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The effects of global warming on goat breeding in the West Mediterranean Region of Turkey

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Abstract. In this study, the effects of global warming on goat breeding were investigated. The research area is the Western Mediterranean Region in Turkey including Antalya, Isparta and Burdur provinces. In the region, goat breeding is done with traditional methods.

The downward trend in precipitation in Antalya will continue and will remain well below the long-term average total precipitation values. Total rainfall will decrease to 871.6 mm in 2025. In addition, the increase in average temperatures will be +0.7 °C and the average temperature will be 19.6 °C in 2025. In this case, it is concluded that the drought will be more serious in the coastal areas of the Mediterranean Climate Region. In the province of Isparta, where the average annual precipitation amount is 570.2 mm, the annual rainfall amount will decrease to 535 mm in 2025. In addition, the average temperature in Isparta will be 13.5 °C in 2025. According to future projections, there will be a strong increase in average temperatures in Burdur and the increase in average temperatures will be +0.7 °C. The average temperature, which is currently 13.2 °C in Burdur, will be 13.9 °C in 2025. Burdur Province, whose monthly total rainfall amount is 428.1 mm, is expected to decrease below 400 mm in 2025 with a decrease of 35 mm. In this case, it turns out that the drought will be experienced in extreme condition in Burdur Province.

Goat breeding is carried out mainly in enterprises in forest and mountain areas in Turkey. Global warming will bring much negativity to human beings, cause some plant and animal species to disappear or decrease but drought-resistant species will survive in future. Goat is very adaptive and it is resistant to drought and thirsty. Hair goat is also very resistant to drought and thirsty, and is fed with woody plant species that are resistant to drought and thirsty. In this respect, the effects of drought and global warming will be felt less on this hair goat production.

Keywords. Sustainable goat breeding, maquis areas, drought, global warming, Turkey.

Les effets du réchauffement climatique sur l'élevage des chèvres dans la région méditerranéenne occidentale de la Turquie

Résumé. Dans cette étude, les effets du réchauffement climatique sur l'élevage caprin ont été étudiés. La zone de recherche est la région de la Méditerranée occidentale en Turquie, y compris les provinces d'Antalya, d'Isparta et de Burdur. Dans la région, l'élevage caprin se fait avec des méthodes traditionnelles. La tendance à la baisse des précipitations à Antalya se poursuivra et restera bien en deçà des valeurs moyennes des précipitations totales à long terme. Les précipitations totales diminueront à 871,6 mm en 2025. De plus, l'augmentation des températures moyennes sera de +0,7 °C et la température moyenne sera de 19,6 °C en 2025. Dans ce cas, il est conclu que la sécheresse sera plus grave. Dans les zones côtières de la région climatique méditerranéenne. Dans la province d'Isparta, où la quantité annuelle moyenne de précipitations est de 570,2 mm, la quantité annuelle de précipitations diminuera à 535 mm en 2025. De plus, la température moyenne à Isparta sera de 13,5 °C en 2025. Selon les projections futures, il y aura une forte augmentation des températures moyennes à Burdur et l'augmentation des températures moyennes sera de +0,7 °C. La température moyenne, qui est actuellement de 13,2 °C à Burdur, sera de 13,9 °C en 2025. La province de Burdur, dont la pluviométrie mensuelle totale est de 428,1 mm, devrait passer sous les 400 mm en 2025 avec une diminution de 35 mm. Dans ce cas, il s'avère que la sécheresse sera vécue dans des conditions extrêmes dans la province de Burdur.

L'élevage de chèvres est principalement réalisé dans des entreprises situées dans des zones forestières et montagneuses en Turquie. Le réchauffement climatique apportera beaucoup de négativité aux êtres humains, entraînera la disparition ou la diminution de certaines espèces végétales et animales, mais les espèces résistantes à la sécheresse survivront à l'avenir. La chèvre est très adaptative et elle est résistante à la sécheresse et à la soif. La chèvre à poils est également très résistante à la sécheresse et à la soif, et se nourrit d'espèces végétales ligneuses résistantes à la sécheresse et à la soif. A cet égard, les effets de la sécheresse et du réchauffement climatique se feront moins ressentir sur cette production de poils de chèvre.

Mots-clés. *Élevage caprin durable, zones de maquis, sécheresse, réchauffement climatique, Turquie.*

I - Introduction

Global warming and climate change are among the environmental problems that threaten the world. Climate change is defined as statistically significant changes in the average state of the climate or its variability over tens or more years (Türkeş, 2008). Climate change may occur due to natural internal processes and external forcing factors, and human-induced changes in the composition of the atmosphere or land use (Türkeş, 2010; Türkeş, 2012).

The potential effects of global climate change, expected to have some global and regional impacts focus on agriculture, forest, clean water resources, sea level, energy, human health, and biodiversity (Doğan and Tüzer, 2011). Turkey covers an area of approximately 780,000 km² and has three different bio-geographical regions. This attribute makes our country rich in terms of biological diversity. Climate change, drought, and land degradation threaten the integrity of ecosystems. Deforestation and desertification are reducing the ecological resilience and richness of globally significant biodiversity. There are various activities that lead to land degradation. However, overgrazing (heavy, premature, uncontrolled, etc.) is generally cited among the main causes of land degradation (Anonymous, 2014).

In Turkey, some of the sheep and goats grazed in pastures or maquis areas in the forests in the form of animal husbandry. The relations between forest resources and sheep and goat husbandry should not be seen as just grazing animals in forests and utilizing the branches and leaves of trees and shrubs that make up the forest as nutrients. The natural conditions of our country, the habits of the society, the expansion of agricultural lands to the detriment of forest and pasture lands, the inefficiency of pasture lands as a result of years of overuse stand before us as the results of these relations.

In order to eliminate the negativities caused by animal grazing in forests, various studies, such as improvement of pastures, arranging grazing plans, reducing the number of animals by changing breeds, encouraging barn livestock, etc., are being carried out by the relevant units, whether in the state or private sector. However, the fact that the problem has not been resolved shows that the studies carried out are far from sufficient.

II - Material and method

In determining the effects of drought and global warming in the Western Mediterranean Region, climate data were analyzed to show the impacts of drought and global warming in Antalya, Isparta, and Burdur provinces.

III - Results

3.4 Antalya Province Findings

According to the data of the General Directorate of Meteorology, the climate values in Antalya are; Average Temperature 18.7 (°C), Average Highest Temperature 24.1 (°C), Average Lowest Temperature 13.7 (°C), Average Sunbathing Time 97.5 (hours), Average Number of Rainy Days 72.5, Annual Total Rainfall 1085.3 (mm) The Highest Temperature is 45.0 (°C) and the Lowest Temperature is -4.6 (°C). A warm and temperate climate prevails in Antalya, and there is much more precipitation in winter than in summer. According to Köppen-Geiger's climate classification, the climate of Antalya is called Csa (Csa; Winter is warm, Summer is very hot and dry, Mediterranean climate Type).

July is the driest month of the year in Antalya province with 4.5 mm of precipitation. With an average precipitation rate of 265.3 mm, the highest precipitation rate is seen in December. Antalya province is one of the centers that receive the most precipitation in the Mediterranean Region.

The air masses that affect our country, especially over the Central Mediterranean, are forced to rise in the Taurus Mountains on the Southwest Anatolian coasts and cause frontal-orographic precipitation. As a result of these effects, it is stated that the annual average total rainfall in Antalya is 1109 mm. The change tendency of precipitation was examined, and a regular decreasing trend emerged from 1975 to 1995. After this year, there was an increase in precipitation until the 2000s, but after 2001, it continued with a faster decrease every year compared to the previous year. Especially 2007 (694.3 mm) and 2008 (289.3 mm) years were the years with the highest decrease (Bahadır, 2011).

Bahadır (2011) concluded that the decreasing trend in precipitation in Antalya will continue and the long-term average total precipitation values will remain well below. So much so that the precipitation that is predicted to be 950 mm in 2010 will decrease to 871.6 mm in 2025. In this case, it is concluded that drought will occur more severely in the coastal areas of the Mediterranean Climate Region. In Antalya, July and August are the hottest months of the year, with a temperature of 34.0°C. The average temperature in January is 14.9 °C, which is the lowest average of the year. The average temperature in Antalya in 2010 was 18.9 oC. According to the findings of the future analysis, it is predicted that there will be a severe increase in the average temperatures in Antalya, and the amount of rising in the average temperatures in the 15-year period will be 0.7 °C. It is expected that the average temperature in Antalya will be 19.6 oC in 2025 (Bahadır, 2011).

3.5 Isparta Province Findings

Average Temperature 12.2 (°C), Average Highest Temperature 18.3 (°C), Average Lowest Temperature 6.1 (°C), Average Sunbathing Time 85.0 (hours), Average Number of Rainy Days 99.3, Annual Total Rainfall 570.2 (mm) The Highest Temperature was 41.2 (°C), and the Lowest Temperature was -21.0 (°C). The climate is warm and temperate in Isparta. In winter, there is much more rainfall than in summer. According to Köppen-Geiger, the climate is Csa. (Csa; Warm in winter, very hot and dry in summer, Mediterranean Climate Type).

The average annual temperature of Isparta is 12.2 °C. The annually average rainfall is 570.2 mm. Isparta, located on the northern skirts of the Taurus Mountains, does not receive as much precipitation as the south-facing stations of the Taurus Mountains, as it stays in the rain.

It states that the long-term average annual precipitation in the province of Isparta is 508 mm. When the variation of precipitation between years in Isparta province is examined, a rapid decrease has emerged from 1978 to 1998. Especially after 1983, dry years have been experienced one after another, and the precipitation amount has remained below the average precipitation rate.

Over time, after the beginning of the 2000s, although there were increases and decreases in precipitation in Isparta province, it received a precipitation rate above the average. However, the precipitation rate, which started to decrease after 2006 again, formed the least rainy year with a total precipitation value of 283 mm in 2008. It is stated that the decreasing trend in the future in Isparta province will continue, and the rate of decrease will be 35 mm in the 15-year period (Bahadır, 2011). Thus, in Isparta, where the average annual precipitation is 570.2 mm, the annual precipitation rate will decrease to 535 mm in 2025. With a temperature of 30.5 °C in Isparta, August is the hottest month of the year. The average temperature in January is 6.1 °C, which is the lowest average of the year.

It is stated that the average temperatures of Isparta in 2010 were 12.8 °C. The future trend in average temperatures in Isparta will be in the form of an increase, and this trend will continue until 2025. However, the high amount of increase has emerged as a result of being strongly affected by global warming. The rate of increase is predicted to be around 0.7 °C in the 15-year period from 2010 to 2025, and the average temperature, which was 12.8 °C in 2010, is estimated to rise to 13.5 °C in 2025 (Bahadır, 2011).

3.6 Burdur Province Findings

According to the data of the General Directorate of Meteorology, the annual climate values in Burdur are; Average Temperature 13.2 (°C), Average Highest Temperature 19.4 (°C), Average Lowest Temperature 7.5 (°C), Average Sunbathing Time 89.0 (hours), Average Number of Rainy Days 88.6, Annual Total Rainfall 428.1 (mm), the Highest Temperature is 41.0 (°C), and the Lowest Temperature is -16.7 (°C). The climate is warm and temperate in Burdur. In winter, there is much more rainfall than in summer. According to Köppen-Geiger, the climate is Csa. (Csa; Warm in winter, very hot and dry in summer, Mediterranean Climate Type).

The average annual temperature of Burdur is 13.2 °C. The average annual rainfall is 428.1 mm. With a temperature of 32.1 °C in Burdur, August is the hottest month of the year. The average temperature in January is 2.5 °C, which is the lowest of the year. In Burdur, like Antalya and Isparta, the decreasing trend in precipitation will continue and will be well below the long annual average total precipitation values. The average temperature in Burdur was 13.2 °C. According to the forecasts for the future, there will be a severe increase in average temperatures in Burdur by 0.7 °C. The average temperature in Burdur, which is currently 13.2 °C, will be 13.9 °C in 2025. In Burdur province, where the average total amount of precipitation is 428.1 mm, it is expected that the precipitation rate will decrease by approximately 35 mm by 2025, to below 400 mm. In this case, the result of extreme drought in Burdur province will emerge.

IV - Conclusion

Global climate change, which has become one of the most important problems today, has brought many discussions and scenarios. Many researchers investigate the effect of it. Also, climate assessment analyses are carried out using different methods. The purpose of using these methods is to achieve more accurate assessments about climates and to make rational plans for the future (Bahadır, 2011).

The results of many climates analyses made for our country has emphasized that the Southeastern Anatolia Region, especially the Mediterranean coasts and our areas where the Mediterranean climate is effective, will be under the influence of global warming (Bahadır and Saraçlı, 2010; Özdemir and Bahadır, 2010a; Özdemir and Bahadır, 2010b). From these studies, Bahadır and Saraçlı (2010) examined the change in synthetic climate data in Isparta and stated that there would be an increase in precipitation and temperature.

According to various climate models used in the IPCC 3rd Assessment Report, the annual average temperatures over Turkey until 2050 are between 1-3 °C considering only the

increases in greenhouse gases; considering the changes in greenhouse gases and sulfate particles, an increase of 1-2 °C is predicted. In precipitation, it is predicted that it will show itself as a decreasing trend in the Mediterranean climate zone in our country (Apak and Ubay, 2007). In addition, when Türkiye's studies on precipitation changes in Turkey are examined, it is stated that annual precipitation tends to decrease throughout the country, and after 1970, dry periods intensified (Türkeş, 1996). As for a global scale, it has been emphasized while precipitation increases between 0.5% and 1% every decade in middle and high latitudes of the northern hemisphere, it decreases by approximately 3% every decade in a significant part of the subtropical lands, including the Mediterranean Basin (Türkes, 2002).

In studies covering 500 years of climatology and climate changes in Europe, especially the change in temperature was examined and it has been concluded that the temperature increase in high latitudes is higher than in low latitudes. When the spatial distribution was examined, it was found that there was an increase of 0.5 °C in the Mediterranean Basin, 0.7 °C in Central Europe, and 0.9 °C in northern Europe. In the aforementioned study, an average of 0.5°C increase in temperature occurs in the Mediterranean Region of our country and Turkey in a broad sense (Brazdil et al., 2010).

It is predicted a drier climate will emerge in the region in the future. It is important to plan the use of primarily climate-related elements such as agricultural production and water resources in the region and to present them by taking into account the change trends in the climate. Thus, investments will be more rational and long-lasting and will contribute to the strategy of the country (Bahadır, 2011).

Despite the motive for the intensification of agricultural production is to feed the increasing population, the demand for organic or ecological products has increased in parallel with the awareness of the society in recent years. Due to the breeding system, hair goat breeding, which is suitable for this structure or may become convenient with a few regulations, is carried out in a large portion of Turkey (Keskin et al., 2017).

In the studies carried out in this regard, the projection of which feed and animal species will be compatible with which region in the livestock-based scenarios to be put forward according to the assumptions and climate models foreseen for the future over animal production has become an essential issue. The economic importance of goats has increased in recent years. In addition, goats can maintain their productivity in extreme climatic conditions with some favorable aspects they have. In particular, it effectively utilizes some feed resources that cannot be exploited by other farm animals and causes less methane emission than other species. This situation puts hair goats and hair goat breeding in an advantageous position in climate change.

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