Eurasian Journal of Food Science and Technology 2022; Vol:6, Issue:1, pp:52-59

The Impact of Climate Change on Food Production in Europe

Maliha AFREEN

Nigde Omer Halisdemir University, Faculty of Agricultural Sciences and Technologies, Nigde, Turkey

Corresponding author: malihaafreen120@gmail.com

ORCID: 0000-0001-7542-1318

Abstract

Food availability and food safety are main concerns with globally increased population. There are many factors involve which can affect the food production and food security. Approximately worldwide food production is obtained from agriculture sector. Climate change is a major factor which can influence the food production at maximum level in agriculture sector. In this pepper we discuss about effects of climatic variations on food crop production in European countries. It was observed from previous studies that temperature, rainfall and precipitation are main factors which can affect the food crop productivity. Mostly Northern and southern regions of Europe are effected by climatic variations. High temperature, low rain fall, long frost periods all can affect crop productivity in different regions according to geographic locations. In recent years high temperature was noticed as a major factor to disturb the agriculture ecosystem by increasing drought and heat stress. High temperature is also favorable for the reproduction of many insects' pasts which can damage the crop and stored food. It is also dangerous for livestock by increasing mortality rate of livestock and due to scarcity of fodder because of high temperature. So there should be a government responsibility to give awareness among farmers to overcome these problems by making new strategies by changing of crop varieties and adjusting crops in alternate cultivating areas.

Keywords: Food production, Climate change, European countries, agricultural ecosystem

Review article
Received Date: 28 May 2022
Accepted Date: 19 June 2022

INTRODUCTION

There are numerous factors that influence food security such as international trade, technological and socio-economic progress, and use of farm land. Climate variability is one of the several reasons that can cause changes in the natural ecosystem and happening of food protection vulnerabilities. These vulnerabilities can rise at any stage of the food chain, from prime production level to feeding, and climate variation might have direct and subsidiary effects on these happenings. Increasing or decreasing changes in climatic values affect living things negatively and cause a decrease in productivity, especially in agricultural production (İstanbulluoğlu et al., 2013). Increasing world population, changing climate conditions and economic activities are growing with each passing day makes it more important than water (Bağdatlı and Bellitürk, 2016).

Basically climate variability affects productivity of agricultural crop in six direct or indirect ways which are given following:

(1) Direct effect of increasing concentration of CO_2 on crop yield and on efficiencies of available sources (Kimball et al., 2002; Ainsworth and Long, 2005). CO_2 and greenhouse gases accumulated in the atmosphere descend to the earth with precipitation. This event is called acid rain. Acid rains change the pH of the water and affect the life of the living creatures in the water. It causes the natural structure of plants to deteriorate (Bağdatlı and Can, 2019). In particular, measures to minimize the impact of greenhouse gases should be taken all over the world and will trigger this increasing the necessary studies and measures to minimize the emissions of carbon emissions will play an important role in reducing the effects of global warming (Bağdatlı and Ballı, 2019). The increment of greenhouse gasses emissions in atmosphere along with the global warming and the changes of temperature and precipitation regimes, have lots of negative effects on agricultural crop production (Bağdatlı et al., 2015).

(2) Direct effect of rainfall, temperature, radiation, precipitation and humidity on crop growth and development (Olesen and Bindi, 2002). Excessive increase and decrease of temperatures negatively affect the life of living things. It will be difficult to find clean water in the future as the increase of temperatures will increase the evaporation level (Bağdatlı and Can, 2020).

(3) Direct damage of crop due to extreme weather conditions like heat waves, storm and flood.

(4) Indirect effect by variations in suitability of diverse crops, basically a north side spreading out of warm-season crops (Carter et al., 1996; Fronzek and Carter, 2007),

(5) Indirect effect by nutritional modifications in crop food, growth of weeds and pests and occurrence of diseases

(6) Indirect damage by degradation of the basic source like “soil erosion” and environmental pollution like leakage of nitrate.

There are numerous other ways through which climate associated features can impact food security comprising, marine acidification and warming, and variations in the transference manners of complex pollutants. Increment in temperature and modified patterns of rainfall have an effect on the perseverance and configurations of existence of microorganisms and the configurations of their resultant foodborne infections (FAO, 2008c).

Europe is a major and furthermost productive provider of food and roughage. It was noticed in 2008 that Europe provided nineteen percent of worldwide meat productivity and twenty percent of worldwide cereal products. Approximately eighty percent of the European meat and sixty three percent of the cereal products are produced in the European countries. The production of European agriculture is mostly high, specifically in Western Europe, and regular cereal yield in the European countries is higher than the world regular yield (Olesen et al., 2011).

Climate variations in different regions of Europe effects agriculture outputs in different ways. In northern regions, climate variation might predominantly have positive influence by increasing yield and types of growing crop species, while there might be negative influence of agriculture on, the quality of surface water.

With the increase in temperature due to climate change, evaporation increases. This causes the evaporation of water resources. (Albut at al., 2018). In southern regions, the drawbacks will be dominate with lesser crop yields, unevenness in yield amount and a decline of appropriate land for customary food crops (Alcamo et al., 2007). In this pepper we give brief description of impacts of climate change on food crop productivity in different regions of Europe.

EFFECTS on CROP PRODUCTIVITY in EUROPE

The impacts of climate variation and augmented atmospheric carbon dioxide are probably lead to generally small upsurge in food crop yield in European countries. Though, effects of climate change can be minimize by using advanced technologies like development of novel varieties of crop and advanced agricultural practices (Ewert et al., 2005). In recent times, cereal products have presented significant less yields, showing that climate variation have greater effect on yield than advanced techniques (Kristensen et al., 2010).

Higher yields of food crops were associated with Climate variation in northern regions of Europe (Alexandrov et al., 2002; Richter and Semenov, 2005), whereas the lesser yield of all crops in the Mediterranean regions, including south regions of European Russia (Alcamo et al., 2005; Maracchi et al., 2005). Commonly reduction in crop yield and upsurge in water requirement are estimated for spring season crops in southern region of Europe (Giannakopoulos et al., 2009), while the influence on autumn season crops can vary according to geographic location (Santos et al., 2002).

In northern side European countries duration of the growing period, hoar frost of late spring and initial autumn and availability of sun heat are usual climatic controls (Olesen and Bindi, 2002). In this type of seasonal conditions short growing period is the main reason of less yield of food crops. For instance in the growing period in Germany is one to three months lengthier than in Scandinavian countries (Mela, 1996), but then again it also differs significantly with the elevation as in Austria varies up to three months (Trnka et al., 2009).

In Nordic countries small growing period is the leading cause for the lesser yields of wheat. Cereal productivity is less in Mediterranean regions due to heat stress, availability of water, and less time period of crop maturation. Therefore permanent food crops including olive, grapevine and fruit trees are more vital in this constituency (Alcamo et al., 2007).

The productivity of some spring season crops including maize, soybeans and sunflower can be decreased in southern Europe (Audsley et al., 2006). Whereas, the productivity of autumn season crops including spring and winter wheat depends on the geographic location. Probably the lesser productivity can be found in the furthermost southern regions and higher productivity in the northern regions including northern areas of Spain and Portugal (Santos et al., 2002; Minguez et al., 2007).

Some food crops that generally grow in southern regions of Europe will turn out to be more appropriate later in northern regions or in higher elevated regions of south.

The prognoses for an assortment of production circumstances demonstrate a 30–50 percent upsurge in appropriate area for maize productivity in Europe at the end of the 21st century, involving Scotland, Ireland, Finland and southern part of Sweden (Hildén and Lethtonen, 2005; Olesen et al., 2007).

The productivity of food crops is less in northern regions of Europe due to cool temperatures (Holmer, 2008), while productivity of food crops in southern regions of Europe is less due to low rainfall and high temperatures (Reidsma and Ewert, 2008). There are many references which shows that growing temperature is a main factor in reduction of food grain productivity globally (Lobell and Field, 2007).

Numerous fruit trees can be easily effected by spring hoar frost during flowering period. A warm climate will develop both the period of the previous spring hoar frost and the periods of flowering, and the threat of flower buds destruction due to late hoar frost are probably endure unaffected (Rochette et al., 2004). Moreover fruit trees also can be damaged by prompt autumn hoar frost, however, there might be a major issue of increased development of pests & diseases (Salinari et al., 2006).

EXTREME WEATHER

The polar ice caps are melting, sea level is rising and soil losses are experienced in coastal areas. Sea level due to melting of glaciers increasing the temperature rose from 10 to 20 centimeters (Bağdatlı and Bellitürk, 2016). Influence of the global climate will have an effect on the change of seasons, especially in the observation of significant changes in temperature and precipitation (Bağdatlı and Arslan, 2020).

The anticipated extreme changes in weather including droughts and high temperature can severely affect the food crop productivity (Meehl and Tebaldi, 2004; Scha¨r et al., 2004, Jones et al. 2003) and decrease the usual production (Trnka et al., 2004). Specifically, in Mediterranean regions of Europe, frequently weather can be changed during growing period of crops like rainfall during sowing and drought or heat pressure during flowering time are probably decrease the productivity of summer season crops like sunflower (Moriondo et al., 2010).

Warm climate is also more favorable for the production of insect pests, since several insects can complete their reproductive cycles in this warm season (Bale et al., 2002).

LIVESTOCK PRODUCTION

Climatic variations like heat pressure and droughts also can be effected on livestock. The expected upsurges in temperature level in Britain could increase the death rate of broiler chickens and pigs (Turnpenny et al., 2001).

Higher drought stress beside the Atlantic coast can decrease the production of fodder crops to that extent where fodder yield will not be enough for livestock until the provision of water irrigation (Holden and Brereton 2002, 2003; Holden et al., 2003).

High temperatures might also upsurge the danger of diseases in livestock through supporting the insects dispersal, which are main carriers of many viral infections from year to year, and also give strength to those insect carriers which become bounded in cooler temperatures (Wittmann and Baylis 2000; Mellor and Wittmann 2002; Colebrook and Wall 2004; Gould et al., 2006).

CONCLUSION

It is concluded from this study that there are many climate variable factors which are disturbing the food crop yield throughout the Europe. In recent years continuously increase in temperature and diverse patterns of precipitation as extensive upsurges in northern regions of Europe and somewhat lesser reductions in southern regions of Europe was observed. These modifications in climate are probable to disturb agronomic ecosystems at all stages including crop yields, crop protection, environmental effects and livestock. Therefore, adaptation policies should be acquaint to decrease damaging effects and to achieve promising positive effects of climate variation. It is necessary for agriculture advisors to increase awareness about climate variations among farmers, that how to manage and overcome the effects of these variabilities.

REFERENCES

Ainsworth E. A. & Long S. P. 2005. What have we learned from 15 years of free-air CO_2 enrichment (FACE)? A meta-analytic review of the responses of photosynthesis, canopy properties and plant production to rising CO_2. *New Phytologist, 165,* 351–372.

Albut S., Bağdatlı M. C. & Dumanlı Ö., 2018. Remote Sensing Determination of Variation in Adjacent Agricultural Fields in the Ergene River, *Journal of Scientific and Engineering Research,* 5(1): 113-122.

Alcamo J., Dronin N., Endejan M., Golubev G. & Kirilenko A. 2007. A new assessment of climate change impacts on food production shortfalls and water availability in Russia. *Global Environmental Change, 17*(3–4), 429–444.

Alcamo J., Endejan M., Kirilenko A., Golubev G. N. & Dronin N. M. 2005. Climate change and its impact on agricultural production in Russia. In: Milanova E., Himiyama Y., Bicik I., (eds) Understand land-use and land-cover change in global and regional context. *Science Publishers, Plymouth,* pp. 35–46.

Alcamo J., Moreno J. M., Nováky B., Bindi M., Corobov R., Devoy R. J. N., Giannakopoulos C., Martin E., Olesen J. E. & Shvidenko A. 2007. Europe. In: Parry M. L., Canziani O. F., Palutikof J. P., van der Linden P. J., Hanson C. E. (Eds.), *Climate Change,* 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, pp. 541–580.

Alexandrov V., Eitzinger J., Cajic V. & Oberforster M. 2002. Potential impact of climate change on selected agricultural crops in northeastern Austria. *Global Change Biology, 8*(4), 372–389.

Audsley E., Pearn K. R., Simota C., Cojocaru G., Koutsidou E., Rousevell M. D. A., Trnka M. & Alexandrov V. 2006. What can scenario modelling tell us about future European scale agricultural land use, and what not? *Environmental Science & Policy, 9*(2), 148–162.

Bale J. S., Masters G. J., Hodkinson I. D., Awmack C., Bezemer T. M., Brown V. K., Butterfield J., Buse A., Coulson J. C., Farrar J., Good J. E. G., Harrington R., Hartley S., Jones T. H., Lindroth R. L., Press M. C., Symrnioudis I., Watt A. D. & Whittaker J. B. 2002. Herbivory in global climate change research: direct effects of rising temperature on insect herbivores. *Global Change Biology, 8*(1), 1–16.

Bağdatlı M.C. & Belliturk K. 2016. Water Resources Have Been Threatened in Thrace Region of Turkey, *Advances in Plants & Agriculture Research, MedCrave Publishing,* 4(1), 227-228.

Bağdatlı M.C. & Can E. 2019. Analysis of Precipitation Datas by Mann Kendall and Sperman's Rho Rank Correlation Statistical Approaches in Nevsehir Province of Turkey**,** *Recent Research in Science and Technology Journal,* (11), 24-31.

Bağdatlı M.C. & Belliturk K. 2016. Negative Effects of Climate Change in Turkey, *Advances in Plants & Agriculture Research, Med Crave Publishing,* 3(2), 44-46.

Bağdatlı M.C. Belliturk K. & Jabbari A. 2015. Possible Effects on Soil and Water Resources Observed in Nevşehir Province in Long Annual Temperature and Rain Changing, *Eurasian Journal of Forest Science,* 3(2), 19-27.

Bağdatlı M. C. & Arslan O. 2020. Trend Analysis of Precipitation Datas Observed for Many Years (1970-2019) in Niğde Center and Ulukisla District of Turkey, *International Journal of Recent Development in Engineering and Technology (IJRDET), 9*(7), 1-8.

Bağdatlı M. C. & Can E. 2020. Temperature Changes of Niğde Province in Turkey: Trend analysis of 50 years data, International Journal of Ecology and Development Research (IJEDR), *6*(2), 62-71.

Bağdatlı M.C. & Ballı Y. 2019. Evaluation with Trend Analysis of The Open Surface Evaporation in Observed for Many Years: The Case Study in Nevsehir Province of Turkey, Recent Research in Science and Technology Journal, (11), 15-23.

Carter T. R., Saarikko R. A. & Niemi K. J. 1996. Assessing the risks and uncertainties of regional crop potential under a changing climate in Finland. *Agricultural and Food Science, Finland. 3,* 329–349.

Colebrook E. & Wall R. 2004. Ectoparasites of livestock in Europe and the Mediterranean region. *Veterinary Parasitology, 120*(4), 251–274.

Ewert F., Rounsevell M. D. A., Reginster I., Metzger M. J. & Leemans R. 2005. Future scenarios of European agricultural land use. I. Estimating changes in crop productivity. *Agriculture, Ecosystems & Environment, 107* (2–3), 101–116.

FAO. 2008c. Food safety and climate change. FAO conference on food security and the challenges of climate change and bioenergy.

Fronzek S. & Carter T. R. 2007. Assessing uncertainties in climate change impacts on resource potential for Europe based on projections from RCMs and GCMs. *Climate change, 81,* 357–371.

Giannakopoulos C., Le Sager P., Bindi M., Moriondo M., Kostopoulou E. & Goodess C. M. 2009. Climatic changes and associated impacts in the Mediterranean resulting from a 2 degrees C global warming. *Global and Planetary Change, 68,* 209–224.

Gould E. A., Higgs S., Buckley A. & Gritsun T. S. 2006. Potential arbovirus emergence and implications for the United Kingdom. *Emerging Infectious Diseases, 12*(4), 549–555.

Hildén M. & Lethtonen H. 2005. The practice and process of adaptation in Finnis agriculture. *FINADAPT Working paper 5, Helsinki,* Finnish Environment Institute Mimeographs, p. 335.

Holden N. M. & Brereton A. J. 2002. An assessment of the potential impact of climate change on grass yield in Ireland over the next 100 years. *Irish Journal of Agricultural and Food Research, 41*(2), 213–226.

Holden N. M. & Brereton A. J. 2003. Potential impacts of climate change on maize production and the introduction of soybean in Ireland. *Irish Journal of Agricultural and Food Research, 42*(1), 1–15.

Holden N. M., Brereton A. J., Fealy R. & Sweeney J. 2003. Possible change in Irish climate and its impact on barley and potato yields. *Agricultural and Forest Meteorology, 116*(3–4), 181–196.

Holmer B. 2008. Fluctuations of winter wheat yields in relation to length of winter in Sweden 1866 to 2006. *Climate Research, 36,* 241–252.

İstanbulluoğlu A., Bağdatlı M.C. & Arslan C. 2013. Uzun Yıllık Yağış Verilerinin Trend Analizi ile Değerlendirilmesi Tekirdağ-Çorlu İlçesi Uygulaması, *Tekirdağ Ziraat Fakültesi Dergisi,* 10(2), 70-77.

Jones P. D., Lister D. H., Jaggard K. W. & Pidgeon J. D. 2003. Future climate impact on the productivity of sugar beet (Beta vulgaris L.) in Europe. *Climate Change, 58* (1–2), 93–108.

Kimball B. A., Kobayahsi K. & Bindi M. 2002. Responses of agricultural crops to free air CO_2 enrichment. *Advances in Agronomy, 77,* 293–368.

Kristensen K., Schelde K. & Olesen J. E. 2010. Winter wheat yield response to climate variability in Denmark. *Journal of Agricultural Sciences*, First View.

Lobell D. B. & Field C. B. 2007. Global scale climate-crop yield relationships and the impacts of recent warming. *Environmental Research Letters*, *2*, 014002.

Maracchi G., Sirotenko O. & Bindi M. 2005. Impacts of present and future climate variability on agriculture and forestry in the temperate regions: Europe. *Climate Change, 70*(1–2), 117–135.

Meehl G. A. & Tebaldi C. 2004. More intense, more frequent, and longer lasting heat waves in the 21st century. *Science, 305*(5686), 994–997.

Mela T. 1996. Northern agriculture: constraints and responses to global climate change. *Agricultural and Food Science, Finland 5,* 229–234.

Mellor P. S. & Wittmann E. J. 2002. Bluetongue virus in the Mediterranean Basin 1998–2001. *Veterinary Journal, 164*(1), 20–37.

Minguez M. I., Ruiz-Ramos M., Dı ´az-Ambrona C. H., Quemada M. & Sau F. 2007. First-order impacts on winter and summer crops assessed with various high-resolution climate models in the Iberian Peninsula. *Climate Change, 81,* 343–355.

Moriondo M., Giannakopoulos C. & Bindi M. 2010. Climate change impact assessment: the role of climate extremes in crop yield simulation. *Climate Change,* Online First.

Olesen J. E. & Bindi M. 2002. Consequences of climate change for European agricultural productivity, land use and policy. *European Journal of Agronomy, 16*(4), 239–262.

Olesen J. E., Carter T. R., Diaz-Ambrona C. H., Fronzek S., Heidmann T., Hickler T., Holt T., Minguez M. I., Morales P., Palutikof J. P., Quemada M., Ruiz-Ramos M., Rubaek G. H., Sau F., Smith B. & Sykes M. T. 2007. Uncertainties in projected impacts of climate change on European agriculture and terrestrial ecosystems based on scenarios from regional climate models. *Climate Change, 81,* 123–143.

Olesen J. E., Trnka M., Kersebaum K. C., Skjelvåg A. O., Seguin B., Peltonen-Sainio P., Rossi F., Kozyra J. & Micale F. 2011. Impacts and adaptation of European crop production systems to climate change. *European journal of agronomy, 34*(2), 96-112.

Reidsma P. & Ewert F. 2008. Regional farm diversity can reduce vulnerability of food production to climate change. *Ecology and Society, 13*, 38.

Richter G. M. & Semenov M. A. 2005. Modelling impacts of climate change on wheat yields in England and Wales: assessing drought risks. *Agricultural Systems, 84*(1), 77–97.

Rochette P., Belanger G., Castonguay Y., Bootsma A. & Mongrain D. 2004. Climate change and winter damage to fruit trees in eastern Canada. Can. *Journal of Plant Sciences, 84,* 1113–1125.

Salinari F., Giosue S., Tubiello F. N., Rettori A., Rossi V., Spanna F., Rosenzweig C. & Gullino M. L. 2006. Downy mildew (Plasmopara viticola) epidemics on grapevine under climate change. *Global Change Biology, 12*(7), 1299–1307.

Santos F. D., Forbes K., Moita R. 2002. (Eds.). Climate Change in Portugal: Scenarios, Impacts and Adaptation Measures. *SIAM project report*, *Gradiva, Lisbon, Portugal,* pp. 456

Scha¨r C., Vidale P. L., Lu¨thi D., Frei C., Ha¨berli C., Liniger M. A. & Appenzeller C. 2004. The role of increasing temperature variability in European summer heatwaves. *Nature*, 427(6972), 332–336.

Trnka M., Dubrovsky M. & Zalud Z. 2004. Climate change impacts and adaptation strategies in spring barley production in the Czech Republic. *Climate Change*, *64*(1–2), 227–255.

Trnka M., Kysely J., Mozny M. & Dubrovsky, M. 2009. Changes in the Central European soil moisture availability and circulation patterns in 1881–2005. *International Journal of Climate* Change, 29, 655–672.

Turnpenny J. R., Parsons D. J., Armstrong A. C., Clark J. A., Cooper K. & Matthews A. M. 2001. Integrated models of livestock systems for climate change studies. 2. Intensive systems. *Global Change Biology*, *7* (2), 163–170.

Wittmann E. J. & Baylis M. 2000. Climate change: effects on culicoides transmitted viruses and implications for the UK. *Veterinary Journal*, *160*(2), 107–117.