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Impacts of Climate Change on Household Income Level of the Farmers: The Case of Sarayonu District of Konya Province in Türkiye*

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Abstract

Climate change is already a common phenomenon to people from all walks of life worldwide. Climate characteristics are essential for sufficient agricultural production to keep the income balance of the households of the producers. However, changes in climate characteristics bring changes in agricultural output which consequently affects the income levels of the producers. This study aims to explore how changes in global climate bring changes in water levels, consequently affecting the agriculture and income source of the households of the study area. This study uses an in-depth interview form to interview the farmers living in the Sarayonu district of Konya province in Turkey to explore their vulnerability to climate change and its impacts on their households' income and poverty levels. The study results show that changes in water resources due to climate change impacts negatively affect the agriculture sector of Sarayonu, which alters the income sources of the households of the farmers. As a result, farmers cannot go for irrigated farming for many years and, consequently, do not have a proper harvest. Since climate change impacts reduce agricultural land productivity, farmers get low quality and less crop yield, leading the households into an income crisis.

Keywords

Climate Change, Water, Agriculture, Farmers, Household Income, Turkey

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İklim Değişikliğinin Çiftçilerin Hanehalkı Gelir Düzeyine Etkileri: Türkiye'de Konya İli Sarayönü İlçesi Örneği

Öz

İklim değişikliği tüm dünyada herkesi kapsayan yaygın bir olgudur. İklimsel özellikler, yeterli tarımsal üretim sağlamak adına üretici hanelerin gelir dengelerini koruması açısından önemlidir. Fakat iklimsel özelliklerdeki değişimler, tarımsal üretimde de değişimlere neden olduklarından üreticilerin gelir düzeylerini ve seviyelerini de etkilemektedir. Bu çalışma, küresel iklim değişikliğinin su seviyelerinde nasıl değişiklikler meydana getirdiğini ve bunun sonucunda çalışma alanındaki hanelerin tarımını ve gelir kaynağını nasıl etkilediğini araştırmayı amaçlamaktadır. Bu çalışma da Türkiye'nin Konya ilinin Sarayönü ilçesinde yaşayan çiftçilerin iklim değişikliğine karşı savunmasızlıklarını ve hanelerinin gelir ve yoksulluk düzeyleri arasındaki ilişkiyi araştırmak için derinlemesine görüşme yöntemi kullanılmıştır. Çalışma sonuçları iklim değişikliğine bağlı su kaynaklarındaki değişimlerin Sarayönü'nün tarım sektörünü olumsuz etkilediğini ve bunun da çiftçi hanelerinin gelir kaynaklarını değiştirdiğini göstermektedir. Çiftçiler yıllardır sulu tarım yapamamakta ve düzgün hasat alamamaktadır. İklim değişikliği tarımsal arazi verimliliğini azalttığından, çiftçiler daha düşük kalite ve daha az mahsul elde ediyor; bu durum hanelerin gelir krizine girmesine neden oluyor.

Anahtar Kelimeler

İklim Değişikliği, Su, Tarım, Çiftçiler, Hane Geliri, Türkiye

Introduction

Because natural climate characteristics such as temperature and precipitation work as direct inputs into proper agricultural production (Durmrul & Kilicarslan, 2017), increasing temperature and decreasing precipitation have adverse effects on the successful yield and the quality of farm products leading to severe economic losses for the producers (Adams et al., 1998; Başoğlu & Telatar, 2013). Konya has been considered a leader in the agriculture and agro-industry sectors because of its wide flat land. Since the 1950s, the area has been known as Grain House of Turkey. As the agriculture sector depends mainly on natural resources, i.e., surface and groundwater and rainfall (Islam, 2022a), it consumes nearly 60% of the world's water resources (MWI, 2007, 2009a, 2009b, 2010). Due to the increase in global temperature and the reduction of rainfall, surface and groundwater will be used more than in previous times. This situation will pressure the area's water resources and reduce agricultural production (Islam, 2022a). As a result, the farmers will face a food supply crisis for their consumption (Devereux & Edwards, 2004). Moreover, Konya, the leader of Turkey's agriculture sector with its vast flat land, uses primarily surface and groundwater reservoirs (Bayramoğlu & Ağızan, 2022; Islam, 2022a) for a maximum harvest of agricultural products. In addition, changes in climate characteristics will have negative impacts not only on agricultural production but also on the food supply, health, industry, and tourism industry of the affected area (T.R. Ministry of Environment and

Urbanization, 2012), because all these sectors have a direct relationship with the levels and quality of water of an area.

Therefore, the global climate, which is changing, brings changes in the social and physical conditions under which people live. Social changes may include migration, impoverishment, and increasing disease (Islam, 2016d). Since Turkey is located in the Mediterranean region, an increase in temperature of 1^0C-2^0C in this region will greatly impact the country's aridity and alter the precipitation patterns of the region (IPCC, 2007). It is projected that due to climate change impacts, Turkey will experience increased temperatures in summer, decreased precipitation in winter, loss of surface water, etc. It is also expected that the country will face increasing in floods, drought frequency, land degradation, and coastal landsliding (IPCC, 2007). All these together will negatively impact agricultural production in the country and alter the farmers' household income. Since it is claimed that climate change will bring a severe threat to Turkey in the future and pressures on water resources will hamper the agricultural sector, it is necessary to develop resilience strategies for the producers so that they can manage their subsistence first and then go for consecutive production. A study on this region also argues that water is like a civilization which affects the farmers' physical and mental health due to less production and income falls of the households (Islam, 2022a). Therefore, it is observed that climate change has multiple impacts on society:

- The diminishing amount of water for agriculture.
- Decreasing water quality.
- Changing sustainable agricultural production patterns.
- Changing biodiversity and ecosystems, which altogether eventually risk food security (Islam, 2022a; 2022b).

Climate changes may also lead to desertification in Turkey which may alter the socioeconomic scenarios in the country (Tramblay et al., 2020). For example, Konya Plain and Iğdir sub-region are located in the semi-arid region, prone to desertification, one of the impacts of climate change (Çetin et al., 2007: 490). All these changes create a negative situation for the agriculture sector, which ensures bread for many people worldwide. Additionally, although all the farmers do not have equal access to adaptation mechanisms, some adaptive mechanisms are found to be attractive among the farmers from the study areas, such as the introduction of new yields, sequential crop systems rather than single cropping, heat-tolerant maize varieties, planting dates, planting more trees, water conservation, changes in irrigation, diversification of crops, and household income diversity (Shikuku et al., 2017: 234-235). Alongside the climate change impacts, it is argued that the severity of the effects depends on how well-informed the farmers are and how they adapt to the climate disasters since the study area is getting warmer and precipitation is getting less day by day. The farmers also adopted adaptive strategies like crop

diversification, planting short-season varieties, changing crop varieties, and planting time. Some factors also play roles in the adaptation process, such as access to services and credit, soil fertility, land tenure, etc. (Fosu-Mensah et al., 2012: 495-496). Therefore, this study entails the impacts of climate variability on the income of the households in Sarayonu district of Konya. In so doing, it has considered many other factors relevant to the income opportunities of the people engaged in the agriculture sector because climate change has direct and indirect impacts.

The agriculture sector ensures many people's livelihoods and maintains a particular country's food supply (Islam, 2022a). Climate change has harsh impacts on various social and physical aspects of the affected communities, i.e., poverty, crime, infrastructure, and so on (Islam, 2016d). It also impacts various sectors like fishing (Islam, 2022b) and particularly the agriculture sector and affects almost 2.5 billion people worldwide who are partially or wholly dependent on this sector for their livelihood—climate change affects nearly all countries, irrespective of their geographical locations. For example, on the one hand, it affects the agriculture sector of Greece, where this sector boosts the economy through its contribution to national agricultural production and the GNP of the country. Because countries of the Mediterranean region will be affected by an increasing trend of drought accompanied by summer hot and consequently, the agriculture sector of these countries, i.e., Greece, some European countries, Turkey, etc., will significantly be hampered due to these changes (Georgopoulou et al., 2017: 164-165; IPCC, 2007: 555). All these conditions destabilize the income-generating activities of the farmers, which may lead to an income loss for the households.

There are some reasons for choosing Konya as the field of study. Konya has the 4th most immense basin, Konya Closed Basin, according to its precipitation area and the availability of its underground water for use (Bayramoğlu & Ağızan, 2022). However, due to the disruption of the natural hydrological regimes and over-consumption of freshwater resources and their impacts on the wetlands, salt lakes, and freshwater sources, the farmers have to change their irrigation schemes which negatively affected the agricultural lands (Islam, 2022a). Consequently, the number and quality of freshwater resources in the area, such as lakes, wetlands, and streams, decrease (Berktay & Nas, 2008: 823). Because of less precipitation, Konya is an arid climate zone. Agricultural drought makes the situation more dangerous for high water-consuming crops (Topak & Acar, 2010: 65). In addition, environmental pollution and global climate change also affect the basin water, which consequently limits the use of water in the irrigation system for proper agricultural production When the producers cannot invest in new irrigation technology for sufficient agricultural products, some of them migrate to other areas though climate-induced internal migration is not adequately recorded (Islam, 2022b) nor the migrants get their refugee identity (Islam, 2016c). Studies show that since

Konya has been experiencing severe drought due to the impacts of climate change on water resources of the area, agricultural production, i.e., production of wheat, barley, etc., has drastically been reduced in the recent years (Al-Bakri et al., 2013; Islam, 2022a; Soylu, 2021; Topak & Acar, 2010). This situation leads to an income crisis for many producers, destabilizing the households' income source and contributing to the region's migration process.

Therefore, some cultivators had to shift to other places, primarily to cities, for their survival. So, many people are getting detached from agricultural production and engaging themselves in other works that will destabilize the food supply or reduce the ability to purchase food (IPCC, 2007: 482). Climate-induced hazards create a situation where the producers decide whether to go for further agricultural production. Previous research on the agriculture sector of Konya shows that the climate of the region has been changing, which has severe impacts on existing water resources and, consequently, on the agriculture sector of the area (Aydın et al., 2015; Dursun et al., 2012; Topak & Acar, 2010). These significantly impact the agricultural actors' income sources and levels. Since the present study emphasizes the effects of climate change on water resources and consequent implications on the agriculture sector and income status of the farmers of Konya, the study results will be helpful for the national and local governments to review the existing risks on the agriculture sector and the households' income of the farmers in order to develop agriculture policies needed for a sustainable agriculture sector and its future.

Literature Review

Climate change impacts bring changes in temperature and rainfall. Durdu (2010) analyzed the effects of climate change on the water resources of the Menderes river basin of Turkey over the last 45 years because the annual precipitation decreased due to a 10C temperature increase in the region. At the same time, climate change affects the water resources of the Southern region of Turkey, where the Seyhan river basin is found (Durdu, 2010). It will lead to a water shortage in those regions of Turkey. Water shortage is expected to affect nearly five billion people worldwide by 2025, potentially leaving more than 60% of people in Southern African countries vulnerable (Devereux & Edwards, 2004; Nhemachena, Nhamo & Matchaya, 2020).

Moreover, as a Mediterranean country, Turkey expects the greatest changes in precipitation due to climate change impacts., a country located in the Mediterranean basin. For example, Turkey generally has the highest amount of rainfall precipitation in the winter season, which is even higher in the coastal areas than in other regions. However, the country has been observing temperature increases due to hydrological changes, particularly in the summer. A study argues that if this situation continues, Turkey is expected to experience

a temperature increase of between 1^0C and 2.5^0C and between 2.5^0C and 5^0C by the mid-21st century and end of the century, respectively (Şen, 2013).

Meanwhile, Şen (2013) argues that annual precipitation will show a decreasing trend in the Southern parts of Turkey, whereas it will show an increasing trend in the Northern parts of the country. Şen (2013) also argues that some critical sectors of Turkey are significantly affected by climate change. These sectors include Human Resources, Water Resources, Agriculture, Forest, Tourism, and Energy. Additionally, being the leading sector of Turkey, where almost 15 million people are engaged, directly and indirectly, the agriculture sector necessitates 73.2% water out of the country's total water supply (Bayramoğlu & Ağızan, 2022; Dogdu & Sagnak, 2008). However, several previous studies show that if the temperature increases by 1^0C, wheat production will decrease by 3%-10%, which may contribute to a total yield loss of 25%-50% when the temperature increases by 3^0C (Chiras, 2012; Gohari et al., 2013; Karapınar et al., 2020). In addition, other studies claim that an increase in temperature and decrease in precipitation will contribute to reducing agricultural production by 15%-60% in Southern Africa, particularly to wheat production loss of 20% in Turkey, from -2.5% to 20.7% in Iran and 4.5% in China (Gohari et. al., 2013; Ozdogan, 2011; Nhemachena et. al., 2020; You et al., 2009). Ekercin et al. (2013) try to find out the effects of climate change on the water resources of Konya through climate data and multi-temporal Landsat images. This paper considers normalized difference vegetation index image interpretation and pre-processing stages as image processing procedures. It shows the effects of climate change on destabilizing ecological balance and water reservoirs alongside the socio-economic benefits of water resources. In this paper, more technical data was collected through the remote sensing method to identify climate change impacts on water resources. The results show that Konya has been observing the drought problem for the last two decades due to two main aspects: uncontrolled use of groundwater in agriculture and lack of sufficient precipitation. Here, the primary source of their data is remote sensing satellites that generally did not consider the social consequences of climate change. The authors of this chapter are not from the social science department; instead mainly from the engineering department (Ekercin et al., 2013). Therefore, the present study concentrates on the social consequences of climate change because it severely affects Turkey's agriculture sector and the lives of the people engaged in it.

Furthermore, a study shows that the water level of Beyşehir lake of Konya has been fluctuating in recent years due to two critical factors, i.e., global warming and the activities of local people. Consequently, on the one hand, the water level rises during the wet season, which is harmful to agriculture and human beings. On the other hand, water flows get reduced during the dry season, leading to drought in this region of Konya. The study results show that human activities are more responsible for the fluctuations of water level in this lake

which, in turn, bring unpleasant situations for the people living there. It is also shown here how evaporation, precipitation, and runoff affect the water level of Beyşehir lake. Simultaneously, the Carsamba river is an essential source of charging water into this lake. Therefore, changes in this river flow ultimately affect the balance of the water level of Beyşehir lake. Because of the dam's construction and unconstrained use of water in agriculture, the lake's water level also gets destabilized. Therefore, the study urges to maintain the water level in Beyşehir lake to ensure the economic benefits of water and claims to educate the farmers about the proper use of water in the irrigation system (Dursun, 2010). In addition to the studies mentioned earlier, There are other studies conducted in the Konya region on climate change and its impacts on water and agriculture, mainly namely Aydın et al., 2015; Dogan, Berktay and Singh (2012); Dursun et al., 2012; Topak and Acar, 2010, etc. Although Konya has been experiencing the negative impacts of climate change, there is no sociological research on this issue in the planned area of Konya province. If we look at the existing research on climate change impacts on water and agriculture in Konya, we see that all research is done by engineers using more natural science perspectives. This study will try to fill this gap by employing sociological research methods and techniques while reaching the goal of this study. Moreover, climate change has affected the agricultural sector directly and indirectly by decreasing surface and groundwater resources. Therefore, in the present study, I will emphasize the impacts of climate change on water resources and agriculture and the consequential effects on the income level of the farmers' households.

Objectives of the study

The aim of this study is to explore the impacts of climate change on the household income of the farmers of Sarayonu in Konya. I will emphasize on the following specific questions to meet the objective of this research:

1. How many water reservoirs are available to meet the need of the agricultural production?
2. How the water resources of the study area were changed in the last 15 years?
3. What are the socio-economic impacts of irrigation system due to the changes in water resources?
4. To what extent does less agricultural production affect thesources and levels of income of the farmers' households?

Methodology

This study employed qualitative research methodology, and the study design is descriptive-exploratory. Farmers were interviewed using a semi-structured in-depth interview form. Since the farmers speak a language other than English, the study language of this research, the interview guides have been

developed in English and Turkish and have been pretested and updated accordingly. Additionally, I have taken the changes in the number of wetlands, lakes, and irrigation pumps of the study area in the last 15 years into consideration to support the study's descriptive design because changes in water sources bring changes in irrigation systems which consequently affect agricultural production and the income of the producers. I have received ethical approval from Ankara Yildirim Beyazit University Ethics Committee (Decision No: 2018-226/28.06.2018/44) for conducting this study.

Furthermore, due to the changes in the natural environment resulting from climate change, many qualitative changes are expected to happen to the community and the people's lives. Therefore, I have used the fieldwork approach, which demands that social life can only be understood through interpretation (Bechhofer & Paterson, 2000; Goffman, 2002). Since Qualitative researchers generally collect data by examining documents, observing behavior, interviewing people, or describing a group of interacting people, I have visited the study area, analyzed some documents, and observed the people while conducting the in-depth interview. I have also taken field notes during the observation and interview to make sure of all the nuances of their responses. This work has helped me successfully finish the field research, as the success of qualitative inquiry depends on the skills, assumptions, and practices of researchers engaged in research (Creswell, 2014; Denzin & Lincoln, 1998; Neuman, 2011). I have used convenience sampling to select the participant farmers from different villages (*Mahalle*) of Sarayonu subdistrict (*İlçe*) to investigate the changes to the household's income due to the changes in water resources and water quality of the area essential for agricultural production. Using snowball sampling, I interviewed 31 farmers to meet the objective of my study. Since it is qualitative research, the number of participants is less significant.

After interviewing farmers whom I could reach, the interview was stopped as extra interviewees had not added any new thematic information, and data saturation was achieved (Crowe et al., 2011). I have asked them what changes came to their community and their life patterns due to the loss of their income levels and sources. I have given them a free choice to express their climate vulnerabilities and the consequences to their household income status. I have transcribed the interview data, then used different themes and subthemes to reach the final results (Islam, 2022b). I have employed the interpretative data analysis technique to analyze the qualitative data because it goes beyond descriptive analysis (Braun & Clarke, 2013; Denzin & Lincoln, 1998; Sanderson & Galway, 2021). I have also used the verbatim method, i.e., direct remarks and opinions of the farmers in the analysis section, to ensure the reliability of this research (Silverman, 2006).

Results and Discussion

The study was conducted in Sarayonu district of Konya province in Turkey. For information about water resources and irrigation systems of the study area, the period of the last 15 years has been considered, i.e., how were the water resources before 15 years and what types of changes happened to the sources and quality of water; to the irrigation systems and to the agricultural products in this period. A report shows that two-thirds of the countries around the world will experience water scarcity by 2025 because the agriculture sector is dependent on water that covers over 70% of the earth's surface; only 2.5% of water is considered freshwater used for drinking, hygiene, agriculture, and industry (SESRIC, 2019). Additionally, climate change has significant effects on water resources because it contributes to low rainfall, less precipitation, etc. Therefore, the farmers who are engaged in rain-fed agriculture, a source of food security, will be able to harvest fewer crops (SESRIC, 2016). This situation may decrease the sources and levels of income of the producers. Therefore, I have focused on the household incomes of the farmers, which are being destabilized due to the loss of agricultural yields resulting from the changes that happened to water reservoirs and irrigation systems due to climate change impacts in the area. In so doing, I have interviewed the farmers of Sarayonu because they are the actors who face climate-induced vulnerability most and whose households' income is affected most.

The socio-demographic results of my study show that the young and educated portion of the population doesn't show their interest in engaging themselves in the agriculture sector due to various reasons, i.e., this sector is no more a profitable one due to climate change impacts to maintain their livelihoods smoothly, the price of agricultural goods and equipment became high, etc. The increasing number of youths receive higher education in cities and find their sources of income there, so they do not return to Sarayonu to be involved in the agriculture sector. All of the respondents also mention that they try to ensure their children's schooling so that they can get a secured job in city areas, as the agriculture sector provides less food and less income to maintain household expenditures. This result supports a previous study that argues that existing limited water reservoirs and cultivable land directly impact climate change because the cultivators harvest less amount of food (Al-Bakri et al., 2013). While talking about the available water reservoirs, the interviewees claim that the water reservoirs are insufficient for agricultural production and their quality of them is degrading gradually. Water services in the study area are provided for agricultural farming from a small number of deep wells. The average deepness of all the wells is about 200-250 meters.

Although farmers are not well informed about the changes happened to the water reservoirs as well as about the climate change impacts observed in their area (Gohar & Cashman, 2016), the actual scenery for Sarayonu district is that existing water resources and quality and the irrigation systems are not

enough for proper agricultural crop production. Moreover, the farmers argue that although the water wells were not so many in number and not so deep, i.e., below 100 meters, 15 years before, they were used to receive sufficient water for irrigation-based agricultural crop production because the stream water flow was excellent and the groundwater level was very close to the surface. They were used to getting regular and high precipitation before 15 years and could harvest sufficient agricultural crops to meet their household needs as well as to sell in the market. This result reflects a common characteristic of an area mainly dependent on agricultural crop production (Çelebi, 2016). However, the conversation with the farmers and the analyzed documents show that the water reservoirs of the study area lost 70% of the total amount of water.

Consequently, the number of water sources has been reducing day by day, and irrigation systems went only to the hands of large and wealthy farmers as digging a deep well is expensive, which small and poor farmers cannot afford. All farmers claim that the water level of the existing water sources of both surface and ground was dropped down. In addition to this, the only pond in the study area that was the primary irrigation source became dry. As a result, farmers cannot go for irrigated farming for many years. Consequently, the households could not ensure proper harvest and lost their income source. Moreover, the groundwater level dropped down, i.e., farmers were used to getting water from about 90 meters deep 15 years ago but now get water from 150-180 meters deep and, in some places, from more than 180 meters deep. Therefore, most of the farmers cannot go for irrigation-based farming and only produce some particular crops in the area.

Several reasons cause changes in water resources. For example, on the one hand, some respondents mention the excessive and unconscious water use by farmers in their agricultural lands. On the other hand, most respondents noted that less and more irregular precipitation and drought happened due to climate change impacts creating excessive pressure on water usage in irrigation. The prime causes of these changes were water reservoirs. Furthermore, because of climate change, the expenses for wells increased, which the poor farmers could not afford. Additionally, the cost of agricultural inputs and production costs increased in the last 15 years, supported by some previous studies (Ahmed, et al., 2011; Batisani, 2012; Wheeler & von Braun, 2013). As a result, these farmers fall into a vicious circle of loss of income as, on the one hand, they don't have a proper harvest; on the other hand, production costs become high. These results match a previous study that claims that when groundwater levels decline due to excessive and ignorant use of water for irrigation in agricultural land, the farmers need to count extra costs (Shahid, 2011). The current study results also show that alongside the physical changes that happened to water reservoirs and agricultural production in the area due to climate change impacts, some other regional and local factors

intensified the yield loss, such as lack of services, increasing use of irrigation, no new deep wells are dug, the front of the stream was affected by the ponds dug in the mountain villages, the irregular, and wild irrigations, etc. The study shows that farmers have to spend more on consuming energy as farming requires more irrigation due to drought and other climate change impacts. They also cannot get back their expenses at the end of the harvest as the number of production decreases, the quality of the crops reduces, etc. Therefore, the farmers don't get the motivation and sufficient capital to go for further cultivation in the next yielding year. Consequently, their income sources and income levels gradually get lesser, which may lead to changes in other social environments of the area, such as poverty, crime, and migration (Islam, 2022d). The ultimate consequence may be more alarming because already 700 million people around the world fighting with poverty, malnutrition and with maintain their basic needs (Hussain et al., 2021; United Nations, 2019).

So, the present study shows that climate change makes the situation of physical and social environments worse. Due to climate change and its impacts on water resources, the efficiency of crops damaged, and crop varieties changes, farmers don't have a good harvest. Therefore, the income levels of the agricultural producers get decrease. This result is supported by a previous study (Gohar & Cashman, 2016). Farmers stop planting particular types of crops, i.e., sugar beet, etc., because of water scarcity. Therefore, the households of the producers become dependent on markets to meet their needs which becomes tough for them due to their income loss. So, some farmers have left farming activities ultimately and shifted to other income-generating activities or migrated to the Konya city area, while others have left some parts of their land empty (Islam, 2022a). One interviewee stated that *we also minimized our productive land area. We produce according to the availability of water.*

The study results cite that in addition to hail precipitation, wind erosion which happened in the study area back to back two years damaged the surface level of the agricultural land of 2 meters. The interviewees argue that this has resulted in the loss of productivity of the land. Thus, they have not got proper harvest in the last years, which negatively affected their household income and living standards. In addition to this, the drought, which is also a pervasive problem in the study area, affected almost every year in the last few years due to a lack of precipitation and snowfall (Bayramoğlu & Ağızan, 2022; Dogan et al., 2012). So, the farmers claim that their economic lives were affected highly because they couldn't even repay the agricultural loan taken from the government and afford the production costs. Consequently, their families have fallen into a tremendous income crisis, even sometimes could not ensure bread for the households, particularly during the lack of good harvest. The interviewees also claim that when a disaster occurs, they lose their plantings, become weak economically and mentally, and face an income crisis in two ways. From the first way, they cannot buy fertilizer and pesticides for their farming and

lose their motivation for further cultivation in the following years. Climate change also exaggerates the situation in a negative direction. The study results also show that drought due to lack of water requires frequent irrigation. But the farmers lack water and so cannot plant and harvest crops properly. All these situations create unexpected conditions for the households of the farmers, and they cannot afford the daily expenses of the households. This is actually the second way of crisis. So, the farmers are in a vicious cycle of climate-induced devastation. A farmer's opinion is as follows:

Before, many fruits and vegetables were produced here, but now we cannot produce them. Since we cannot produce them, we are to buy them from others. It means we become dependent on other people's production, whereas before, we were sufficient. But because of the fall in household income, we cannot buy fruits and vegetables from the market.

The above statement elucidates the economic condition of the farmers who are, in many cases, unable to ensure their income diversity in the study area. This situation makes the farmers weak physically and mentally alongside the economic crisis because they cannot have proper nutrition. The results show that the number of water reservoirs decreased, and the quality of the existing water sources dropped due to climate change impacts. So, the participants argue that because they get less and low-quality water, they harvest less and low-quality yields. As a result, their household income drops and moves towards an economic crisis at the household level. At the same time, when agricultural food production drops at the community level, then the price of the commodity also increases. Thus, the farmers and their households affected by the diverse impacts of climate change cannot buy daily commodities necessary for maintaining the subsistence of the households. This result supports the previous studies which claim that climate change affects the water sources and food supply of the affected areas (Gohar & Cashman, 2016; IPCC, 2007).

Furthermore, all of the respondents claim that the Sarayonu area has been suffering from drought due to less precipitation, strong wind, and hail precipitation in particular and from uneven and irregular rainfall and snowfall in general. Therefore, they had to change their production pattern as an adaptation mechanism. In the study area, farmers had been helping each other by taking a lease of lands, and particularly rich farmers take the lands of small farmers through partnerships. However, the situation changes. The rich farmers also irrigate their own lands difficult and, thus, cannot help the small farming owners. People also changed the crop varieties, i.e., previously, they were used to plant vegetables and fruits but now only produce crops that don't require irrigation, like beans, chickpeas, sugar beet, wheat, and barley. Or some farmers leave their lands empty for a year. A respondent's view: *Because of the lack of water, the agricultural land where I have planted*

70 decares1 of sugar beets or beans was divided in half-half, and one half of the land was to follow and the other half to produce green crops. The farmers have been trying to build resilience to climate change and its impacts on water resources by adopting traditional and affordable mechanisms through cooperatives which they can do their best. However, most of the respondents blame the government services and facilities, especially the adaptive mechanisms.

It is clear from the results that in every disaster government sometimes only sends some staff to determine the losses, but later no steps are found. The farmers also claim that government does not allow farmers to dig new wells, and they don't increase the subsidy to the agriculture sector. So, farmers are to buy diesel, fertilizer, pesticides, and seeds at a high cost. In addition, gradually, the price of agricultural equipment is increasing. So, the farmers' expectation from the government is only to lessen the price of the agricultural production materials and to start issuing the license to dig new wells so that they can continue crop production. So, they also mention that if the number of water resources can be increased and new wells can be dug, they will be able to regain their previous income from the agriculture sector. The local actors also demand long-term annual unconditional monetary support from the government as the banks provide them with short-term payment type credit. Even some farmers angrily evaluated the activities of the government in this way: *Government support every sector except the farmers. The expenses of the products that farmers produce are too much. The agricultural crops become worthless. So, the government should take initiatives so that the farmers can cheaply produce crops.*

Although there is some support from the government to the farmers, they are insufficient. Government should provide cumulative support to the irrigation system. Furthermore, the farmers mention that the government has introduced advanced technologies in the agriculture sector, but they cannot afford them as they are costly. They are already in an income crisis due to the loss of agricultural production resulting from climate change impacts. Therefore, all of the interviewees claim that the government should reduce the price of agricultural goods and make the local government bodies active while at the same time, they should consult about the problems with the local farmers and engage them in the decision-making processes because their farmings and their households are vulnerable to climate-induced risks and disasters.

Conclusion

Climate change impacts are the prime concern for Turkey because the country's agriculture sector, which is highly dependent on natural climate characteristics or a maximum yield, has been experiencing negative implications of climate change impacts. Like global temperature, Turkey has also been observing temperature increase, which creates two-fold problems for the country's agriculture sector. On the one hand, Turkey has been observing

changes in precipitation due to climate change impacts. As a result, the country has been experiencing a decreasing trend in water levels and water quality necessary for agricultural production. On the other hand, because of the temperature increase, the farmers are highly dependent on irrigation-based production, which they cannot afford due to the soc-economic status of their households. Therefore, they cannot produce quality agricultural goods in the last consecutive years. These two-fold implications on the agriculture sector destabilize the income source of the farmers and the income levels of the farmers' households.

The present study entails that sufficient water resources are vital for good agricultural yields, ensuring the income availability of the farmers' households. Equating civilization with water, the respondents foresee the loss of civilization due to the drastic fall in water reservoirs and the water quality in the region's future. It can be inferred from this statement that the statement explicitly explains the future of Turkey because the country is still primarily dependent on its agriculture sector to maintain high GDP. Thus, alongside the risks and hazards of climate change in the agriculture sector of Turkey, the people engaged in this sector also struggle with the high prices of agricultural incentives such as seeds, diesel, manure, pesticides, etc. In addition, farmers cannot pay the right price for their products in the market economy. This reverse condition creates a double edge situation for the farmers. As a result, they lose motivation to go for further production in the following years. Therefore, climate change and its impacts on water resources and consequential effects on the agriculture sector affect the income sources and levels of the farmers' households. So, some of those farmers have developed many coping strategies to adapt to the changing situations of the environment, such as introducing new irrigation systems and new crop varieties and keeping some portion of cultivable land empty. In contrast, others migrated to city areas as a part of an adaptive mechanism. This study concludes with the suggestion that the government should listen to the voice of this group of people, support them financially, and reduce the price of agricultural incentives to ensure their households' income, as they are the largest group that ensures the supply of food demands in Turkey.

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