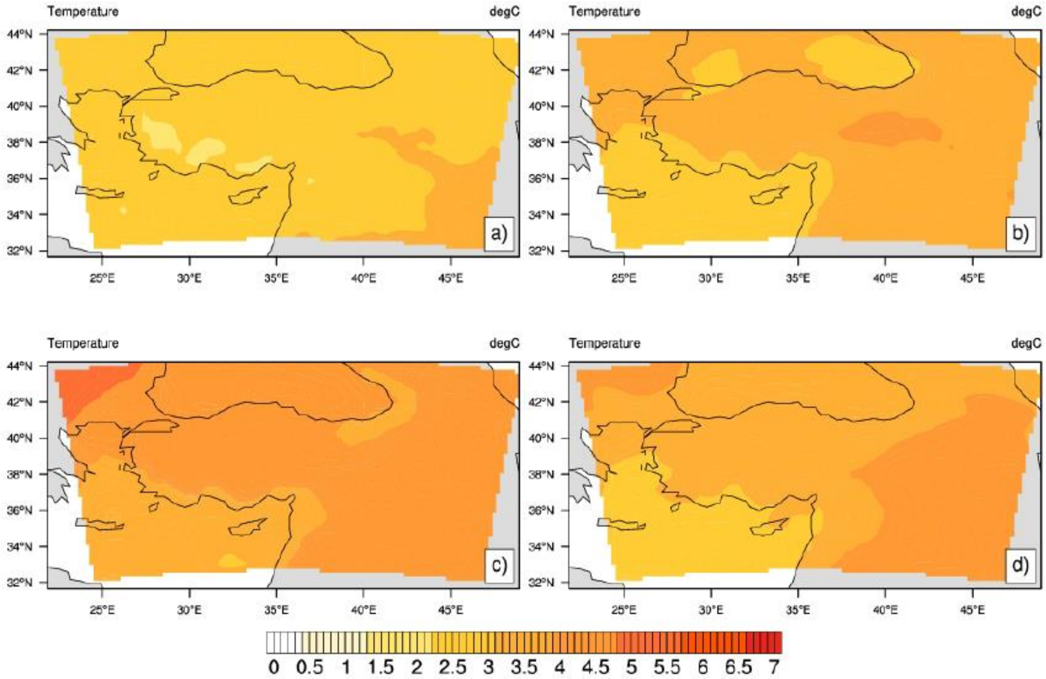
[1] *See also* Sen, B., Topcu, S., Türkeş, M., Sen, B., & Warner, J. F. (2012). Projecting climate change, drought conditions and crop productivity in Türkiye. *Climate Research*, *52*, 175-191; Dumrul, Y., Kilicarslan, Z., (2017). Economic impacts of climate change on agriculture: empirical evidence from ARDL approach for Türkiye. Journal of Business, Economics and Finance (JBEF), V.6, Iss.4, p.336-347; Karahasan, B. C., & Pinar, M. (2023). Climate change and spatial agricultural development in Türkiye. *Review of Development Economics*.

frequency and magnitude of extreme precipitation events. The magnitude of extreme precipitation events is expected to rise. Specifically, the magnitude of storms is projected to increase by 27-31.29% under the RCP4.5 scenario and by 31.29-43.51% under the RCP8.5. Additionally, Öztürk, Türkeş, and Kurnaz (2011) projected changes in mean temperature and precipitation for the years 2070-2100 relative to the 1970-2000 period using the RegCM4.3.5 (Regional Climate Model). The HadGEM2 (Hadley Global Environment Model 2) was used for data input in the regional climate model. Figure 1 and Figure 2 present the projections of the temperature rate under RCP4.5 and RCP8.5 emission scenarios.

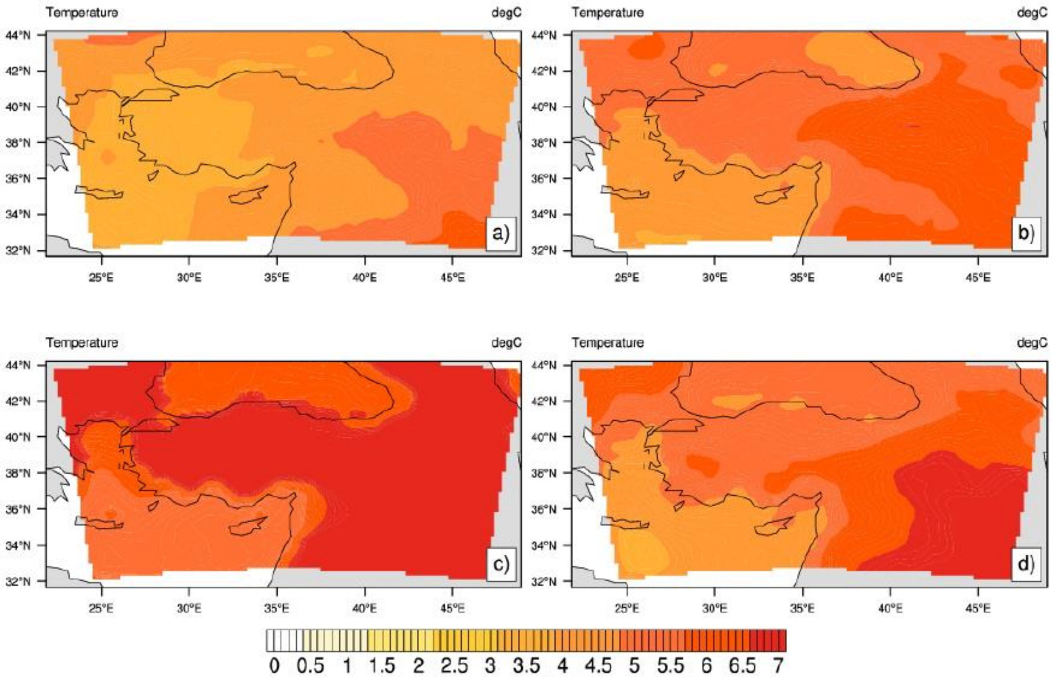
Figure 1. Projected mean air temperatures with RCP4.5 scenario for 2070-2100.



Source: Adapted from Öztürk et al. (2011)
Note: The panels show changes for (a) winter, (b) spring, (c) summer, and (d) autumn seasons.

Under the RCP4.5 scenario, it is expected that summer temperatures during the period 2070-2100 will increase by 4-6.5°C compared to the reference period (Öztürk et al., 2011). The anticipated average temperature rise for the winter season is approximately 3.5°C. Moreover, temperature increases during the spring and autumn seasons are projected to reach up to 4-4.5°C. In contrast, under the RCP8.5 scenario, the average temperature increases are projected to be higher than those in the RCP4.5 scenario. For the period 2070-2100, summer temperatures are projected to increase by 5.5-7°C. The temperature rise in the winter season is around 4.5°C, while for the spring and autumn seasons, it is observed to be between 5-7°C (Öztürk et al., 2011). scenario (Nuri Balov & Altunkaynak, 2019).

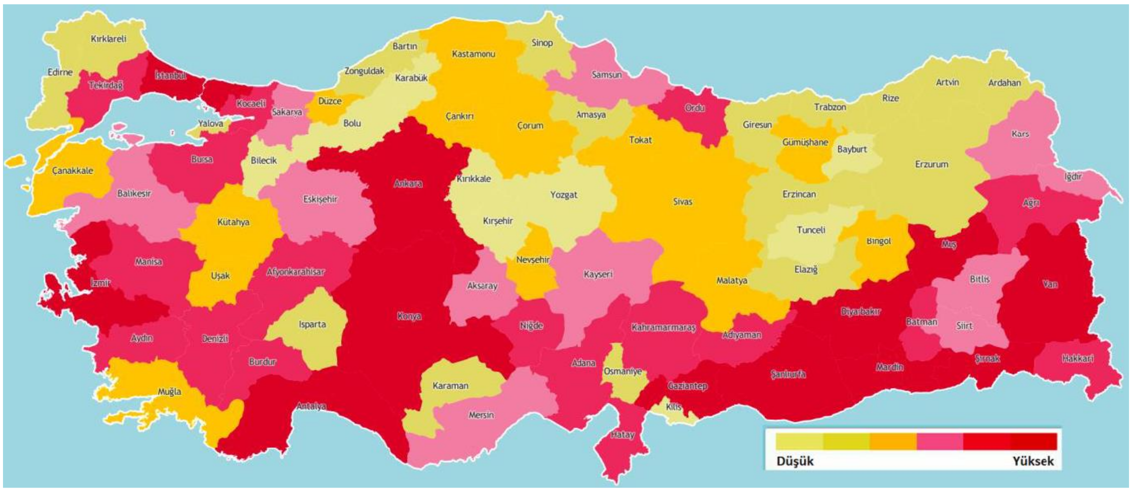
Figure 2. Projected mean air temperatures with RCP8.5 scenario for 2070-2100.



Source: Adapted from Öztürk et al. (2011)

Drought is a natural event that appears when there is deficiency of precipitation from normal level. This low level of precipitation rate causes hydrological imbalances, which have an adverse impact on land resources and production systems. Drought becomes a disaster if environmental effects coincide with effects on local people (Wilhite & Pulwarty, 2017). Meteorological drought can be defined as drought combined with raised temperature and lower humidity. Agricultural drought occurs when irrigation water and soil moisture are insufficient for agriculture, usually appearing after a long meteorological drought period (Kurnaz, 2014). There are 4 types of drought events: meteorological, hydrological, agricultural, and socio-economical droughts. Long-term drought events (longer than two years) can cause a decrease in groundwater and reservoir amount and level, a rise in water pollution, an increase in soil erosion, a rise in forest fires, biodiversity loss, an increase in the vulnerability of agricultural ecosystems (Türkeş, 2020; Öztürk, 2011). Türkiye is considered a medium to high-risk country when evaluated based on current climate and climate variability, as well as future climate change and variability (Türkeş, 2020; Öztürk, 2011). Determining and qualifying (frequency, severity/magnitude, duration, and geographical distribution) the drought is a complex process. In this process, many climatological, hydrological or meteorological indicators and indices are used in order to determine and qualify drought.

Figure 3. Drought Hazard/Disaster Social Vulnerability Index for Türkiye



Source: Adapted from Türkeş (2017)

Türkeş (2017) assessed the risk of drought potential for Türkiye using the drought risk formula and the Social Precipitation Index (SPI) estimations based on drought occurrence probabilities. As shown in Figure 3, provinces in the middle of Aegean (i.e., İzmir, Manisa, Aydın), all provinces in the Mediterranean Region except Isparta and Osmaniye; whole of South-eastern Anatolia Region except Kilis; Eastern Anatolia Provinces such as Van, Muş, Ağrı, Şırnak and Hakkari; Konya, Ankara, Niğde, and Eskisehir provinces in Central Anatolia; and Istanbul, Bursa, Tekirdağ and Kocaeli in the Marmara have highest Drought Hazard-Disaster scores. Mediterranean geography is one of the most vulnerable locations. Therefore, Türkiye is at higher risk of facing long-term meteorological droughts, and these conditions will worsen as meteorological droughts turn into agricultural droughts. In other words, the agricultural sector in Türkiye will face hard times in the near future (Kurnaz, 2014). Hence, the only way to endure severe problems in the agricultural sector is to take control of agricultural water use by creating a sustainable irrigation system. According to the temperature projections of the Turkish State Meteorological Service (TSMS, 2023), the average annual temperatures of Türkiye are expected to increase by 1.5 – 2.6°C in the period 2016-2099 under RCP4.5. Moreover, the expected rise in temperature for RCP8.5 is 2.5 – 3.7°C. As a result of this warming trend in the atmosphere, there will be more evaporation, droughts, and erratic rainfall

(Tokuşlu, 2022). The expected rise in extreme meteorological events due to climate change is also a critical concern. Flooding, avalanches, extreme colds, storms, hail, lighting, drought-extreme heat, fog, and excessive snow are effective meteorological disasters in Türkiye (TSMS, 2023).

CHAPTER 2
LITERATURE REVIEW

The effectiveness of the support provided to popularize the drip irrigation system, one of the building blocks of sustainable agriculture, has been examined by researchers in studies carried out in various regions of Türkiye. In a study, Aydın et al. (2019) analyzed the evaluations of farmers who benefited from drip irrigation support in Edirne Province. The study examined factors such as the success status, usage, and legal and economic structure of the drip irrigation support program. The research involved 41 producers who received drip irrigation support in Edirne province between 2012 and 2017, as well as an equal number of producers who did not receive support. The analysis utilized simple calculations (averages, percentages) and multidimensional scaling methods. The results indicated that the most important criteria for farmers, both those receiving support and those not receiving support, in choosing the drip irrigation method were ease of water application, economic conditions, and the characteristics of the water source and irrigation water. Yolal and Değirmenci (2020) assessed grant support applications for pressurized irrigation systems in Yozgat province. They analyzed survey data from 50 producers using frequency tables and descriptive statistics. The research findings revealed that farmers with higher education levels, access to equipment, land ownership, and higher income levels benefited from the grant support program. Additionally, it was observed that younger farmers were more inclined to adopt modern methods. However, farmers using drip irrigation systems expressed complaints about the lack of consultant services. Demircioğlu and Çakmak (2016) evaluated Ziraat Bank's pressurized irrigation supports by surveying 81 producers across 11 provinces in Türkiye. The research revealed that the support system was inadequate, lacking in training and technical services, thus rendering the policy ineffective. Moreover, Yıldız and Yürdem (2017) conducted a survey among businesses using drip irrigation systems in the Kemalpaşa District of İzmir Province to assess the producers' knowledge level regarding the system's usage. They found that producers had low awareness of drip irrigation system projects and predicted energy and water savings were not achieved due to incorrect installation and unconscious irrigation frequency. Policies aimed at popularizing soil analysis have garnered the attention of many researchers. Surveys conducted in various regions have examined the effectiveness of the soil analysis support policy, particularly the requirement for soil analysis as a prerequisite for receiving fertilizer support in the 2014-2016 period. For instance, Küçükkaya and Özçelik (2014) investigated the effectiveness of soil analysis support on businesses in the Gölbaşı District of Ankara Province using Chi-Square and t-test methods. The study examined producers' soil analysis and fertilizer consumption, knowledge, socio-economic characteristics, and interactions with extension staff. The research found a positive relationship between the production area and the rate of soil analysis. Additionally, the study highlighted the need to establish a control mechanism regarding fertilization, particularly based on soil analysis results. Şahinli et al. (2016) conducted surveys with farmers who had and had not undergone soil analysis in Cihanbeyli, Ilgın, Karatay, and Seydişehir Districts of Konya Province. They examined the fertilizer use behavior of farmers using dummy regression analysis. The research revealed that 60% of farmers who had undergone soil analysis and 72% of those who had not analyzed their soil did not apply fertilization according to the analysis results but based on their own experience. Çarkacı et al. (2016) investigated soil analysis support from a socio-economic perspective by comparing the fertilization practices of farmers who received support and those who did not in Konya province. The analysis of research results revealed that only 16.66% of farmers who had undergone soil analysis applied fertilization in accordance with the analysis results. Consequently, it was concluded that mere policy implementation is inadequate, and additional training and awareness-raising activities are necessary to increase producers' awareness. Tanrıverdi and Çelik (2016) also investigated the reasons and approaches of producers for soil analysis by conducting a survey to determine the effect of soil analysis support in Çumra District of Konya Province. The study found that 52% of farmers who had undergone soil analysis fertilized according to the analysis results. Çönoğlu et al. (2016) surveyed farmers in Ödemiş and Bayındır Districts of İzmir Province to evaluate the application results of soil analysis support based on field data. The findings revealed that the rate of soil analysis was quite low, with the main reasons being the producers' preference to fertilize based on their own experience and the difficulty of accessing laboratories during the soil analysis process. Yüzbaşıoğlu (2019) investigated the situation of producers having soil analysis in the Central District of Tokat Province. Data obtained from surveys conducted with 88 producers showed that 80.68% of farmers do not have soil analysis done, as they rely on their own experience. Altıntaş and Altıntaş (2012) also conducted a survey with producers in Tokat Province, examining soil analysis support from a socio-economic perspective. Chi-square analysis, G test, and fit analysis methods were used. The analysis revealed that farmers who cultivate rented land, have low levels of social participation and environmental relations, belong to low-income groups, and have low soil analysis awareness do not benefit from soil analysis support. In another study, the soil analysis and fertilization practices of producers were examined with survey data collected from 379 farmers residing in the Central District of Kahramanmaraş Province (Kızıloğlu and Kızılaslan, 2017). The findings indicated that the general tendency was to fertilize based on the producers' own experiences. Researchers attributed this to the lack of sufficient information about soil analysis among producers. Özdemir et al. (2022) conducted a survey with farmers in 10 provinces of Türkiye to evaluate the consequences of soil analysis and fertilizer support applied in 2015. The impact evaluation method used included maximum likelihood and a two-stage estimator. The research found that fertilizer support motivated producers to fertilize efficiently. Additionally, the analysis conducted in terms of gross income revealed that if all surveyed producers benefited from fertilizer support, an additional gross income of 491.36 TL/daa could be obtained (Özdemir et al., 2022).

Only the current situation was analyzed in the survey studies, and a program or structure that eliminated the deficiencies aimed at changing more effective and productive behavioral decisions was not presented. However, the fieldwork in this research aims to provide a program or policy proposal to change the current situation, influencing producer behavior decisions that producers will voluntarily implement to maximize their profits.

Discrete choice experiments accompanied by these models have been used by researchers in many fields of economics. Especially in health economics, it has been prevalent since the last decade of the 20th century (Ryan & Hughes, 1997; McKenzie, Caims & Osman, 2001; Longworth, Ratcliffe & Boulton, 2001; Gyrd-Hansen, Slothuus, 2002; Hjelmgren & Anel, 2007; Cheraghi-Sohi et al., 2008; de Bekker-Grob et al., 2008; Prosser et al., 2013; Jiang et al., 2022). The DCE model is also widely used in transportation (Louviere & Hensher, 1982; Louviere & Woodworth, 1983; Truong & Hensher, 1985; Monchambert, 2020; Will et al., 2022), environmental economics (Borchers, Duke, and

Parsons, 2007; Hoyos, 2010; Cicia et al., 2012; Botelho et al., 2018; Lee, Yoo, and Huh, 2020), energy economics (Komarek, Lupi, and Kaplowitz, 2011; Susaeta et al., 2011; Soliño et al., 2012; Kaenzig, Heinzle, and Wüstenhagen, 2013; Vecchiato & Tempesta, 2015), marketing (Holm et al., 2016; Möser, Glauser, and Becker, 2019; Abshiro et al., 2021; Lehmann et al., 2021; Oliveira et al., 2021) and more recently, agriculture sectors. Studies related to the agricultural sector can be broadly categorized under a few subheadings: Agricultural insurance (Möllmann, Michels, & Musshoff, 2019; Ali et al., 2021), climate change mitigation and adaptation (Pröbsel-Haider et al., 2016; Zemo & Termansen, 2018; Block, Danne, & Mußhoff, 2024), food choice (Ara, 2003; Erdem, 2015; Dennis, Tonsor, and Lusk, 2021), agricultural credit (Ding & Abdulai, 2018; Kong et al., 2020; Ogouvide et al., 2020; Sarfo et al., 2021) and landscape (Schaak & Musshoff, 2020).

In this context, the number of studies using DCE in the field of agriculture worldwide is considerable and shows a clearly increasing trend. However, this is not the case for Türkiye. A literature review revealed only one study that used DCE in the agriculture sector, a PhD thesis (Akyüz, 2019). Akyüz (2019) analyzed the behavior and perception of farmers toward adaptation policies for climate change. The study focuses on the Küçük Menderes basin in Türkiye. When the participant responses regarding the irrigation method, seed use, fertilizer use, and payment alternatives created for the choice experiment method were examined, it was determined that the irrigation method was the most crucial alternative for farmers, followed by seed, fertilizer, and payment alternatives. Among the irrigation method alternatives, farmers considered the use of drip irrigation systems more accurate. In this context, it was found that farmers are willing to pay 439.13 TL per year for the use of drip irrigation systems instead of traditional irrigation (Akyüz, 2019). On the other hand, international studies have shown that the choice experiment method, increasingly popular among researchers, is preferred in many countries to analyze producer and consumer behavior. This method, which can also analyze producers' willingness to pay for the choices offered when cost data is added, provides effective analysis results to researchers. Therefore, the choice experiment method is a practical experimental economics approach that can be used to determine policies for achieving a sustainable agricultural system or to improve existing policies. For instance, Blasch et al. (2022) determined the willingness of producers to pay for the use of precision agriculture technologies, which help reduce producer costs and the environmental impact of agriculture by decreasing fertilizer use and water consumption, using the choice experiment method. In this study, conducted through face-to-face interviews with 250 randomly selected producers in Italy, it was found that pioneer farmers who have been using precision agriculture technologies for a long time have a significant influence on the preferences of other producers. Schaafsma et al. (2019) investigated the preferences of producers in Malawi regarding different planting techniques and tree planting options to increase resilience to climate change and soil fertility using the choice experiment design. The findings revealed that the probability of choosing one of the CSA (climate-smart agriculture) packages increased as the credit level increased. Moreover, Liesivaara and Myyrä (2014) examined the willingness of producers in Finland to pay for grain insurance using the choice experiment. Participants' responses indicated an inelastic demand for grain insurance. Similarly, Doherty et al. (2021) investigated Irish producers' preferences for grain insurance against extraordinary natural events using the choice experiment method. The study also analyzed the effectiveness of publicly supported climate risk insurance in the country and found that young producers, producers in specific regions, and producers previously affected by extraordinary natural events were more willing to take out insurance.

Various policies using the behavioral economics approach can influence farmers' behavioral decisions in various agricultural practices and contribute to a rapid and effective transition to a sustainable agricultural system against the potential effects of climate change. However, very few studies have been conducted in this context. One of these rare studies is by Duflo et al. (2011), who managed to increase the amount of fertilizer used by producers with the ‘nudge’ strategy in a field study in Kenya. The SAFI program was created to ‘nudge’ producers, offering the opportunity for a field officer to visit farmers immediately after harvest to receive a fertilizer voucher at market price but with free delivery. During the visit, the producer must decide whether to participate in the SAFI program and receive the desired amount of fertilizer. To mitigate constraints in short-term liquidity, which affects the producer's decision, the option of paying in cash or corn (at market price) was offered. Participants received receipts indicating the delivery date and the amount of fertilizer purchased. Opting for late delivery through this program provided a more substantial commitment to fertilizer use, as the fertilizer could potentially be resold for some cost, and the coupons themselves were non-transferable. Additionally, according to Duflo et al. (2011), fertilizer use costs are decreased by reducing the producer's travel costs and the time spent considering using the SAFI program. To test the model's predictions, the SAFI program was implemented as part of a randomized field trial in two versions over two seasons, in 2003 and 2004. The research found that 31% of producers offered SAFI in the first season and 39% in the second season purchased fertilizer through this program. The SAFI program increased adoption in Season 2 by 10.5 percentage points (Duflo et al., 2011). This demonstrates that with a slight "nudge," farmers' behavioral decisions were affected, achieving the target result of increasing fertilizer use. Chabé-Ferret et al. (2019) investigated whether social comparison incentives would encourage water-saving behavior among farmers as a complementary element to the traditional measures of European Union CAP. They conducted a randomized controlled trial among 200 farmers equipped with smart irrigation meters in southwest France. In the experiment, individual and collective water consumption information produced by intelligent meters was sent to farmers weekly to ‘nudge’ them. At the end of the study, Chabé-Ferret et al. (2019) pointed out that producers who would not consume water to do so are encouraged by the ‘urge’ of social comparison. Moreover, it deters producers with high water consumption from exceeding 80% of their quota by influencing their irrigation behavior decisions. In another field study, a ‘nudge’ strategy was applied via letter to encourage Nebraska agricultural operators to register with the US Department of Agriculture's Conservation Stewardship Program (CSP) (Czap et al., 2019). Different versions of a recruitment/registration letter were sent to producers in 36 Nebraska counties where CSP enrollment is historically low. The study used a standard letter and a nudge letter from the NRCS, the administrator of the CSP. Standard letters were sent to 1079 farmers, and nudge letters were sent to 1084 farmers. The expressions of empathy in the nudge letters were sent in two different ways: photocopies and personalized manuscripts. The study found that letters doubled program enrollment rates compared to the control group (no letters were sent), and the result was statistically significant. When looking at the pairwise comparison of the rates, it was observed that the difference between the photocopy and handwritten empathy impulse is statistically significant and that the handwritten empathy impulse led to a higher number of applications (Czap et al., 2019). Moreover, Peth et al. (2018) aimed to increase compliance among German farmers with the minimum distance to water rule using the ‘nudge’ strategy. At the end of the study, Peth et al. (2018) pointed out that nudging has a preventive effect, causing a decline in the share of non-compliant participants and illegally fertilized areas. A review of the studies indicates that changes can be achieved in the behavioral decisions of individuals by using the factors obtained from the analyses aimed at influencing the behavioral decisions of the producers. Therefore, it is essential for policymakers to consider this issue when producing agricultural policies. It seems that policies that include factors that may affect farmers' behavioral decisions will be more successful in terms of effectiveness.

CHAPTER 3
METHODOLOGY

3.1. DISCRETE CHOICE EXPERIMENT DESIGN

The fundamental part of the study was to elicit the producers' willingness to adopt a drip irrigation system and conduct soil analysis, as well as their preferences for specific indicators such as interest rate, potential increase in yield, credit amount, etc. In this context, the method used to perform this analysis was the discrete choice experiment (DCE). The discrete choice experiment is one of the experimental economics methods used in health economics, water, transportation, tourism, and agriculture studies, and its usage area and popularity are increasing in the scientific community (Čop & Njavro, 2022). The basis of this technique is Lancaster's value theory and random utility theory (Lancaster, 1966). The DCE is a method in which participants are asked to indicate their preferences among two or more attribute alternatives. The value of these alternatives may be attributable to changes beyond current markets or conditions. In this respect, it is quite different from rational choice. The standard economic model of rational choice assumes that, in decision-making, individuals maximize their utilities by identifying available options and then choosing the most preferred one (Johnston et al., 2013). In a chosen experiment, participants are typically asked to complete a series of choice sets consisting of two or more options, each containing neither option (Schaafsma et al., 2019; Lancsar, Fiebig, and Hole, 2017). The choice of participant shows the importance of attributes statistically. Additionally, if there is an attribute that contains price, the willingness to pay for changes in each of the attributes can be predicted by choice experiment analysis (Schaafsma et al., 2019).

3.2. EMPIRICAL MODEL

The random utility framework is the baseline of all econometric models used to analyze discrete choice experiments. The main assumption of the theory is that a decision-maker always chooses the alternative with the highest benefit to maximize utility (Lancaster, 1966; McFadden, 1974; Train, 2009). In this context, to analyze consumer behavior data, there are several discrete choice models such as multinominal logit model (MNL; McFadden, 1974) nested logit model (McFadden, 1978), conditional logit model

(McFadden, 1974), latent class model (McFadden, 1986), and mixed logit model (Revelt & Train, 1998; McFadden & Train, 2000; Hensher & Greene, 2003). These models are derived under the utility maximization behavior assumption, and therefore, they are also referred to as random utility maximization models.

The following equation is the baseline form of the random utility theory; therefore, it is a random utility maximization model.

(1) $$U_{ij} = V_{ij} + \varepsilon_{ij};\ i = 1, \ldots\ldots, N;\ j = 1, \ldots., J$$

Equation 1 represents the utility that decision-maker i derives from choosing an alternative j, where there are N decision-makers selecting from J alternatives. As demonstrated, the random utility function has two components: a representative utility (deterministic) component, V_{ij}, and a stochastic disturbance component, ε_{ij}, which represents the unobserved part. The deterministic component, V_{ij}, is specified as a linear index and also called the systematic component, which contains two parts: the first part is the vector of attributes, x'_{ij}, and the second part is s'_i, which represents a vector of characteristics specific to the individual:

(2) $$V_{ij} = x'_{ij}\beta + s'_i\gamma_j$$

Utilities are intrinsically stochastic due to the random component. Therefore, the probability that decision-maker i will choose alternative k can be predicted. The following function represents the probability that individual i chooses alternative k over all other alternatives j:

(3) $$\begin{aligned} P_{ik} &= Pr\left[U_{ik} > U_{ij}, \forall j \neq k\right] \\ &= Pr\left[V_{ik} + \varepsilon_{ik} > V_{ij} + \varepsilon_{ij}, \forall j \neq k\right] \\ &= Pr\left[V_{ik} - V_{ij} > \varepsilon_{ij} - \varepsilon_{ik}, \forall j \neq k\right] \end{aligned}$$

Equation 3 also states that the probability of an individual i chooses alternative k equals to the probability that the systematic and random components of all other alternatives compete with alternative k. Therefore, after some algebraic manipulations, the logit choice probability expression is obtained:

(4) $$L_{ik} = \frac{e^{(V_{ik})}}{\sum_{j=1}^{J} e^{(V_{ij})}}$$

3.2.1. Mixed Logit Model

In this study, the mixed logit model (MXL) is applied to analyze DCE data using the statistical software NLOGIT and R. The multinomial logit and mixed logit (also called random-parameters logit) models are the most well-known among various models of discrete choice experiments (Traets, Sanchez, & Vandebroek, 2020). The multinomial model is also the most basic model used in the analysis of stated preference choice data (Erdem, 2015). However, the multinomial logit model has extremely strict, restrictive assumptions: the stochastic disturbance component, ε_{ij}, is an independent and identically distributed (i.d.d.) term, which implies that all decision-makers have homogeneous preferences. According to this assumption, error components of various alternatives cannot be correlated. This assumption leads to the property of Independence of Irrelevant Alternatives (IAA; Revelt & Train, 1998; Hensher & Greene, 2003; Train, 2009). In contrast, the mixed logit model can approximate any random utility model due to its highly flexible characteristics. The main assumption of the mixed logit model is that unobserved factors of utility comprise two components: a part that follows any distribution (normal, log, truncated, and uniform) specified by the researcher and a part that is i.i.d. extreme value (Revelt & Train, 1998; Train, 2009). Thus, the mixed logit model allows heterogeneity across preferences. Therefore, with behavioral realism, the mixed logit model is more consistent than the multinomial model (Block ext al., 2024).

The mixed logit probability specification is exact as the specification of the standard logit model except that in the mixed logit model, β varies over individuals rather than being fixed. Utility-maximization behavior implies that individual know their own β_i and ε_{ij} values for all alternatives and chooses alternative k if and only if $U_{ik} > U_{ij}, \forall j \neq k$. In the standard logit model, the β_i can be observed by the researcher since the multinomial logit model assumes ε_{ij}'s are iid extreme values. In this case, the probability of conditional on β_i is:

(5) $$L_{ik}(\beta_i) = \frac{e^{\beta_i{}' x_{ik}}}{\sum_j e^{\beta_i{}' x_{ij}}}$$

However, if the researcher does not know β_i, cannot condition on β. At this point, the unconditional choice probability function is used, which is evaluated by taking the integrals of the logit probability, $L_{ik}(\beta_i)$, over all parameters of β_i:

$$(6) \qquad P_{ik} = \int \left(\frac{e^{\beta_i{}' x_{ik}}}{\sum_j e^{\beta_i{}' x_{ij}}} \right) f(\beta)\, d\beta,$$

where $f(\beta)$ represent the density function. Thus, the mixed logit probabilities equation is obtained. In the MXL model, the distribution of the coefficients is specified, and the distribution of those parameters is estimated by the researcher. The distribution of the coefficients, $f(\beta)$, can be set as normal, lognormal, truncated normal, and uniform. The distribution of the coefficients has been specified to be lognormal or normal in most applications, such as Revelt & Train (1998), Erdem (2015), Lancsar et al. (2017), Blasch et al. (2022)

3.3. SURVEY DESIGN

3.3.1. Attributes

In the study, three different options were created by adding soil and mobile soil analysis options to the drip irrigation system loan in the Modern Pressurized Irrigation Loans program provided by Ziraat Bank. With the choice experiment method, farmers' willingness to choose three options with some specific attributes will be measured. These specific attributes are a potential increase in yield, agricultural consultancy advice, credit amount, interest rate, the start time of loan repayment, and the loan's maturity. These are the most relevant attributes that could affect the adaptation of drip irrigation and soil analysis within the specified program. These attributes had to meet the three specified characteristics: first, they must characterize the various types of drip irrigation and soil analysis packages; second, they must be relevant to farmers' decisions to adopt, as stated by farmers participating in focus groups; and third, they must be relevant to the literature on the determinants of drip irrigation adoption and credit use decisions (Ding & Abdulai, 2018; Kong et al., 2020)

Since there are two attributes with five levels, one attribute with two levels, and four attributes with three levels, the total number of profiles in the study is calculated as

$5^2 \, x \, 2 \, x \, 3^4 \; = \; 4050$. As it is impossible to use all the profiles and ask respondents to select their best option, creating a subset of these profiles is necessary. The most widely used method to construct subset profiles/choice sets (cards) is orthogonal main-effect design (Ara, 2003). Orthogonal design ensures the statistical independence of the attributes by setting all attributes as orthogonal (Johnson et al., 2013). The SPSS software was used for orthogonal design, and 49 choice cards were obtained. In order to have an equal number of tables, one of the cards was randomly selected and removed. The tables were created from the remaining 48 cards by matching two randomly selected cards. Therefore, a total of 24 tables containing 2 different card options were created. These 24 tables were divided into 3 versions, each containing 8 tables, and the participants were asked about their choices in each of the 8 different tables in one of these 3 versions. Drip irrigation is the cornerstone of the packages; the minimum installation cost of the drip irrigation system for an area of 10 decares is around 20 thousand Turkish Lira. 15 thousand Turkish Lira, the cost includes mainline pipes, and the durability of these pipes is 10-15 years, while the durability period of intermediate line pipes costing 5 thousand lira is 4-5 years. In other words, this cost is the cost of a system that can be used for an average of 7 years. In 2024, the standard soil fertility analysis fee performed in the laboratories of the MAF is 600 Turkish Lira for 10 decares of land. It takes 10-12 days for the analysis results to be announced. On the other hand, Doktar company's digital soil analyzer of Dutch origin can analyze a 10-decare land within 30 minutes. In the analysis, 9 soil ingredients, such as body structure, pH, clay, and soil temperature values, can be measured. As a result of the analysis, a product-based fertilization program is created and can be transmitted to your smart devices. The cost of the product reaches 10 thousand euros when the unlimited use license fee is included, so it seems more logical for this product to be supplied by municipalities or cooperatives (there are many municipalities and cooperatives currently using it). While calculating the cost in this study, we took into account that the product would be supplied in this way. Participants were asked to indicate which of the 3 options they preferred for each table from the packages created using this information. While 2 of these 3 options represent different package contents, one represents neither option. As demonstrated in Table 1, the package contents have 3 levels: drip irrigation system, drip irrigation system and soil analysis, drip irrigation system, and digital soil analysis. Another of the attributes used in the selection experiment is the expected change in yield. Research has shown that the drip irrigation system increases crop yield by up to 50%, and as a result of soil analysis, it has been found that crop yield increases by up to 50% thanks to the use of correct fertilizer. In this study, in order to have a realistic research result, the values of the potential change in product yield were taken as 20%, 30%, 40%, 50%, and 60%. Another key attribute is free agricultural consultant support, which is extremely important in using the mentioned systems and is shown as one of the most significant deficiencies in the implemented projects. This consultancy support will be provided for the duration of the loan term. A similar application was made in a loan program created by İş Bank for use in pressurized systems. İş Bank decided to provide an advisory system called ImeceMobil to 100 farmers free of charge. Using the average cost information for a 10 decare area, 20,30,40,50 and 60 thousand Turkish Lira values were assigned to the loan amount. Considering that current interest-free loans may change depending on Türkiye's economic situation, the interest rate attribute was also included in the experiment, and values of 0%, 5%, and 10% were assigned. It has been taken into account that the loan repayment starts after 2 years under current conditions, and again, for economic reasons, values of 0, 1, and 2 years have been assigned to the repayment start period. The payment maturity of the loan, which is our last attribute, takes the values of 4,5 and 6 years.

Table 1. Attribute Levels

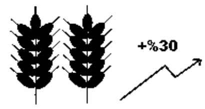
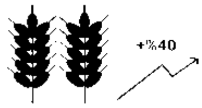
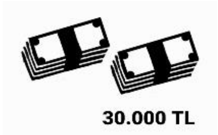
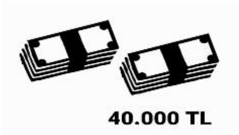
Attribute	No. of Levels	Levels
Packages	3	Drip Irrigation, Drip Irrigation and Soil Analysis, Drip Irrigation, and Mobile Soil Analysis
Potential Increase in Yield	5	20%, 30%, 40%, 50%, 60%
Agricultural Adviser	2	Yes, No
Credit Amount	5	20, 30, 40, 50, 60
Interest Rates	3	0%, 5%, 10%
Repayment Time	3	Same year, 1 year later, 2 year later
Loan Maturity	3	4-year, 5-year, 6-year

Note: The levels of the credit amount attributes are in thousands of Turkish Lira.

3.2.2. Survey

The questionnaire started with filter questions designed to ensure the participation of producers actively engaged in farming, holding decision-making authority in farm operations, and being responsible for making agricultural investment decisions over the next five years. The first part of the survey begins with questions about the characteristics of the participating farmers, such as age, gender, education level, and years of farming experience. This part also includes questions on farm characteristics, such as farm type, size, type of ownership, lease agreement, most cultivated crops, type of irrigation, size of irrigated area, and soil analysis. Next, there are two 5-level Likert scale-type questions. The first one is about the reason behind the use of surface irrigation (i.e., low cost per decare, taking less time, inspiration from neighborhoods, ease of irrigation labor, low annual maintenance cost, etc.). The other Likert scale-type question is about investigating the importance of the various problems in the farms of the participants (i.e., irrigation cost, soil analysis cost, difficulty to access credit, low product prices, high input prices [diesel oil, seed, fertilizer, etc.], lack of access to necessary information and insufficient agricultural policies). Moreover, some questions about climate change need to be answered in order to observe the regional effects of climate change. Participants were asked which of the effects of climate change (i.e., increase in temperature, decrease in water resources, drought, decrease in plant nutrients, increase in natural disasters [i.e., floods, erosion], necessary changes in seeds due to heat or disease, increase in plant diseases and decrease in production) they had already experienced, and which effects they expected to occur. Additionally, it is also asked whether farmers had taken any precautions against climate change and, if so, what these precautions were. The second part of the questionnaire is about the choice experiment, so to inform participants about drip irrigation, soil analysis, and other attributes in the experiment, an information page with descriptions of these attributes was provided. Subsequently, respondents were shown the choice cards, an example of which is presented in Figure 1, and were asked for their preferences. Three choice cards that offered two different drip irrigation credit options with various attributes and characteristics (see Section 3.2.1, Table 1, and Figure 4) were shown to the respondents. In the last part of the survey, there are questions related to the conservation of nature and adapting to technological development on a 5-point Likert scale, as well as questions about farm income.

Figure 4. Example Choice Card Presented to the Respondents

	Option A	**Option B**	**None of the two options**
Packages	Drip irrigation and mobile soil analysis	Drip irrigation and soil analysis	Neither
Potential increase in yield			No change
Agricultural consultant advice			No advice
Credit/Cost amount			No credit/cost
Interest rates	%10	%5	No interest
Repayment time	2 years later	1 years later	No repayment
Loan maturity	4-year	4-year	No repayment

Which option would you choose?

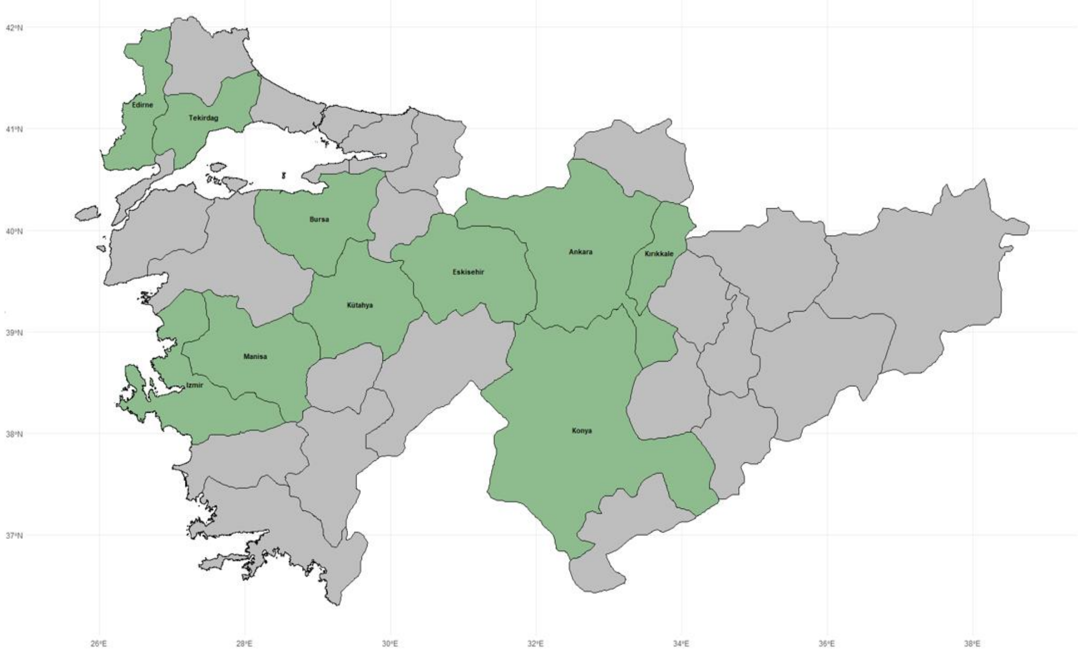
Option A ☐ **Option B** ☐ **None** ☐

CHAPTER 4
DATA

The data for this research was obtained through face-to-face interviews with farmers. The survey was conducted in the provinces of Ankara, Kırıkkale, Eskişehir, Konya, Kütahya, Bursa, İzmir, Manisa, Tekirdağ, and Edirne. The selection of these provinces considered factors such as grain production intensity, irrigated agriculture potential, and the regional impacts of climate change. In this context, the regions most affected by climate change are expected to be Marmara, Aegean, Central Anatolia, Southeastern Anatolia, and the Mediterranean (see Section 1.2, Figure 1, Figure 2, and Figure 3).

The Mediterranean region was excluded from the survey due to the prevalence of greenhouse cultivation, and the Black Sea region was omitted as it is anticipated to be minimally affected or even positively influenced by climate change, according to some studies. The Southeastern Anatolia region was excluded from the survey due to the February 6 earthquake. Consequently, the survey was conducted in provinces in the Marmara, Aegean, and Central Anatolia regions, which have high potential for irrigated agriculture and significant cereal production. These provinces are highlighted in Figure 3 on the map of the Aegean, Marmara, and Central Anatolia regions to indicate the survey areas.

Figure 5. Map of the Aegean, Marmara, and Central Anatolia Regions



4.1. SAMPLE SIZE AND DATA COLLECTION

4.1.1. Sample Size Calculation

Various formulas exist to determine the minimum sample size for DCE. One of the famous methods is the parametric approach of Louviere, Hensher, and Swait (2000). The approach assumes that the study is conducted to measure choice probability with a specific level of accuracy (Louviere et al., 2000; Ara, 2002; de-Bekker Grob et al., 2015). The formula of the approach is:

$$(7) \qquad n \geq \frac{q}{apc^2}\left[\Phi^{-1}\left(1-\frac{\alpha}{2}\right)\right]^2$$

In Equation 7, n represents the minimum required sample size of the study, p is the true population proportion, where $q = 1 - p$, a is the number of the choice sets per decision-maker answered, c represents the relative accuracy (10%, 20%), α is the significance level, and Φ^{-1} is the inverse cumulative normal distribution function. If the relative accuracy, c, is set to 0.1, the significance level is 5 %, and p is 0.6, the minimum sample size is found to be 96.

Another approach in the context of determining the minimum sample size is Orme's (2010) rule of thumb method. The formula of Orme is:

$$(8) \qquad n \geq \frac{500*L}{J*a}$$

This approach is used only when estimating the main effect. In the Equation 8, L represent the maximum number of levels per attribute, J represents the number of alternatives and a is the number of choice sets per decision-maker answered (Ara, 2002). In this study, L is the 5 for Yield, Credit Amount attributes (See section 3.2.1), $J = 3$ and $a = 8$. When these values are put into Equation 8, the minimum sample size is found to be 104.

In the context of the agriculture sector, reaching farmers is often tricky, so in DCE studies targeting farmers as a focus group, the sample size can be quite small. This is a common limitation in this field, e.g., Block et al. (2024) designed their analyses using data collected from 150 German farmers, the sample of study of Möllmann et al. (2019) is 103 German farmers, 148 Austrian farmers in Pröbstl-Haider et al. (2016), Chèze, David and

Martinet (2020) conducted their analyze with the sample of 90 French farmers, 104 French farmers in Jaeck and Lifran (2014), and the sample of the study of Beharry-Borg et al. (2013) is 97 English farmers.

4.1.2. Data Collection

The data of this study was collected between February 17 and May 8, 2024, by visiting farmer coffeehouses in district centers, villages and neighborhoods, and farms. Although there were occasional variations, the survey process generally proceeded in a conversational manner. The survey can be completed in approximately 20 minutes, but due to mutual dialogues, this duration is sometimes extended to 90-100 minutes. It can be inferred that a bond of familiarity was established with the respondents, which ensured that people filled out the survey sincerely. To test the discrete choice experiment model, which is the main focus of our survey, a face-to-face survey was conducted with a total of 17 people in 3 villages of Çelebi District of Kırıkkale. The trial model worked as expected; therefore, the field research continued without making any changes to the survey questions or design. Including the trial process, face-to-face surveys were carried out with producers in ten provinces across three regions of Türkiye: Marmara, Aegean, and Central Anatolia. As shown in Table 2, in the Central Anatolia Region, surveys were performed with a total of 197 farmers from 13 randomly selected districts and 33 neighborhoods/villages in the provinces of Kırıkkale, Ankara, Konya, and Eskişehir. In the Aegean Region, surveys were conducted with a total of 168 farmers from 9 randomly selected districts and 13 neighborhoods/villages in the provinces of Kütahya, Manisa, and İzmir. In the Marmara Region, surveys were carried out with a total of 156 farmers from 10 randomly selected districts and 33 neighborhoods/villages in the provinces of Bursa, Tekirdağ, and Edirne. Therefore, a total of 521 people were surveyed in 79 neighborhoods/villages across 32 randomly selected districts in 10 provinces, including the trial sample. In this manner, the sample size of the study is significantly higher than the required sample size.

Table 2. Number of Surveys by District

Regions	*Province*	District	*Neighborhoods/Villages*	Number of Surveys
Central Anatolia	*Kırıkkale*	Çelebi	*Karabucak, Alıcıyeniyapan, Kaldırım*	17
	Ankara	Polatlı	*Yeniköseler, Beylikköprü, Kıranharmanı, Karailyas*	21
		Ayaş	*Çanıllı, Başayaş*	22
		Beypazarı	*District center, Akçakavak, Kırbaşı, Kayabükü, Acısu, Başağaç, Dikmen, Akkaya*	16
	Konya	Çeltik	*İshakuşağı, Adakasım, Gökpınar*	23
		Sarayönü	*Gözlü*	14
		Altınekin	*District center, Akıncılar*	22
	Eskişehir	Günyüzü	*District center, Yağrı, Kavuncu*	20
		Mahmudiye	*District center, Kaymazyayla, Türkmenmecidiye, İsmetpaşa*	10
		Çifteler	*District center*	8
		Seyitgazi	*Kırka*	7
		Odunpazarı	*Uluçayır, Yenisofça, Yürükkırka, Kargın, Akkaya*	14
		Tepebaşı	*Kızılinler*	3
Marmara	*Bursa*	İnegöl	*District center, Boğazköy, Çitli, Şehitler, Hamzabey, Babasultan,*	18
		Yenişehir	*District center, Çelebi*	17
		Karacabey	*Karakoca, Hotanlı, Ortasarıbey, Yenisarıbeyi, Sultaniye*	14
	Tekirdağ	Süleymanpaşa	*Karacakılavuz, Karaevli, Gazioğlu*	30
		Hayrabolu	*Kurtdere, Delibedir, Soylu, Canhıdır, Bayramşah, Hacıllı*	16
		Malkara	*Yenice, Develi, İbribey*	13
	Edirne	İpsala	*Yenikarpuzlu*	9
		Keşan	*Yenimuhacir, Beyendik, Akhoca, Kılıçbey, Orhaniye, Siğilli*	18
		Uzunköprü	*District center, Hasanpınar*	6
		Havsa	*Oğulpaşa, Abalar*	15
Ege	*Kütahya*	Altıntaş	*District center, Gecek, Alibey, Çayıbaşı, Eymir*	31
		Aslanapa	*District center*	13
		Çavdarhisar	*District center*	14
	Manisa	Kula	*District center, Güvercinlik, Dereköy, Ortaköy, Yurtbaşı*	5
		Salihli	*District center*	6
		Saruhanlı	*District center, Yılmaz, Büyükbelen*	39
		Şehzadeler	*District center*	7
	İzmir	Menderes	*Çileme*	20
		Tire	*District center, Kahrat, Gökçen*	33

4.2. SAMPLE DESCRIPTION

The total number of completed questionnaires is 521. Table 3 provides an overview of the average farmer and farm characteristics, separately for the total sample as well as for the Aegean, Marmara, and Central Anatolia regions. The characteristics of all three regions are pretty similar; therefore, unless there are significant differences, the presentation is based on the full sample.

All of the respondent farmers were male. The average age of farmers was 52. 10 % of farmers were under 33 years old, and 33 % were between 33 and 49 years old, making the proportion of farmers who are middle-aged or younger 43 %. Meanwhile, the proportion of farmers over 65 years old is 17.5%, but this rate shows significant regional differences. The proportion of farmers aged 65 and over is relatively low in the Marmara region, 11 %, and Central Anatolia, 10 %, while it is very high in the Aegean region, 32 %. Still, the average age of the farmers participating in the survey is considerably younger compared to the general age statistics for Türkiye. In 2023, the average age of the 5.162 million farmers registered in the system of the Union of Turkish Agricultural Chambers was 58, with 34 % of them being 65 years old or older. The proportion of farmers aged 33 and younger is only 5 % (Union of Turkish Agricultural Chambers [TZOB], 2023). The educational statistics of the participants show that the proportion of those who completed primary and secondary school is 45% and 19%, respectively. The proportion of farmers with a high school education is 25%, while the proportion of those with undergraduate and postgraduate education is 9.4% and 0.2%, respectively. In regional matters, it was observed that the proportion of farmers with high school and higher education is quite similar for the Aegean and Central Anatolia regions, at 27.9% and 32%, respectively. In the Marmara region, however, the proportion of individuals with high school and higher education is significantly higher than in the other two regions, at 45.4%. According to the statistics on another farmer characteristic, the role on the farm is that 92.5% of the farmers own their operations, while 7.5% work as managers on farms or as employees in cooperatives. When examining the statistics of farm characteristics related to farm type, it is found that 14% of the enterprises are individual operations, 83.9% are family-run farms, and only 2.1% are affiliated with a company or cooperative. According to farm size statistics, the average farm size is 331 decares, of which 210 decares (63%)

is owned land and 121 decares (37%) is rented land. However, 19% of the farms have less than 50 decares of land. 42% of the observations in the sample show a farm size between 50 and 250 decares.

Table 3. Description of the Samples (%)

Farmer characteristics		Full sample	Aegean region	Marmara region	Central Anatolia region
Age	*Below 33 years*	10.0	7.7	14.1	8.6
	Between 33 and 49 years	32.6	18.5	39.7	39.1
	Between 50 and 64 years	39.9	41.7	35.3	42.1
	65 years or above	17.5	32.1	10.9	10.2
Education	*Primary/elementary school*	45.7	54.8	39.0	43.1
	Secondary school	19.7	17.3	15.6	24.9
	High school	25.0	19.6	32.5	23.9
	Bachelor's degree	9.4	8.3	12.3	8.1
	PhD degree	0.2	0.0	0.6	0.0
	Other	0.0	0.0	0.0	0.0
Role on the farm	*Owner of the farm*	92.5	95.8	88.4	92.9
	Manager of the farm/cooperative	7.5	4.2	11.6	7.1
Farm characteristics					
Farm type	*Private farm*	14.0	13.7	5.1	21.3
	Long-established family farm	83.7	80.9	93.6	78.2
	First-generation family farm	0.2	0.0	0.7	0.0
	Part of a farming company/cooperative	2.1	5.4	0.6	0.5
Farm size	*Less than 50 daa*	19.0	32.1	14.1	11.7
	Between 50 and 250 daa	42.0	48.2	46.2	33.5
	Between 260 and 500 daa	22.8	13.7	25.6	28.4
	Between 500 and 1000 daa	10.8	5.4	5.8	19.3
	More than 1,000 daa	5.4	0.6	8.3	7.1

The proportion of farms with land between 260 and 1,000 decares is 33.6%. The proportion of farms with over 1,000 decares of land is only 5.4%. Regionally, the land size of farms in the Aegean region is lower than that in the other two regions. The average farm size in Türkiye is 76 decares (Turkish Statistical Institute [TurkStat], 2018). On the other hand, it is around 610 decares in Germany (COM, 2023), approximately 414 decares in the Netherlands (Van Gelder, 2024), and 1,800 decares in the USA (USDA, 2022). Thus, although the average farm size in the sample surveyed approaches that of European countries, the overall average farm size in Türkiye remains relatively low. When evaluated together with farm-type statistics, it is evident that the agricultural structure in Türkiye is still far from a capitalist structure, with small family farms being quite prevalent.

Table 4. The Five Most Planted Crops for the Full Sample

Crops	Land	Share
Wheat	59,065	34.2
Barley	29,651	17.2
Corn	19,611	11.4
Sunflowers	15,057	8.7
Sugar beet	12,073	7.0
Total	135,457	78.5
Other Crops	37,192	21.5
All Crops	172,649	100

The "All Crops" section represents the total arable land in full sample.

Table 5. The Five Most Planted Crops by Region

Aegean Region			Marmara Region			Central Anatolia Region		
Crops	Land	Share	Crops	Land	Share	Crops	Land	Share
Wheat	6,861	24.6	Wheat	23,166	42.0	Wheat	29,038	32.4
Corn	6,304	22.6	Sunflowers	8,026	14.6	Barley	18,178	20.3
Barley	4,675	16.9	Barley	6,748	12.2	Corn	9,207	10.2
Grape	2,868	10.3	Corn	4,100	7.4	Sunflowers	6,731	7.5
Sugar beet	2,275	8.2	Rice	2,640	4.8	Alfalfa	1,324	1.5
Total	23,033	82.6	Total	44,680	81.0	Total	64,478	71.9
Other Crops	4,822	17.4	Other Crops	10,492	19.0	Other Crops	25,144	28.1
All Crops	27,855	100	All Crops	55,172	100	All Crops	89,622	100

The "All Crops" section represents the total arable land in that region and its share in the full sample.

Table 4 and Table 5 present the statistics of the five most planted crops for the full sample and by region. The ranking of barley, wheat, corn, and sunflower aligns with the national ranking in Türkiye. These were the four most planted crops nationwide in 2023 (TurkStat, 2023). Indeed, according to regional statistics in Table 5, wheat was the most planted crop in all three regions. Although the ranking of corn and barley varies, they are among the top five most planted crops in all three regions. Furthermore, sunflower was the second most planted crop in the Marmara region, while grape was the fourth most planted crop in the Aegean region. These regional sample results also coincide with TurkStat (2023) data.

Table 6. Regional Comparison of Likert-Scale Scores for Farming Challenges.

	Full Sample	Aegean	Marmara	Central Anatolia
Challenges	Scores	Scores	Scores	Scores
Irrigation cost	4.49	4.32	4.13	4.80
Soil analysis cost	3.16	3.00	3.13	3.31
Barriers to credit access	3.66	3.65	3.36	3.90
Low yield	3.50	3.58	3.32	3.58
Low product prices	4.59	4.33	4.69	4.72
High input prices	4.96	4.94	4.94	4.98
Lack of access to information	3.86	3.55	3.85	4.11
Inadequacy in policies	4.80	4.82	4.82	4.77

Note: Scores range from 1 (minor challenge) to 5 (major challenge).

Table 6 above illustrates the ratings of farmers on eight possible challenges they experienced while running their operations, using a 5-point Likert scale (1 represents the minor challenge, 5 represents the major challenge). High input prices, with an average score of 4.96, were the highest-ranked challenge faced by farmers. Soil analysis cost scored the lowest, with a score of 3.16. Remarkably, inadequacy in agricultural policies scored the second highest, with a score of 4.8. Although the regional scores were generally similar, there were significant differences in the scores for irrigation cost and lack of access to information. The irrigation cost score was relatively low and similar in the Aegean and Marmara regions, while it was pretty high in the Central Anatolia region, at 4.8. Another challenge that varies at the regional level is the lack of access to information, which scored lowest in the Aegean region with a score of 3.55 and highest in the Central Anatolia region with a score of 4.11.

Table 7. Regional Distribution of Irrigation Methods

	Full Sample		Aegean		Marmara		Central Anatolia	
	Area	Share	Area	Share	Area	Share	Area	Share
Total area under drip irrigation	33,858	35.7	8,565	43.2	6,195	60.2	19,098	29.6
Total area under sprinkler irrigation	52,280	55.2	6,556	33.0	1,400	13.6	44,324	68.6
Total area under surface irrigation	8,600	9.1	4,723	23.8	2,697	26.2	1,180	1.8
Total irrigated land	94,738	(54.9)	19,844	(71.2)	10,292	(18.7)	64,602	(72.1)

Note: The numbers inside the parentheses show the share of irrigated land in the total land of that sample.

Table 7 presents the regional distribution of irrigation methods. According to the statistics, the total irrigated land is 94,738 decares, which means 54.9% of the land owned by the surveyed farmers is irrigated. In the sample, contrary to the national average in Türkiye, the rates of using pressurized irrigation systems are pretty high: the rate of using drip irrigation is 36%, and the rate of using sprinkler irrigation is 55%. The rate of using surface irrigation is only 9%. However, these statistics vary significantly at the regional level. While 71% and 72% of agricultural lands in the Aegean and Central Anatolia regions are irrigated, only 19% of agricultural lands in the Marmara region are irrigated. In the Aegean and Marmara regions, which were rich in rivers, the rate of using surface irrigation was relatively high, at 24% and 26%, respectively. In contrast, this rate was only 2% in the Central Anatolia region, which is poor in rivers. The use of drip and sprinkler irrigation systems varies depending on the crop. However, in conditions where the water is excessively sandy or gravelly, sprinkler systems can be used as a substitute for drip irrigation systems. This is indeed the reason the use of sprinkler irrigation systems in the Central Anatolia region is much higher than that of drip irrigation systems.

Table 8 below illustrates the conduction of soil analysis and the use of irrigation methods by region. The statistics in the table indicated that 53% of the surveyed farmers conducted soil analysis. When asked about the frequency of their soil analysis, only 18% reported doing it regularly. This value was relatively higher in the Aegean region (27%) because farmers conducted analyses before planting vineyards, and some farmers even mentioned that companies offered free analyses. The proportion of farmers who conducted soil analysis at least once was 17%, and those who did it occasionally were relatively high at 65%. To further detail this question, farmers were asked about the periods in which they conducted soil analysis. Respondents generally mentioned that they conducted the analysis once or a few times after the 2014 law (which mandated soil analysis to benefit from fuel, seed, and soil analysis support). The statistics on the use of irrigation systems are consistent with the statistics on the area of land where irrigation systems are used. Additionally, the proportion of farmers who have the opportunity for irrigated farming but do not use pressurized irrigation systems and are considering using drip irrigation is 44%. At the regional level, this proportion is relatively low and similar in the Marmara and Central Anatolia regions, at 34% and 31%, respectively. However, it is pretty high in the Aegean region, at 76%.

Table 8. Regional Variations in Soil Analysis Conduction and Irrigation Use (%)

		Full Sample	Aegean	Marmara	Central Anatolia
		Share	Share	Share	Share
Conduct soil analysis	Yes	53.4	54.2	56.4	49.7
	-At least one time	(16.9)	(15.6)	(22.1)	(13.3)
	-Occasionally	(65.0)	(57.1)	(64.7)	(71.4)
	-Regularly	(18.1)	(27.3)	(13.2)	(15.3)
	No	46.6	45.8	43.6	50.3
	(want to analyze)	(53.2)	(42.9)	(63.6)	(35.4)
Use drip irrigation		50.7	54.6	44.2	53.3
Use sprinkler irrigation		50.9	44.0	25.0	77.2
Use surface irrigation		24.2	57.1	12.2	5.6
Use either a sprinkler or drip		74.3	76.8	48.1	92.9
Want to use drip irrigation		43.6	75.8	34.1	30.7

Notes: "At least one time," "Occasionally," and "Regularly" indicate the frequency of soil analysis conduction. "(Want to analyze)" displays the share of respondents who have never conducted soil analysis but wish to do so.

Lastly, Table 9 presents the average scores of farmers' responses to questions about expected and experienced impacts of climate change, asked in a binary format (1 if expected or experienced, 0 if not). Almost all farmers both expected and experienced an increase in temperature, a decrease in water resources, drought, an increase in plant diseases, and a decrease in yield across all regions. While 87% of farmers expected a decrease in plant nutrients, 82% experienced it. The expectation was highest in the Marmara region (0.91), but the experience was lowest (0.80) in the same region. 77% of farmers expected a transition to resilient seeds, while 71% experienced it; similar to the decrease in plant nutrients, the Marmara region showed the highest expectation (0.90) and experience (0.78). Expectations and experiences of an increase in natural events were significantly lower, with only 32% expecting it and 22% experiencing it. Marmara and Central Anatolia regions reported higher percentages compared to the Aegean region. Indeed, in the Marmara region, 26% of respondents reported an increase in hail events due to climate change, compared to 9% in Central Anatolia and 6% in the Aegean region.

Table 9. Expected and Experienced Impacts of Climate Change by Region

	Full Sample		Aegean		Marmara		Central Anatolia	
	Exp.	Expd.	Exp.	Expd.	Exp.	Expd.	Exp.	Expd.
Increase in temperature	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Decrease in water resources	0.96	0.95	0.95	0.95	0.93	0.92	0.98	0.98
Drought	0.97	0.97	0.98	0.98	0.95	0.95	0.98	0.97
Decrease in plant nutrients	0.87	0.82	0.82	0.82	0.91	0.80	0.89	0.83
Increase in natural events	0.32	0.22	0.10	0.11	0.42	0.26	0.44	0.28
Transition to resilient seeds	0.77	0.71	0.72	0.69	0.90	0.78	0.71	0.66
Increase in plant diseases	0.93	0.92	0.88	0.88	0.96	0.94	0.96	0.95
Decrease in yield	0.93	0.92	0.90	0.90	0.99	0.99	0.90	0.88

Note: "Exp." stands for "Expected," and "Expd." stands for "Experienced."

Additionally, insufficient snowfall during the winter months and rising temperatures have led to a significant increase in the number of field mice in the Central Anatolia region, particularly in Ankara, Eskişehir, and Kütahya. Of the 197 people surveyed, 75 (38%) reported suffering from this issue. During the survey process, it was observed that there is no practical, effective method agreed upon by farmers for addressing this problem, with even farmers living in the same village offering different solutions. The statistics regarding the questions asked to farmers about whether they take precautions against climate change and what those precautions are reveal that 62% and 60% of farmers in the Marmara and Aegean regions, respectively, take precautions. In contrast, only 35% of farmers in the Central Anatolia region take such measures. Among the adaptation measures taken, two key actions stand out: obtaining agricultural insurance (TARSIM) and using certified seeds. According to the statistics, the rate of obtaining agricultural insurance is 55% in the Marmara region and 24% in both the Aegean and Central Anatolia regions. The rate of using certified seeds is 29% in the Aegean region, while it is 6% in both the Marmara and Central Anatolia regions.

CHAPTER 5
RESULTS

5.1. CHOICE EXPERIMENT

All 521 farmers who participated in the survey answered the choice cards. Of these, 173 farmers (33.2%) never chose one of the drip irrigation credit packages. At the regional level, those who chose the 'none' option for all packages included 78 out of 156 farmers (50%) in the Marmara region, 57 out of 197 farmers (28.9%) in the Central Anatolia region, and 38 out of 168 farmers (22.6%) in the Aegean region. The provinces that increased the rate of never choosing the options in the Marmara region are Edirne, 35 out of 48 farmers, and Tekirdağ, 33 out of 59 farmers. The main reasons cited by farmers for this situation were: (i) the belief that drip irrigation reduces the yield of rice production, which is common in Edirne, by up to 50%; (ii) the perception that the Thrace region being outside the scope of the IPARD project and cannot benefit from any supports; (iii) lack of potential for irrigation in the area; (iv) decrease in water levels of rivers (Maritsa); (v) pollution of the Ergene River due to factory waste, making it unsuitable for agricultural irrigation; (vi) dramatic increase in file fee for credits; (vii) high irrigation costs due to electricity and diesel prices. The following results from the mixed logit model on full samples, regional samples, and provincial samples are presented.

5.2. ESTIMATED RESULTS

A total of 12,504 observations from 521 respondents who opted for the drip irrigation credit packages were initially analyzed using three mixed logit models, each varying according to the explanatory variables they contained. For efficiency reasons, a Halton sequence of 1000 replications (a variance reduction technique) was estimated using the Berndt-Hall-Hall-Hausman (BHHH) maximization method (Ara, 2002; Blasch, 2022). Additionally, in the mixed logit model specification of this study, different models containing various combinations of random parameters and distributions were analyzed to determine which parameters will be random and what their distributions will be. Among these models, the likelihood ratio test indicated that the model with yield, interest rate, repayment time, and loan maturity as random parameters, with the distribution of the parameters set as a normal distribution, and package 1 and package 3 as random parameters, with the distribution of the parameters set as uniform distribution, provides the best fit. The credit attribute can also be included as a random parameter, but this calculates willingness to pay in a much more complex way (Ara, 2002).

5.2.1. Full Sample Estimation Results

Firstly, a mixed model (Model I) containing only the attributes, without a constant term, was run. Then, Model II, which includes a status quo term, was estimated. Finally, Model III, a MXL with statistically significant interaction terms, was analyzed. Table 10, Table 11, and Table 13 report the estimated models, respectively. As shown, the status-quo parameter in Model II is a negative and highly significant constant, indicating that decision-makers strongly prefer taking action by selecting the non-status-quo option.

Table 10. Results of MXL Model I Analysis

	MXL Model I					
Parameters	Coefficient		S. E	Std. R. P.		S. E
Package 1	0.017		0.088	0.744	*	0.364
Package 3	0.006		0.113	1.825	***	0.274
Yield	0.081	***	0.005	0.090	***	0.007
Adviser	0.852	***	0.102			
Credit	-0.000027	***	0.000003			
Interest rate	-0.257	***	0.018	0.164	***	0.022
Repayment time	0.271	***	0.049	0.260		0.161
Loan maturity	-0.177	***	0.043	1.418	***	0.105
Log-likelihood	-2233.3					
N. Observations	4168					

‘***’ Significant at 0%, ‘**’ significant at 0.1%, ‘*’ significant at 1%, ‘.’ significant at 5%
Notes: S.E: standard error, Srd. R. P: standard deviation of the distribution of random parameters.

The level "Package 2," which is one of the levels of the package attribute, is not included in any of the models. As shown in Table 1, the package attribute has three levels converted to dummy variables prior to analysis: drip irrigation (Package 1), drip irrigation and soil analysis (Package 2), and drip irrigation with mobile soil analysis (Package 3). However, due to multicollinearity issues, one of these levels had to be excluded, and analyses determined that removing ‘Package 2’ was the most appropriate course of action.

Table 11. Results of MXL Model II Analysis

	MXL Model II: with constant					
Parameters	Coefficient		S.E	Std. R. P.		S.E
Status quo	-3.466	***	0.472			
Package 1	0.047		0.088	0.752	*	0.361
Package 3	0.008		0.111	1.594	***	0.290
Yield	0.083	***	0.005	0.080	***	0.007
Adviser	0.668	***	0.101			
Credit	-0.000037	***	0.000004			
Interest rate	-0.258	***	0.019	0.164	***	0.022
Repayment time	0.224	***	0.049	0.191		0.197
Loan maturity	-0.734	***	0.085	1.801	***	0.136
Log-likelihood	-2200.1					
N. Observations	4168					

'***' Significant at 0%, '**' significant at 0.1%, '*' significant at 1%, '.' significant at 5%
Notes: S.E: standard error, Srd. R. P: standard deviation of the distribution of random parameters.

In Table 12, the likelihood ratio test comparing Model I and Model II indicates that Model II fits the data significantly better. Therefore, the model with the status quo constant (Model II) was adopted, and the results are interpreted in terms of Model II henceforward.

Table 12. Results of Likelihood Ratio Test

Models	Df	LogL	Df	Chisq	r(>Chisq)
Model I	13	-2233.3			
Model II	14	-2200.1	1	66.4	0.3682E-15***

*** Significant at 0%.

All the attributes of Model II are statistically significant at the 0% level with expected signs, except for package 1 and package 3 parameters. Package 1 and package 3 have positive but insignificant coefficients, which means that when considering all the factors in the model, package 1 and package 3 do not significantly affect the likelihood of choosing a non-status quo option. This result was expected, as during the survey process, it was generally observed that respondents did not prioritize the package contents. Instead, they placed greater importance on the monetary variables, such as credit amount, interest rates, and repayment terms. Moreover, yield (potential increase in yield), adviser, and repayment time have positive and highly significant coefficients, indicating that an increase in yield, having adviser support, and longer repayment time increase the utility of the decision-maker, thus raising the probability of profile selection. In contrast, credit amount, interest rate, and loan maturity attributes have negative coefficients. In general, one would expect loan maturity to have a positive effect, particularly in countries with high inflation like Türkiye. Under conditions of zero or fixed interest rates, extending the loan maturity period should benefit the borrower. However, the surveyed farmers in this study indicated a preference for repaying their loans as quickly as possible despite the potential financial advantages of longer loan terms. This preference stems from a fear of debt; respondents expressed a desire to secure their financial situation by minimizing their debt obligations, even if it means missing out on the potential benefits of more extended repayment periods. Besides, among the attributes, the most important for farmers was agricultural advice. This result was somewhat surprising because, during the survey process, there was a group that said, ‘Of course, we would like an advisor; it would be good,’ while another group said, ‘There is no need for an advisor. Even if they say it is free, they can somehow charge us.’ However, Model II suggests a great deal of preference heterogeneity for most choice attributes, except repayment time. However, the attributes-only model does not uncover the underlying sources of heterogeneity. Therefore, in the MXL III, interactions between attributes and some farmer and farm characteristics are included. According to the statistics in Table 13, all the attributes except package 1, package 3 and adviser are statistically significant. Contrary to MXL model II, repayment time has also been expected sign. Hence, all the parameters have expected signs in the MXL model with interaction terms. Based on the interaction term statistics in Table 13, conducting soil analysis affects the preferences for credit package features. It was found that individuals who conduct soil analysis have an increased effect on the yield coefficient of the selection probability. In other words, farmers who conduct soil analysis place more value on potential increases in yield when making their choices. This is an expected result because farmers who conduct soil analysis and apply a proper fertilization program based on the results are aware that they can achieve higher yields. Additionally, it is estimated that farm size positively affects package preferences, which means that farmers with larger land find the support of an agricultural adviser more valuable. The other interaction term states that the positive effect of having an agricultural adviser on utility is further amplified for individuals who use a drip irrigation system. In other words, individuals who use drip irrigation systems are more likely to choose options that include agricultural adviser support. The lack of agricultural consultancy support in drip irrigation system subsidies is one of the most significant shortcomings, as farmers themselves have highlighted this deficiency in various studies. According to Nalbantoğlu (2014), 20% of farmers who benefited from drip irrigation subsidies installed the system incorrectly. In Yıldız and Yürdem's (2017) study, it was found that farmers performed entirely incorrect and costly procedures during the use of the drip irrigation system due to the lack of agricultural adviser support. In fact, the findings obtained in this study also support this situation, as the coefficient of the interaction term is relatively high, 0.659.

Table 13. Results of MXL Model III analysis

	MXL Model III: with interaction terms					
Parameters	Coefficient		S.E	Std. R. P.		(S.E)
Status quo	-3.672	***	0.495			
Package 1	0.038		0.091	0.918	**	0.327
Package 3	0.014		0.114	1.584	***	0.301
Yield	0.070	***	0.006	0.084		0.007
Adviser	0.128		0.161			
Credit	-0.00008	***	0.000			
Interest rate	-0.273	***	0.020	0.176	***	0.023
Repayment time	0.549	***	0.180	0.202		0.208
Loan maturity	0.171	***	0.129	1.731	***	0.133
Yield * Soil analysis	0.027	***	0.006			
Adviser * Land	0.001	**	0.0002			
Adviser * Using drip irr.	0.659	***	0.182			
Credit * Education	0.000013	***	0.000002			
Credit * Using drip irr.	0.000024	***	0.000005			
Repayment time * Age	-0.006	*	0.004			
Loan maturity * Age	-0.017	***	0.003			
Log Likelihood	-5.964.1					
N. Observations	4168 (521 resp.)					

'***' Significant at 0%, '**' significant at 0.1%, '*' significant at 1%, '.' significant at 5% Notes: S.E: standard error, Std. R. P: standard deviation of the distribution of random parameters.

The interaction terms involving credit attributes suggest that the effect of the credit amount on the selection probability is higher for farmers who are more educated and for those who use drip irrigation systems. On the other hand, as expected, the interaction terms of the Age variable with Repayment Time and Loan Maturity have negative and significant coefficients. This indicates that the effect of repayment time and loan maturity on selection probability decreases with the age of the farmer. In other words, older farmers (risk averse) prefer shorter repayment periods and loan maturities compared to younger farmers. This finding is consistent with the general understanding that older individuals are more risk-averse.

Table 14. Results of MWTP Calculation

Attributes	MWTP
Package 1	127
Package 3	22
Yield	226
Adviser	1,823
Interest rate	-705
Repayment time	611
Loan maturity	-2,001

Note: Calculated using estimated coefficients from Model II.

Table 14 presents the marginal willingness to pay (MWTP) calculated for Model 2. As shown in Table 14, the MWTP of respondents for Package 1 relative to Package 2 is 127 TL per decare. This value is slightly lower for Package 3, at 22 TL per decare, indicating that Package 1 is the most preferred option. The primary reason for this preference is the inclusion of soil analysis in Packages 2 and 3. During the survey, some farmers expressed sentiments such as, "We do not need to conduct soil analysis; I know my soil better than anyone," while others mentioned their distrust in the results from soil analysis laboratories, sharing incidents they experienced. For example, M. Ç., a farmer from Alibey village in Altıntaş, Kütahya, shared an incident he experienced: "To test the reliability of the soil analysis results, I took a soil sample from a specific area of my field and divided it into three parts. Then, I sent these samples for analysis as if they were from three different fields. The results showed significantly different values for each sample even though the soil sample was the same. In my opinion, they do not conduct proper soil analysis and just input random results." Respondents are willing to pay 225 TL per decare for a 1% potential increase in yield. Considering that wheat is the most widely planted crop in the entire sample, it is observed that the yield of the wheat in the surveyed regions ranges from 300 to 1,000 kg per decare, with yields exceeding 500 kg in many regions.

Assuming an average yield of 600 kg per decare and considering that the expected price of wheat this season is 15 TL, a 1% increase in yield could potentially bring an additional income of 90 TL per decare. Additionally, it has been observed that in many surveyed regions, the same field can be planted twice in a season and, in some parts of İzmir, even three to four times. Therefore, a 1% increase in yield could provide an income of 150-200 TL per decare in some regions during the season. To sum up, the analysis results are consistent, and the potential increase in yield has significant importance. The MWTP for the agricultural adviser is 1,823 TL. Agricultural advisory support will be provided in the package for the duration of the loan term. Given that the average loan term is 5-6 years, farmers are willing to pay an average annual amount of 304-365 TL for this support. Therefore, farmers highly value agricultural advisory support. With the help of an agricultural advisor, the drip irrigation system can be used more effectively (reducing costs and increasing yields), and better productivity can be achieved through support during the planting and fertilization processes. In other words, farmers generally recognize the benefits that an agricultural advisor can provide. In contrast, the MWTP of farmers for a 1 percentage point decrease in interest rate was found to be 705 TL. This is also an expected result because, during the survey, farmers complained about the interest rates and the substantial rise in the cost of filing fees for credit. Although these loans are said to be interest-free, Ziraat Bank has significantly increased file fee costs. In agricultural loans, file fee costs, which varied between 2% and 5% on average depending on the type of collateralized asset three years ago, have now reached 15-17%. Another attribute is repayment time; statistics indicate that farmers are willing to pay 611 TL for a 1-year increase in repayment time. This period is one where there are no payment obligations, so farmers prefer an extension of this period. Indeed, the drip irrigation system takes about two years to stabilize and achieve the desired efficiency increase after installation. Therefore, a more extended repayment period is of greater importance to farmers who are aware of this process. On the other hand, the MWTP for the loan maturity attribute is -2001 TL. The negative sign, as previously mentioned, stems from the "fear of debt" impulse. According to the general consensus among farmers, the repayment process should be completed as quickly as possible once it begins. This urgency is due to the inherent uncertainties in the agricultural production process. Any natural disaster could significantly reduce or even nullify the crop yield. Expected increases in grain prices may not materialize, or input prices could rise above expectations. Farmers who are required to mortgage assets far exceeding the value of the loan amount for agricultural credits cannot overlook these potential setbacks.

5.2.3. Regional Estimation Results

Table 15. Results of MXL Model Analysis for Marmara Region

	MXL Model IV				
Parameters	Coefficient		S.E	Std. R. P.	S.E
Status quo	-3.352	**	1.145		
Package 1	0.118		0.244	1.623 *	0.639
Package 3	0.197		0.291	1.737 *	0.787
Yield	-0.134	***	0.031	0.396 ***	0.064
Adviser	0.673	*	0.265		
Credit	-0.000074	***	0.000013		
Interest rate	-0.396	***	0.064	0.156 **	0.055
Repayment time	0.408	**	0.143	0.833 ***	0.232
Loan maturity	-0.107		0.166	0.557 ***	0.118
Log-likelihood	-507.8				
N. Observations	1248 (156 resp.)				

‘***’ Significant at 0%, ‘**’ significant at 0.1%, ‘*’ significant at 1%, ‘.’ significant at 5%

When comparing the results of the full sample with those of the Marmara region estimations, two notable differences stand out: the yield coefficient is negative, and the loan maturity is insignificant, as demonstrated in Table 15. The negative coefficient for yield in the Marmara region may be attributed to the attitudes of farmers in Edirne. Specifically, among farmers who cultivate rice, there is a belief that drip irrigation reduces the yield of rice production by up to 50%. Furthermore, as shown in Tables 16 and 17, the estimation results for the Aegean and Central Anatolia regions are similar to the full sample results. The only difference is that in the Central Anatolia region, the package 1 and package 2 parameters have negative coefficients. However, as with the other samples, the package 1 and package 2 parameters in the Central Anatolia region are statistically insignificant.

Table 16. Results of MXL Model Analysis for Aegean Region

	MXL Model V				
Parameters	Coefficient		S.E	Std. R. P.	S.E
Status quo	-3.456	***	0.960		
Package 1	0.063		0.154	0.770	0.631
Package 3	0.084		0.201	1.818 ***	0.484
Yield	0.101	***	0.010	0.108 ***	0.014
Adviser	0.802	***	0.183		
Credit	-0.000048	***	0.000007		
Interest rate	-0.194	***	0.025	0.098 *	0.042
Repayment time	0.196	*	0.089	0.230	0.301
Loan maturity	-0.218	.	0.126	1.499 ***	0.210
Log-likelihood	-736.3				
N. Observations	1344 (168 resp.)				

Table 17. Results of MXL Model Analysis for Central Anatolia Region

	MXL Model VI				
Parameters	Coefficient		S.E	Std. R. P.	S.E
Status quo	-3.431	***	0.692		
Package 1	-0.001		0.126	0.461	0.832
Package 3	-0.048		0.161	1.380 **	0.437
Yield	0.066	***	0.007	0.057 ***	0.009
Adviser	0.544	***	0.142		
Credit	-0.000018	***	0.000005		
Interest rate	-0.306	***	0.033	0.228 ***	0.036
Repayment time	0.223	**	0.070	0.058	0.762
Loan maturity	-0.547	***	0.121	1.525 ***	0.200
Log-likelihood	-893.5				
N. Observations	1576 (197 resp.)				

Contrary to MXL model results, the MWTP values indicate regional differences in preferences for these critical attributes. Table 18 below illustrates that Central Anatolia has the highest positive values for agricultural advisers and the most negative values for interest rates and loan maturity. This indicates a high demand for immediate and practical financial support and advisory services in the region. In contrast, the Aegean region exhibits lower sensitivity to interest rates and repayment times. The Marmara region shows values close to the full sample for repayment time and interest rate but has a low demand for advisory services. These results reflect regional variations in financial stability and agricultural practices.

Table 18. MWTP Calculation Results by Regions

	Full Sample	Marmara	Aegean	Central Anatolia
Attributes	MWTP	MWTP	MWTP	MWTP
Package 1	-	-	-	-
Package 3	-	-	-	-
Yield	226	-180	210	359
Adviser	1,823	904	1,668	2,977
Interest rate	-705	-532	-403	-1,676
Repayment time	611	548	408	1,220
Loan maturity	-2,001	-	-453	-2,994

5.2.3. Provincial Estimation Results

Table 19. Results of MXL Model Analysis for Bursa

	MXL Model VII			
Parameters	Coefficient	S.E	Std. R. P.	S.E
Status quo	-4.505 **	1.626		
Package 1	0.348	0.370	1.861 *	0.847
Package 3	0.336	0.422	2.084 *	1.063
Yield	0.114 ***	0.025	0.166 ***	0.039
Adviser	-0.169	0.369		
Credit	-0.00007 ***	0.00002		
Interest rate	-0.350 ***	0.084	0.123	0.082
Repayment time	0.287	0.172	-0.035	1.104
Loan maturity	-0.380	0.232	0.654 ***	0.176
N. Observations	392 (49resp.)			

In the analyses conducted for the provinces of Edirne and Tekirdağ (excluding the constant parameter), all attributes were found to be statistically significant. In contrast, the analysis for Bursa Province revealed that only the constant, yield, credit, and interest rate parameters were statistically significant (See Table 19, Table 20, and Table 21).

Table 20. Results of MXL Model Analysis for Tekirdağ

	MXL Model VIII			
Parameters	Coefficient	S.E	Std. R. P.	S.E
Status quo	3.029	2.799		
Package 1	2.941 ***	0.670	39.852 ***	1.055
Package 3	4.270 ***	0.470	52.771 ***	1.057
Yield	0.073 ***	0.020	4.459 ***	0.008
Adviser	20.489 ***	0.370		
Credit	-0.002 ***	0.00002		
Interest rate	-6.435 ***	0.073	-1.555 ***	0.040
Repayment time	2.094 ***	0.302	12.180 ***	0.293
Loan maturity	3.890 ***	0.232	11.267 ***	0.085
N. Observations	472 (59 resp.)			

Table 21. Results of MXL Model Analysis for Edirne

	MXL Model IX			
Parameters	Coefficient	S.E	Std. R. P.	S.E
Status quo	-59.469 *	25.145		
Package 1	-13.520 ***	0.364	64.574 ***	0.573
Package 3	-6.360 ***	0.430	62.176 ***	0.821
Yield	-3.851 ***	0.017	5.125 ***	0.011
Adviser	30.238 ***	0.298		
Credit	0.001 ***	0.00001		
Interest rate	-4.638 ***	0.043	4.216 ***	0.043
Repayment time	3.037 ***	0.216	19.717 ***	0.145
Loan maturity	-46.909 ***	0.233	55.047 ***	0.195
N. Observations	384 (48 resp.)			

There are differences in the signs of the parameters between Edirne and Tekirdağ. The results for Tekirdağ are as expected: the coefficients for package 1, package 2, yield, adviser, repayment time, and loan maturity attributes are positive, while the coefficients for credit and interest rate attributes are negative. However, the opposite is true for Edirne, where the coefficients for package 1, package 2, yield, and loan maturity are harmful, and the coefficient for the credit attribute is positive. Due to the positive value of the credit attribute, the MWTP for Edirne cannot be calculated. Therefore, farmers in Edirne exhibit distinct preferences and sensitivities compared to other regions. On the contrary, the

MWTP estimation results for Tekirdağ are consistent, similar to the full sample, and show expected outcomes.

Table 23. Results of MXL Model Analysis for Kütahya

	MXL Model X			
Parameters	Coefficient	S.E	Std. R. P.	S.E
Status quo	-7.467 ***	2.101		
Package 1	0.222	0.226	0.022	7.551
Package 3	-0.321	0.342	1.701 *	0.806
Yield	0.089 ***	0.014	0.040 *	0.019
Adviser	0.750 *	0.301		
Credit	-0.00004 ***	0.00001		
Interest rate	-0.247 ***	0.044	0.129 *	0.054
Repayment time	0.424 **	0.139	0.024	2.399
Loan maturity	-0.173	0.204	1.558 ***	0.382
N. Observations	464 (58 resp.)			

Table 24. Results of MXL Model Analysis for Manisa

	MXL Model XI			
Parameters	Coefficient	S.E	Std. R. P.	S.E
Status quo	-2.149	1.672		
Package 1	0.136	0.263	0.111	4.713
Package 3	1.277 ***	0.366	0.925	1.243
Yield	0.129 ***	0.022	0.215 ***	0.044
Adviser	1.035 **	0.334		
Credit	-0.00008 ***	0.00002		
Interest rate	-0.157 ***	0.039	-0.005	0.415
Repayment time	-0.098	0.168	0.676 *	0.312
Loan maturity	0.226	0.217	0.772 ***	0.211
N. Observations	456 (57 resp.)			

The analysis results for Kütahya are parallel to those of the full sample. However, the results for Manisa show some differences, with package 3 being statistically significant while repayment time becomes insignificant. In Manisa, the most common crop is vineyards. While drip irrigation cannot be used for older, deep-rooted trees, it can be applied to newly established vineyards. Additionally, nearly all farmers mentioned that they conduct soil analysis before planting their vineyards. At this point, given the usual challenges of traditional soil analysis, such as waiting times and transportation difficulties, it is consistent that farmers prefer the package 3 option, which includes a mobile soil analysis device.

Table 25. Results of MXL Model Analysis for İzmir

	MXL Model XII			
Parameters	Coefficient	S.E	Std. R. P.	S.E
Status quo	-11.712	7.534		
Package 1	-10.666 ***	2.796	29.111 ***	3.600
Package 3	-6.785 *	3.345	-7.920	5.266
Yield	-0.043	0.103	3.249 ***	0.089
Adviser	9.749 ***	2.924		
Credit	-0.0004 ***	0.0001		
Interest rate	-2.958 ***	0.482	2.155 ***	0.329
Repayment time	2.740 *	1.304	2.225	1.377
Loan maturity	-0.006	1.077	10.031 ***	0.162
N. Observations	424 (53 resp.)			

Table 26. MWTP Calculation Results by Provinces in the Aegean Region

	Aegean Region	Kütahya	Manisa	İzmir
Attributes	MWTP	MWTP	MWTP	MWTP
Package 1	-	-	-	-2,579
Package 3	-	-789	1,635	-1,641
Yield	210	-	165	-
Adviser	1,668	1,842	1,325	2,357
Interest rate	-403	-607	-201	-715
Repayment time	408	1,043	-	663
Loan maturity	-453	-	-	-

In İzmir, further differences are observed, with package 1 and package 3 attributes having negative and statistically significant coefficients, while the yield parameter is insignificant. One reason for the negative coefficient of package 1 and package 3, as mentioned by farmers in the Çileme neighborhood of the Menderes district, is the high appeal of surface irrigation. Another reason is the sandy nature of the wells, which causes blockages in the pipes despite filtration, leading to inefficient irrigation. From this, we can infer that farmers do not believe that switching to drip irrigation will increase their yield, and they may even think it will decrease. Therefore, this inference also explains the negative and insignificant yield coefficient.

Table 27. Results of MXL Model Analysis for Ankara

	MXL Model XIII			
Parameters	Coefficient	S.E	Std. R. P.	S.E
Status quo	-0.424	1.5711		
Package 1	-1.175 *	0.54956	3.592 **	1.1118
Package 3	-1.652 *	0.70365	4.350 **	1.3925
Yield	0.078 **	0.025457	0.261 ***	0.067818
Adviser	2.682 ***	0.71825		
Credit	-0.00001	0.00002		
Interest rate	-0.584 ***	0.14842	0.553 ***	0.14508
Repayment time	0.314	0.25008	0.194	0.41145
Loan maturity	-0.295	0.25809	1.141 ***	0.33081
N. Observations	472 (59 resp.)			

Table 28. Results of MXL Model Analysis for Konya

	MXL Model XIV			
Parameters	Coefficient	S.E	Std. R. P.	S.E
Status quo	-2.823 *	1.172		
Package 1	0.042	0.316	1.277	0.917
Package 3	0.422	0.358	1.256	0.937
Yield	-0.032	0.021	0.239 ***	0.049
Adviser	1.020 **	0.372		
Credit	-0.00006 ***	0.00001		
Interest rate	-0.363 ***	0.065	0.174 **	0.054
Repayment time	-0.069	0.145	-0.002	2.251
Loan maturity	0.226	0.194	-0.013	0.884
N. Observations	472 (59 resp.)			

According to the estimation results for Ankara, it is noteworthy that the package 1 and package 3 attributes are negatively significant, while the credit attribute is insignificant. Farmers seem to prefer package 2, which includes a drip irrigation system and soil analysis. According to the farmers, due to the decreasing water level of the Sakarya River, the irrigated agricultural lands in the Polatlı district have significantly decreased. In Beypazarı and Polatlı, deep wells have been drilled to provide water, causing an increase in salinity, soil degradation, and a reduction in organic matter. Given these circumstances, it is evident that farmers lack the capability to transition to drip irrigation systems, even if they wish to. This explains why the credit parameter is statistically insignificant. Due to the insignificance of the credit attribute, the MWTP for attributes cannot be calculated. The estimation results for Konya are consistent with the full sample results, except for the insignificance of the yield and repayment time parameters.

Table 29. Results of MXL Model Analysis for Eskişehir

	MXL Model XV				
Parameters	Coefficient		S.E	Std. R. P.	S.E
Status quo	-4.670	**	1.718		
Package 1	0.011		0.260	0.021	5.156
Package 3	-0.351		0.319	-0.178	5.071
Yield	0.062	***	0.015	0.065 **	0.021
Adviser	0.402		0.294		
Credit	0.00000036		0.00001		
Interest rate	-0.432	***	0.074	0.345 ***	0.071
Repayment time	0.488	**	0.160	0.423	0.401
Loan maturity	-0.446	*	0.225	1.616 ***	0.403
N. Observations	496 (62 resp.)				

Table 30. MWTP Calculation Results by Provinces in Central Anatolia.

	Central Anatolia	Ankara	Konya	Eskişehir
Attributes	MWTP	MWTP	MWTP	MWTP
Package 1	-	-	-	-
Package 3	-	-	-	-
Yield	359	-	-	-
Adviser	2977	-	1719	-
Interest rate	-1676	-	-612	-
Repayment time	1220	-	-	-
Loan maturity	-2994	-	-	-

The MWTP could not be calculated in the Ankara and Eskişehir samples because the credit attribute was found to be insignificant.

When examining the statistics for Eskişehir, it is observed that alongside the package 1 and package 2 parameters, the advisor and credit parameters are also statistically insignificant. Specifically, in the Günyüzü district of Eskişehir, during the survey, farmers expressed sentiments such as, "We are small farmers; even if we wanted these loans, they would not give them to us. Finding collateral to mortgage is a separate issue altogether." The insignificance of package 1, package 2, and credit parameters may reflect this situation. Similar to Ankara, the credit attribute in Eskişehir was also found to be insignificant, and thus, MWTP could not be calculated. Therefore, within the provinces of the Central Anatolia region, MWTP values could only be calculated for the advisor and interest rate parameters in Konya. The obtained values are consistent with those in the full sample. The MWTP for an advisor is 1,823 TL in the full sample, while it is 1,719 TL in Konya. The MWTP for interest rate is -705 TL in the full sample, while it is -612 TL in Konya.

CHAPTER 6
POLICY IMPLICATIONS

The analysis conducted using DCE reveals that the coefficient for interest rates is negative and highly significant at all levels. This aligns with observations during the survey, where farmers expressed adverse reactions to interest rates across the board. Therefore, it is evident that the most burdensome factor for farmers is the interest on loans, which they describe as "crushing their backs." This issue is directly related to the file fees associated with loans for pressured irrigation systems. As someone who personally used agricultural loans three years ago, I know that file fees ranged from 3% to 5% of the loan amount. However, farmers now report that these fees have risen to as much as 17%. From this perspective, it can be said that the interest for these "zero-interest" loans is effectively being collected upfront under the guise of file fees. Farmers are aware of this and express sentiments such as, "How can I take this loan, even if it is low interest? Maybe it would be better than this." Therefore, regulating the amount of file fees is crucial for the success of pressured irrigation support policies.

As shown in the results, while farmers' preferences are similar at the full sample and regional levels, the analysis at the provincial level reveals variations in the coefficient signs and significance levels for all attributes except interest rates. This suggests that some policies may not be suitable for nationwide implementation and should be adopted at the provincial level for tremendous success. In this context, provincial and district agricultural and forestry directorates and agricultural chambers, which at least 80% of surveyed farmers complained about for their perceived inactivity, could be inspected and reassigned as necessary. This would ensure that farmers receive accurate and practical guidance on fertilization and can increase productivity. Many farmers indicated that they apply 70-90 kg of fertilizer, with some disregarding the agriculturalists' recommendations to use less.

Another factor influencing farmers' decisions is soil analysis. The findings from the choice experiment analysis vary in this regard. However, a significant portion of surveyed farmers stated that they do not conduct soil analysis due to distrust in the results. When informed about mobile soil analysis devices, farmers expressed that this could be a very logical application. They mentioned that many agricultural chambers or district agricultural and forestry directorates have the necessary capital to acquire such devices. This would alleviate concerns about trust since the entire process would be visible. It would greatly facilitate logistics and save time. Therefore, this is a highly sensitive issue that needs consideration.

An issue not covered in the analysis but frequently mentioned by farmers is the deepening of wells in many surveyed areas. Although the depth varies, there is a general trend of decreasing water levels. For example, in the Polatlı district, the depth has increased from 20m to 70-80m; in Tire, İzmir, from 60m to 150m; in Çeltik, İshakuşsağı, Konya, from 80m to 200-250m; and in Altınekin, Akıncılar, Konya, from 200m to 500-600m. This situation requires urgent intervention, and more sustainable solutions must be found and implemented according to the potential for irrigated agriculture.

Farmers are highly dissatisfied with current policies, as reflected in the Likert-scale question where the inadequacy in policies challenge scored 4.8 out of 5. Furthermore, a significant number of farmers expressed frustration during the survey, saying, "Is there even a policy?" and indicated that they wanted to score 10 or more, particularly concerning product pricing policies. Therefore, necessary changes and implementations need to be made for the policies to achieve the desired success. In this regard, the findings obtained in this study will pave the way for developing effective policies and shed light on this path.

CONCLUSION

Climate change is an environmental problem that has worldwide effects and will cause major crises in the food supply in the near future, especially due to agricultural impacts, if functional mitigation and adaptation programs are not created and implemented as soon as possible. General and regional circulation models are being created to examine these potential impacts caused by climate change. According to the findings of the General Circulation Model, Türkiye is one of the countries that are expected to suffer the most from the effects of climate change. When examining regional models for Türkiye, serious drought risks are expected in the future, depending on temperature and precipitation values, especially in the central and southern parts. Therefore, in this study, research was conducted on the provinces in this region with intensive grain production and irrigated agriculture potential. Research elicited the willingness of producers to pay for drip irrigation system installation and soil analysis using the choice experiment method, which is one of the popular methods of non-market valuation technique. Data was obtained by a face-to-face survey conducted with a total of 521 people in 79 neighborhoods/villages across 32 randomly selected districts in 10 provinces, including the trial sample.

The average age of interviewed farmers is 52 years, and the average farming experience is 34 years. The share of farmers aged 49 and under is 43%. In other words, surveyed farmers are experienced and have an average of 35-40 years of knowledge about the climate and soil structure of their region. The average land area of the participants is 331 decares. 25% of the farmers participating in the survey are high school graduates, and 9% are university graduates.

Overall, most producers are aware of the benefits of the drip irrigation system. Indeed, 51% of the surveyed producers are actively using drip irrigation. When the scope is expanded to include all pressurized irrigation systems, it is found that 74.3% of the producers are using either drip or sprinkler irrigation systems. Among those who do not use pressurized irrigation, 44% expressed a desire to adopt drip irrigation. Despite this, several challenges hinder the transition to drip irrigation, such as inadequate irrigation resources, clogging of drip pipes due to sandy water, and high costs of electricity and diesel fuel. A similar situation applies to soil analysis. Of the farmers surveyed, 53.4% have conducted soil analysis at least once. Additionally, 53% of those who have never conducted a soil analysis expressed a desire to do so. However, the distance to analysis centers, which are typically located in provincial centers, and the lack of trust in the analysis results prevent farmers from conducting soil analysis.

The results of the DCE analysis for the full sample indicate that potential increases in yield, agricultural advisor, credit amount, interest rate, repayment time, and loan maturity are significant attributes affecting farmers' preferences. It is found that the status-quo parameter is a negative and highly significant constant, which means that decision-makers strongly prefer taking action by selecting the non-status-quo option. Package 1 and Package 3, which refer to drip irrigation and Drip Irrigation with Mobile Soil Analysis, respectively, have positive but insignificant coefficients. When comparing regional analyses with the full sample analysis, generally similar results are found. However, when the research is deepened to the provincial level, significantly different results are obtained. For example, Manisa and Tekirdağ are the provinces where package 3, which includes the drip irrigation system and mobile soil analysis, is positively significant. In Manisa, the widespread use of drip irrigation in the most common crop, grapevines, and the practice of soil analysis before establishing vineyards suggest that the farmer profile in this region is inclined toward these practices. Thus, the inclusion of a mobile soil analysis device, which facilitates the analysis process, significantly increases the package's preference. In Tekirdağ, the primary reason for this positive significance is the presence of well-informed farmers with extensive lands in the Hayrabolu and Süleymanpaşa districts.

In the willingness to pay analysis, it is calculated that producers are willing to pay 225 TL for a 1% increase in yield. When we examine wheat yield and seasonal crops, a 1% yield increase can provide an income of 150-200 TL per decare in some regions. Therefore, the analysis results are consistent, and the potential increase in yield attribute is significant for farmers. Another common and highly significant attribute is the interest rate. The MWTP of farmers for a 1 percentage point decrease in the interest rate was found to be 705 TL. This result is expected, as farmers frequently complained about interest rates and the substantial rise in file fee costs of credits during the survey. Although these loans are said to be interest-free, Ziraat Bank has significantly increased file fee costs. In agricultural loans, file fee costs, which varied between 2% and 5% on average depending on the type of collateralized asset three years ago, have now reached 15-17%.

In summary, this study is comprehensive and qualitative, reaching a total of 521 individuals across various provinces, districts, neighborhoods, and villages visited during the survey process. The discrete choice experiment revealed that the interest rate is the most crucial factor for farmers when considering the adoption of drip irrigation systems and soil analysis. The findings emphasize the importance of providing not only financial support but also advisory services to ensure the effective implementation of drip irrigation and soil analysis. Additionally, to persuade farmers to conduct soil analysis and act according to the results, it is necessary to increase confidence in the analysis outcomes. Mobile soil analysis devices can be used for this purpose because the entire analysis process takes place in front of the farmer's eyes. Moreover, the study underscores the need for tailored policies at the provincial level to address the specific needs and preferences of farmers in different regions. By understanding and addressing these preferences, policymakers can design more effective strategies to promote sustainable agricultural practices, ultimately enhancing productivity and resilience in Türkiye's agricultural sector. This research contributes valuable insights into the factors influencing farmers' adoption of sustainable technologies and provides a foundation for future studies and policy development in this critical area.

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APPENDIX 1: SURVEY QUESTIONS

Filtre Soruları:

1. **Aktif olarak çiftçilik yapmakta mısınız?**

Evet (Ankete devam)		Hayır (Anketi durdur)	

2. **Çiftlikteki karar verici kişi siz misiniz?**

Evet (Ankete devam)		Hayır (Anketi durdur)	

3. **Önümüzdeki 5 yıl için tarımsal yatırım kararını veren kişi siz misiniz?**

Evet (Ankete devam)		Hayır (Anketi durdur)	

İlk olarak sizinle ve çiftliğinizle ilgili birkaç soru soracağım. Vereceğiniz cevapların hiçbiri bilimsel analiz dışında hiçbir amaçla kullanılmayacaktır. Hiçbir şekilde isim alınmayacaktır. Cevaplarınız anonim kalacaktır.

4. **Cinsiyetiniz?**

Kadın		Erkek	

5. **Kaç yaşındasınız?**

6. **Tamamladığınız en yüksek eğitim düzeyi nedir?**

1. İlkokul		4. Üniversite (Lisans)	
2. Ortaokul		5. Üniversite (Lisansüstü)	
3. Lise		6. Diğer	

7. **Çiftlikteki pozisyonunuz nedir?**

Kiracı	
Çiftlik sahibi	
Çiftlik yöneticisi/ kooperatif çalışanı	
Diğer: …………………………………………………………….	

8. **Arazi genişliğiniz nedir?**

Kendi alanınız (da)	
Kiralık alan (da)	

9. **Kendi kullanımınız için arazi kiralarken kontrat yapmakta mısınız?** *(Hayır ise 11. soruya geçiniz)*

Evet		Hayır	

10. **Kontrat süreniz genellikle kaç yıl olmakta?**

1 yıl ve altı	
2 yıl	
3 yıl	
4 yıl	
5 yıl ve üzeri	

11. Çiftliğinizi nasıl tanımlarsınız?

Bireysel işletme	
Aile işletmesi (Çok kuşaklı)	
Aile işletmesi (İlk kuşak)	
Şirket ya da kooperatife bağlı	
Diğer: ………………………………………………………….	

12. Hasat sonrası tarlada kalan sapı, anızı ne yaparsınız?

1. Tarlada bırakırım		
2. Gübre yaparım		
3. Hayvancılıkla uğraşanlara satarım (fiyat/ton) / ücretsiz veririm		
4. Biyogaz tesisine satarım (fiyat/ton) / ücretsiz veririm		
5. Yakacak olarak satarım (fiyat/ton)		
6. Yakarım		
7. Diğer: ……………………………………………………….		

13. Kaç yıldır çiftçilik yapmaktasınız, bu sürenin kaç yılında yöneticiydiniz?

Toplam süre		Yöneticilik süresi	

14. En çok ekim yaptığınız ürünler hangileridir? Hangi üründen kaç dekar alana ekim yapmaktasınız?

Ürün 1		……………...da
Ürün 2		……………...da
Ürün 3		……………...da
Ürün 4		……………...da
Ürün 5		……………...da

15. Toprak analizi yaptırmakta mısınız? *(Evet ise 17. soruya geçiniz)*

Evet		Hayır	

16. Analiz yaptırmayı düşünüyor musunuz?

Evet		Hayır	

17. Toprak analizini ne şekilde yaptırmaktasınız?

1. Düzenli		..........…senedir
2. Bazı dönemler yaptırdım		
3. Bugüne kadar en az bir kere yaptırdım		

18. **Çiftliğinizde aşağıdaki sulama yöntemlerinden birini ya da birkaçını kullanmakta mısınız? Kaç dekar alan sulamaktasınız?** *(Damla sulama sistemi kullanılıyor ise 21. soruya geçiniz)*

Damla sulama		………...…da
Yağmurlama		………...…da
Pivot		………...…da
Yüzeysel sulama		………...…da

19. En çok kullandığınız sulama sistemini tercih etme nedenlerinizi nasıl değerlendirirsiniz? [*Lütfen her sorun için, önemlilik derecesini 1'den (Hiç önemli değil), 5'e (Çok önemli) kadar, 5 puanlık bir ölçekte belirtin.]*

	Önemlilik derecesi				
	1	2	3	4	5
1. Dekar başına maliyet düşük alması					
2. Daha az zaman alması					
3. Çevremden gördüm					
4. Sulama işçiliği kolaylığı					
5. Yıllık bakım maliyetinin düşük olması					
6. Su tasarrufu					
7. Verimlilik artışı					
8. Gübreleme kolaylığı					
9. Yabancı otlarla mücadele avantajı					
10. Diğer: ………………………………….					

20. Damla sulama sistemi kullanmayı düşünmekte misiniz?

Evet		Hayır	

21. İklim değişikliğinin aşağıdaki etkilerden hangisine ya da hangilerine neden olabileceğini düşünmektesiniz?

Sıcaklık artışı	
Su kaynaklarında azalma	
Kuraklık	
Bitki besin maddelerinde azalma	
Sel, erozyon gibi doğal afetlerin artması	
Suyu daha az tüketen, sıcaklığa dayanaklı bitki kullanımına zorunlu geçiş	
Bitki hastalıklarında artış	
Üretimin azalması	
Diğer: …………………………………………………………………...	

22. Bu olaylardan hangisi ya da hangilerini zaten yaşadınız?

Sıcaklık artışı	
Su kaynaklarında azalma	
Kuraklık	
Bitki besin maddelerinde azalma	
Sel, erozyon gibi doğal afetlerin artması	
Suyu daha az tüketen, sıcaklığa dayanaklı bitki kullanımına zorunlu geçiş	
Bitki hastalıklarında artış	
Üretimin azalması	
Diğer: …………………………………………………………………...	

23. Yakın gelecekte yaşayacağınızı düşündüğünüz etkiler nelerdir?

24. İklim değişikliğinin etkilerine karşı herhangi bir önlem almakta mısınız? *(Evet ise, aldığınız önlemleri aşağıdaki listeye yazınız)*

Evet		Hayır	

25. Aşağıdaki problemler çiftliğiniz için ne derecede sorun teşkil etmektedir?

[*Lütfen her sorun için, zorluğun kapsamını 1'den (küçük bir zorluk) 5'e (büyük bir zorluk) kadar 5 puanlık bir ölçekte belirtin.]*

	Problemin derecesi				
	1	2	3	4	5
1. Sulama maliyetleri					
2. Toprak analizi maliyetleri					
3. Kredi erişimi					
4. Düşük verimlilik					
5. Ürün satış fiyatları					
6. Girdi fiyatları (mazot, tohum, gübre, vs.)					
7. Gerekli bilgilere erişim eksikliği					
8. Tarımsal politikalardaki yetersizlik					
7. Diğer……………………………………					

SEÇİM DENEYİ ÇIKTILARI

Tablolar	**Seçenek 1**	**Seçenek 2**	**Hiçbiri**
Tablo 1			
Tablo 2			
Tablo 3			
Tablo 4			
Tablo 5			
Tablo 6			
Tablo 7			
Tablo 8			

Şimdi sizlere az önce gösterilen paketler hakkındaki seçiminize yönelik birkaç soru yönelteceğim.

[2 seçenekten biri hiç seçilmediyse 26. soruya geçiniz, seçildiyse 27. soruya geçiniz.]

26. Hiçbiri seçeneğini tercih etmenizdeki temel etken ya da etkenler nelerdir?

1. Kredi kullanmak istemiyorum.	
2. Kredi çekmekteki bürokratik zorluk.	
3. Maliyetler çok yüksek.	
4. Kredi faizi çok yüksek	
5. Verim artışının bu düzeyde olacağını düşünmüyorum.	
6. Bu uygulamaların çiftliğim için kârlı olacağını düşünmüyorum.	
7. Çiftliğimde yakın zamanda herhangi bir yatırım yapmayacağım.	
8. Farklı bir sulama sistemi kullanıyorum.	
9. Diğer: ……………………………………………………………	

27. Paketlerin içeriğindeki nitelikler seçiminizde ne derecede etkili olmuştur?

[*Lütfen her nitelik için önemlilik derecesini 0'dan (Dikkate alınmadı) 4'e (Çok önemli) kadar belirtin.]*

	Dikkate alınmadı	Önemsiz	Az Önemli	Oldukça önemli	Çok Önemli
	0	1	2	3	4
1. Paket içeriği					
2. Verimdeki potansiyel artış					
3. Danışmanlık hizmeti					
4. Kredi Miktarı					
5. Kredi Faizi					
6. Kredi ödemesinin başlangıç tarihi					
7. Kredi Vadesi					

28. Lütfen aşağıdaki ifadelerin her biri için katılıp katılmadığınızı 1'den (Kesinlikle katılmıyorum) 5'e (Kesinlikle katılıyorum) kadar 5'li bir ölçekte belirtiniz.

	Kesinlikle Katılmıyorum		⇔		Kesinlikle Katılıyorum
	1	2	3	4	5
1. Çiftçiler, mümkün olduğunca doğanın korunmasına katkıda bulunmakla yükümlüdür.					
2. Çiftçiler, mevcut teknolojileri kullanarak sürdürülebilir bir tarım yapmalıdır.					

29. Geçtiğimiz yıl çiftliğinizin geliri ne kadardı?

Gelir	

APPENDIX 2: ETHICS COMISSION FORM

Tarih: 21/06/2023 13:48
Sayı: E-35853172-301.10-00002911832

00002911832

T.C.
HACETTEPE ÜNİVERSİTESİ REKTÖRLÜĞÜ
Rektörlük

Sayı : E-35853172-301.10-00002911832 21/06/2023
Konu : Etik Komisyon İzni (Oğuzhan ÇELİK)

SOSYAL BİLİMLER ENSTİTÜSÜ MÜDÜRLÜĞÜNE

İlgi: 26.05.2023 tarihli ve E-12908312-301.10-00002867178 sayılı yazınız.

Enstitünüz İktisat Anabilim Dalı İngilizce İktisat Yüksek Lisans Programı öğrencisi **Oğuzhan ÇELİK**'in **Dr. Öğr. Üyesi Shihomi Ara AKSOY** danışmanlığında hazırladığı; **"İklim Değişikliğinin Türkiye'deki Tarımsal Üretime Etkisi ve Adaptasyon Senaryoları"** başlıklı tez çalışması Üniversitemiz Senatosu Etik Komisyonunun **13 Haziran 2023** tarihinde yapmış olduğu toplantıda incelenmiş olup, etik açıdan uygun bulunmuştur.

Bilgilerinizi ve gereğini rica ederim.

Prof. Dr. Sibel AKSU YILDIRIM
Rektör Yardımcısı

Bu belge güvenli elektronik imza ile imzalanmıştır.

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APPENDIX 3: ORIGINALITY REPORT

	HACETTEPE ÜNİVERSİTESİ **SOSYAL BİLİMLER ENSTİTÜSÜ**	Doküman Kodu *Form No.*	FRM-YL-15
		Yayım Tarihi *Date of Pub.*	04.12.2023
	FRM-YL-15 **Yüksek Lisans Tezi Orijinallik Raporu** *Master's Thesis Dissertation Originality Report*	Revizyon No *Rev. No.*	02
		Revizyon Tarihi *Rev.Date*	25.01.2024

HACETTEPE ÜNİVERSİTESİ
SOSYAL BİLİMLER ENSTİTÜSÜ
İKTİSAT ANABİLİM DALI BAŞKANLIĞINA

Tarih: 03/07/2024

Tez Başlığı: Çiftçilerin Damla Sulama ve Toprak Analizi Tercihleri: Türkiye'de Ayrık Seçim Deneyi
Tez Başlığı (Almanca/Fransızca)*:...

Yukarıda başlığı verilen tezimin a) Kapak sayfası, b) Giriş, c) Ana bölümler ve d) Sonuç kısımlarından oluşan toplam 62 sayfalık kısmına ilişkin, 01/07/2024 tarihinde şahsım/tez danışmanım tarafından Turnitin adlı intihal tespit programından aşağıda işaretlenmiş filtrelemeler uygulanarak alınmış olan orijinallik raporuna göre, tezimin benzerlik oranı %6'dır.

Uygulanan filtrelemeler*:

1. ☒ Kabul/Onay ve Bildirim sayfaları hariç
2. ☒ Kaynakça hariç
3. ☒ Alıntılar hariç
4. ☐ Alıntılar dâhil
5. ☒ 5 kelimeden daha az örtüşme içeren metin kısımları hariç

Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü Tez Çalışması Orijinallik Raporu Alınması ve Kullanılması Uygulama Esasları'nı inceledim ve bu Uygulama Esasları'nda belirtilen azami benzerlik oranlarına göre tezimin herhangi bir intihal içermediğini; aksinin tespit edileceği muhtemel durumlarda doğabilecek her türlü hukuki sorumluluğu kabul ettiğimi ve yukarıda vermiş olduğum bilgilerin doğru olduğunu beyan ederim.

Gereğini saygılarımla arz ederim.

Ad-Soyad/İmza

Öğrenci Bilgileri	**Ad-Soyad**	Oğuzhan ÇELİK
	Öğrenci No	N21138760
	Enstitü Anabilim Dalı	İktisat (İngilizce)
	Programı	İktisat (İngilizce) Tezli Yüksek Lisans

DANIŞMAN ONAYI

Dr. Öğr. Üyesi Shihomi ARA AKSOY
UYGUNDUR.

	HACETTEPE ÜNİVERSİTESİ SOSYAL BİLİMLER ENSTİTÜSÜ	Doküman Kodu *Form No.*	FRM-YL-15
		Yayım Tarihi *Date of Pub.*	04.12.2023
	FRM-YL-15 **Yüksek Lisans Tezi Orijinallik Raporu** *Master's Thesis Dissertation Originality Report*	Revizyon No *Rev. No.*	02
		Revizyon Tarihi *Rev.Date*	25.01.2024

TO HACETTEPE UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
DEPARTMENT OF ECONOMICS

Date: 03/07/2024

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Student Information		
	Name-Surname	Oğuzhan ÇELİK
	Student Number	N21138760
	Department	Economics
	Programme	Master of Arts in Economics

SUPERVISOR'S APPROVAL

Asst. Prof. Dr. Shihomi ARA AKSOY
APPROVED