

Agriculture and Climate Change in Turkey

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Climate change is an irreversible phenomenon with profound consequences for the Earth's climate system. Manmade greenhouse emissions are responsible for the alteration of the Earth's climate. As the most direct effect of climate change temperature increases (between +1°C to +5.8°C) will have serious and profound impacts on all aspects related to the state of the natural systems and of the production economy, especially in agriculture, forestry and natural habitats. Climate models that are used to carry out climate change scenario simulations suggest that the increases in greenhouse gasses affect not only surface temperatures but also all climate parameters from precipitation to sea levels. The same climate models also indicate that the changes are not uniformly distributed around the world, and there are places where the impacts are larger than those in other areas.

The Mediterranean Basin is shown among the regions which will be affected maximally from global warming and climate change and therefore it is identified by the Fourth Evaluation Report of IPCC (IPCC, 2007) as one of the most vulnerable region to future climate change. Likewise, Giorgi (2006) defined the Mediterranean region as one of the climate change "hotspots" in future projections. Evans (2009) examined future predictions of 18 GCMs over the Middle East, and showed that the largest precipitation decrease (annually more than 25%), caused by less storm track activity over the eastern Mediterranean, would occur over southwestern Turkey in 2095. The General Circulation Model (GCM) simulations largely agree on a basin-wide precipitation reduction in the Mediterranean Basin (IPCC, 2007; IPCC, 2013).

Climate change in Turkey

Turkey which is located in the eastern part of the basin has been identified as one of the countries that could be profoundly affected by this change. Different regions of Turkey have been affected by climate change at different ways and levels. According to "1st Turkish Climatic Change National Announcement"; winter precipitation in the western provinces of Turkey has decreased significantly in the last five decades and on the other hand summer temperatures have increased dramatically. Accordingly, the mean flows of the rivers in the western and southwestern regions of Turkey have decreased significantly (Türkeş, 2003).

Studies has been showed that), generally in Turkey, increase tendency is observed in the daily maximum and minimum temperature values of the period of 1961-2008, reducing tendency is observed in the daily maximum and minimum temperature differences (Toros, 2012). Actually, Turkey has been experiencing several meteorological droughts recently and in the last decades. The longest and most severe droughts in the past 40 years occurred in 1971-1974, 1983-1984, 1989-1990, 1996-2001, 2001-2003, 2007-2008 and 2013-2014. The longest of these droughts began as meteorological drought and later developed into agricultural and hydrological drought. This caused agriculture yield losses, shrinking and insufficient underground and above-ground water sources. It can be said that; the increased frequency and severity of meteorological droughts in Turkey are caused by changes in global climate patterns.

There is no doubt that climate change will exacerbate the aforementioned and other possible risks and vulnerabilities because Turkey lies in an area that is projected to be one of most vulnerable areas to climate change in the World. Several projects have been carried out to understand and project climate change and its effects for Turkey.

The pioneering project has been made by SMS (State Meteorological Service) to generate regional climate projection for Turkey up to 2100 using dynamic downscaling method in a way to be compatible with scenarios used in IPCC 5. Assessment Report (IPCC, 2013). In the projections which are produced by using HadGEM2-ES based on RCP4.5 and RCP8.5 scenarios, are compared; it is seen that the temperature is continuously in an increasing trend for the 2013-2099 period in both scenarios.

But the average temperature increase is 2.5°C according to RCP4.5, whereas the temperature increase is 3.6°C according to RCP8.5. In both scenarios, decreases in raining are expected for the 2013-2099 period and these decreases do not follow a regular regime. Decrease is approximately 50 mm/year according to RCP4.5 and 47 mm/year according to RCP8.5. In this term, in which the drought is gradually increasing and getting intense, it is seen that the values increase up to 150 days. The possibility that there will not be any rain during the summer season for 4 months is considerably increasing.

Impact on agriculture and adaptation measures

It is already known that the agriculture sector is not only a victim of climate change but also one of the reasons of this phenomenon. The destructive impacts of climate change on agriculture should be dealt through the development, food security, environmental, biodiversity and sustainability of the ecosystem services. Agriculture is one of the top sectors in Turkey with 24.6 % of employment, and 3.7% of exportation (TurStat_g, 2014). Turkey continues its effort in agricultural productivity and technology intensive production models to achieve its agricultural production goals. However in addition to that, natural disasters of which frequency and severity have increased should be taken into consideration. There happen losses in agricultural production (crop, animal and aquaculture production) thus this cause sustainability of agriculture to be at risk.

Since agriculture is one of the most affected sectors by climate, the impact will increase in years, it can be concluded that serious measures need to be taken in this regard. Adaptation to the impacts of climate change should be one of the primary strategies of production oriented policies in the agriculture sector in Turkey. For this reason, it is necessary that the action plans and national and regional development strategies regarding the sector are revised and/or adaptation strategies specific to the sector are prepared.

Indeed, many current policies which are carried out for the activation of the agricultural structure in Turkey contain the necessary activities which will support the direct or indirect adaptation to the impacts of the climate change.

In Turkey, the fields that are sown for agricultural production are 23.8 million hectare in 2013 and about 1/4 of this sown field can be watered and dry agriculture is carried out in an important part of it. For this reason, agricultural production depends directly on raining. Despite the prominence of the agricultural sector some of the projections show that many regions for some of the top crops and fruits of Turkey overlap with the areas where the projections show decreases in rainfall as mentioned above. The decreases that will occur in the amount of precipitation will have negative impact on agriculture and water resources. The climates of Turkey are suitable to grow a wide variety of crops, vegetables and fruits. Thus, it could be stated that climate change will increasingly threaten the food security of Turkey in the 21st century.

Studies that investigate the effects of climate change on agriculture in our country by taking a lot of factors and future scenarios have been performed. In one of the studies (Dellal, McCarl, and Butt, 2011), the changes that will show up in the production values of wheat, barley, corn, sunflower, and cotton, which are generally produced in Turkey and the economic reflections of these changes are investigated. In the study, it is predicted that there will be a 7.6% decrease in wheat and barley yield, a 10.1% decrease in corn yield, a 3.8% decrease in cotton yield, and a 6.5% decrease in sunflower yield according to 2050 climate change projections. It is predicted that there will be an increase in the product prices between 0.1% and 12.6% parallel to the decrease in production and that this increase will increase the welfare of producers whereas it will decrease the welfare of consumers and the total welfare. In this context, it is necessary to identify and adopt species that are better suited to the new climate conditions using biotechnologies to encourage or induce the development of drought-tolerant characteristics. Relevant research institutes of Ministry of Food Agriculture and Livestock (MFAL) have started to develop products resistant to drought and farmer's implementations and 17 drought resistant wheats, used to make breads, and 8 drought resistant wheats, used to make macaroni, and 12 drought resistant barley has been developed so far.

Since serious drought problems have been faced in certain regions as mentioned above so as to lessen the impact of climate change on agriculture, it is required to develop the measures that are taken for adapting to the impacts of the drought.

Within this scope, the integration of the impacts of climate changes into “Turkey Agricultural Drought Strategy and Action Plan” has been prepared in 2008 and updated every 5 years regularly in terms of water resources, food safety, natural disaster risks, and ecosystem services. This plan is not only put into practice in case of drought and which is forgotten in rain years; but also it is a plan which envisages the implementation of the mid and long term precautions in order to be prepared against future droughts and their impacts even in rain years. Besides to, a “Drought Test Center” International Research Institute has been set up and started to operate. Because the Center is willing to cooperate with ICARDA and other international organizations to work together, it is expected that the center will support to the food security of the region.

When climate change impacts (flood, drought, heats, etc) are taken into consideration, it would be necessary to develop disaster management policies throughout the country. Methods and essentials about the agricultural insurances application are determined in order to ensure the reimbursement of the losses that the producers will be subject to because of the risks that are pointed to in Agricultural Insurances Law, which came into effect in 2005. Agricultural Insurances Pool (TARSIM) is formed in accordance with the law and 50% of the insurance premium that the farmer will pay is met. TARSIM is an important instrument in that it protects agriculture sector, which has a strategical role and function in economy, and increase is recorded in all of its basic data in years.

The Food-Water-Climate Nexus

The increase in water requirements due to population increase, global warming and climate change negatively affects especially the water resources used in agriculture in Turkey. As of today, 75% of the water amount which is consumed as 46 billion m³ annually is used for agricultural irrigation purposes. The total of the cultivated areas is 28 million hectares; the irrigable areas are approximately 25.8 million hectares.

In Turkey, it has been envisaged that the areas of 8,5 million hectares in total which can be irrigated technically and economically with current water potential will be equipped with irrigation facilities until 2023. The main purpose of this activity has been determined as decreasing the 75% consumption rate of irrigation water to 65% with the help of modern irrigation techniques. Under the limited water conditions has given priority to pressurized irrigation systems for the purpose of more effective water use; approximately 91% of the total area is irrigated by using surface irrigation methods such as furrow, border, and wild flooding. The remaining part is irrigated with pressurized irrigation methods, i.e. sprinklers and drips. An area of about 500,000 ha is equipped with sprinkler irrigation systems consisting of portable pipes, which are widely used among farmers in Turkey (mainly for sugar beet, cereals, clover, sunflower, melon, and vegetables).

In that reason it is of vital importance to take necessary measures and to give the required necessity to water management in agriculture. Turkey takes initiatives for improving of the irrigation water productivity as follows programme started to implement subsidies for water saving irrigation technologies. Government supports to farmers improve pressurized irrigation systems, “0 (zero)” interest of the credit, 60% discount in the interest of the credits given by the MFAL through Agricultural Bank is provided to the farmers to use drip irrigation systems. Farmers became increasingly interested in this type of project and use of pressure irrigation systems has been much more widespread. In order to provide for sustainable water management in agriculture, land consolidation and in-field development works has been simultaneously constructed with irrigation systems.

Besides to supports for the proper water management, “National Water Research-Development and Innovation Strategy (2012–2016)”, “National Water Quality Management Strategy (2012–2023)” and (National Climate Change Action Plan (2011-2023)) have been prepared and put into force. In these documents, strategic targets and actions have been determined. For example, National Climate Action Plan has focused on important fields which one of those is Agricultural sector and Food Security. Within the MFAL, all relevant governmental organizations are in cooperation in this Plan.

For the purpose of decreasing the water utilization in agricultural sector activities another new initiative was launched by the MFAL in order to do cross domain production planning. For this reason, in Turkey, the production areas have been determined as “agricultural basins” by taking the climate, soil, topography and field grades into account within the framework of “Agricultural Basins Production and Support Model in Turkey”. The main purpose in cross domain production planning is to do an effective production planning in agricultural sector, to protect the agricultural biological diversity and land and water resources and to reduce the utilization of water in agriculture. In this context, it has been aimed that the most appropriate habitats for agricultural products are determined by taking the water resources into consideration within the framework of adaptation works for the climate change and by this way, the use of water in agriculture is decreased.

In Rural Development Plan (2010-2013) conducted by MFAL agricultural use of renewable energy resources are indicated and subjects on providing environment friendly aquaculture is included in the plan to remove problems as environment pollution and climate change. For extending integrated basin rehabilitation practices, decision on conducting the natural resource rehabilitation studies being conducted on basin base according to the United Nations Framework Convention on Climate Change, Biological Diversity Agreement and The United Nations Convention to Combat Desertification which our country is a part of is included in the plan (MFAL, 2010).

Moreover, studies and projects regarding the effects of climate change on risks for sustainable agriculture are being performed. National Biological Diversity Strategy and Action Plan” is prepared as Turkey’s responsibility. This strategical plan has been updated by also considering the requirement that the activities of Turkey in this area must be in accordance with the regulations of European Union in the scope of nature protection sector and in this framework, six thematic working areas have been generated in order to adapt to the effects of climate change. These areas are agricultural biological diversity, climate change is added to the Action Plan as an article and it is decided that it will be considered in the scope of determining and monitoring the effects of climate change on biological diversity.

Agricultural Extension Services Project; in the scope of the project and adaptation to climate change, it is aimed to educate irrigation publisher to work in farmer education and publication activities for conscious and economical water usage. The target audience of the project, which is under the operation of Ministry of Food, Agriculture and Livestock, Department of Training, Extension, and Publications, consists of Ministry personnel and irrigation Publisher’s. Woman Farmer Training Program; It is aimed to educate women who live in rural areas and do farming and to develop the cooperation between institutions, with the Woman Farmer Training Cooperation Protocol, which was signed between Ministry of Food, Agriculture, and Livestock, Ministry of Family and Social Policies and Turkey Union of Chambers of Agriculture in 2012.

The education program, which includes “climate change, cooperativity, entrepreneurship- leadership, social security, social gender equality, violence against women, personal rights and freedoms” subjects that are determined in the scope of the protocol for woman farmers and subjects determined in the direction of the needs of woman farmers, is applied mutually with protocol parties. Agriculture TV With Agriculture; TV application, which is carried out by Ministry of Food, Agriculture, and Livestock, Department of Training, Extension and Publications, education and publication activities are done for raising awareness targeting farmers on the effects of climate change on agriculture and livelihoods since 2010.

Conclusion

Impact of climate change on agriculture sector is pivotal for food safety because in Turkey agriculture is the priority sector for socio-economic reasons and it is where the population’s food supply mostly comes from. As a result of impacts of climate change, amount of water for agriculture will diminish, quality of water will decrease, biodiversity and ecosystem services will be lost, sustainable agricultural production patterns will change, pastures will degrade and farmers will find themselves incapacitated in terms of adaptation to climate change; and all these will eventually risk food security.

Adaptation to the impacts of climate change should be one of the primary strategies of production oriented policies in the agriculture sector in Turkey. For this reason, it is necessary that the action plans and national and regional development strategies regarding the aforesaid sector are revised and/or adaptation strategies specific to the sector are prepared. Indeed, many current policies which are carried out for the activation of the agricultural structure in Turkey contain the necessary activities which will support the direct or indirect adaptation to the impacts of the climate change. In order to adapt to the impacts of the climate change on agriculture sector, certain issues such as notably food security, production, consumption, price, insurance systems, farmer support and market policies, productivity and competition, drought and desertification, conservation of biodiversity, production of plant should be dealt with together. In addition to this, by the integration of the issues that have been mentioned above with current legal and institutional arrangements, the strategic plans, various policies and programmes, it is aimed to provide sustainable use of natural resources in agriculture and to create an organized and competitive structure for adapting to the impacts of climate change.

In Turkey, the legislation on the issues related to adapting the impacts of the climate change in the agricultural sector is mainly in the area of responsibility and authority of the Ministry of Food Agriculture and Livestock. In the recent period, in the agricultural sector many new legal and institutional arrangements were made in order to strengthen the administrative and institutional infrastructure related to food, feed, veterinary services and plant health. It has been aimed that necessary revisions are realized in the Agriculture Strategy, National Rural Development Strategy and Turkey Agricultural Drought Strategy and Action Plan (2008-2020) by establishing direct and integrated connection between the policy of adaptation to climate change and agricultural production policies.

Turkey has already developed and developing strategies, plans and policies and applying them to deal with difficulties; such as for the food security and proper water management, “National Water Research-Development and Innovation Strategy (2012–2016)”, “National Water Quality Management Strategy (2012–2023)” and “National Climate Change Action Plan (2011-2023)” have been prepared and put into force.

The Ministry of Food Agriculture and Livestock (MFAL), The Ministry of Forestry and Water Affairs and Scientific and Technological Research Council of Turkey being in the first place, all the governmental organizations are operating in cooperation.

UNCCD Ankara COP12 which was held in Turkey in 2015 draw attention to land degradation in the areas having the most sensitive ecosystems and the problems of people living in those regions. Turkey took initiatives as means to actively promote stakeholders to share the knowledge and experience in adopting climate friendly agriculture to enhance agriculture resilience to climate change and to cooperate on the contribution of soil and water conservation.

Bibliography / More information

- Dellal, I., McCarl, B. A., and Butt, T., 2011. The Economic Assessment of Climate Change on Turkish Agriculture. *Journal of Environmental Protection and Ecology*, 12(1), 376-385.
- Evans, Jason P. 2009. “21st century climate change in the Middle East.” *Climate Change* 92: 417–432.
- Giorgi, F., 2006. “Climate change hot-spots.” *Biophysical Research Letters* 33:8. Accessed November 3, 2013. L08707. doi:10.1029/2006GL025734.
- IPCC 2007. Intergovernmental Panel on Climate Change Staff. Fourth Assessment Report – Climate Change 2007: Mitigation, Vulnerability and Adaptation. Contribution of Working Group II to the fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge.
- IPCC 2013. Summary for Policymakers Climate Change 2013: The Physical
- Science Basis Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, 2013, Cambridge, UK
- MFAL, 2010. Kırsal Kalkınma Planı 2010-2013. T.C. Gıda Tarım ve Hayvancılık Bakanlığı: taken from http://tarim.gov.tr/Belgeler/KutuMenu/Kirsal_Kalkinma_Plani.pdf address
- Türkeş, M., 2003. Spatial and temporal variations in precipitation and aridity index series of Turkey, In: Bolle H-J (Ed.), *Mediterranean Climate – Variability and Trends*, Regional Climate Studies. Springer Verlag, Heidelberg, 181-213.
- TürkStat, 2014. Türkiye İstatistik Kurumu: taken from “http://www.tuik.gov.tr/sjp/duyuru/upload/yayinrapor/GSKD_Bolgesel_2004-2011.pdf” address.
- Toros, H. (2012). Spatio-temporal variation of daily extreme temperatures over Turkey. *International Journal of Climatology*, s. 32(7), 1047-1055.