

Article

Climate Change and Food Security: The Impact of Some Key Variables on Wheat Yield in Kazakhstan

Stanislav E. Shmelev^{1,2,*}, Vitaliy Salnikov², Galina Turulina², Svetlana Polyakova², Tamara Tazhibayeva², Tobias Schnitzler³  and Irina A. Shmeleva⁴

¹ Environment Europe Limited, Oxford OX2 6JG, UK

² Faculty of Geography and Environmental Sciences, Al-Farabi Kazakh National University, Almaty 050040, Kazakhstan; Vitali.Salnikov@kaznu.kz (V.S.); Galina.Turulina@kaznu.kz (G.T.); Svetlana.Polyakova@kaznu.kz (S.P.); tamara.tazhibayeva@kaznu.kz (T.T.)

³ Austrian Committee, The World University Service (WUS), 8010 Graz, Austria; tobias.schnitzler@wus-austria.org

⁴ Institute of Design and Urban Studies, ITMO University, 197101 St. Petersburg, Russia; irina_shmeleva@hotmail.com

* Correspondence: s.shmelev@lse.ac.uk



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Abstract: In such drought-prone regions as Kazakhstan, research on regional drought characteristics and their formation conditions is of paramount importance for actions to mitigate drought risks caused by climate change. This paper presents the results of research on the spatio-temporal patterns of atmospheric droughts as one of the most important factors hindering the formation of crop yields. The influence of several potential predictors characterizing teleconnection in the coupled “atmosphere–ocean” system and cosmic-geophysical factors affecting their formation is analyzed. The spatial relationships between atmospheric aridity at the individual stations of the investigated area and the wheat yield in Kazakhstan as well as its relationships with potential predictors were determined using econometric methods. High correlation was shown between wheat yield fluctuations and Multivariate El-Niño–Southern Oscillation (ENSO), galactic cosmic radiation, solar activity, and atmospheric drought expressed through the soil moisture index, which in turn depends on precipitation levels and temperatures. The model could be modified further so that the individual components could be forecasted into the future using various time series in an ARIMA model. The resulting integration of these forecasts would allow the prediction of wheat yields in the future. The obtained results can be used in the process of creating effective mechanisms for adaptation to climate change and droughts based on their early diagnosis.

Keywords: climate change; food security; sustainable development goals; econometric modelling; Asia; Kazakhstan

1. Introduction

There is a strong sense of urgency in dealing with climate change. The latest IPCC report outlines that “Human activities are estimated to have caused approximately 1.0 °C of global warming above preindustrial levels, with a likely range of 0.8 °C to 1.2 °C. Global warming is likely to reach 1.5 °C between 2030 and 2052 if it continues to increase at the current rate” [1]. The United Nations announced 17 Sustainable Development Goals, which include SDG1 ‘No poverty’, SDG2 ‘Zero hunger’, SDG3 ‘Good health and wellbeing’, SDG11 ‘Sustainable cities and communities’, and SDG13 ‘Climate action’, most closely related to climate change and its impacts on food security [2]. Climate change is starting to have a significant impact on ecosystems and food production. The latest IPCC report asserts that “Climate models project robust differences in regional climate characteristics between present-day and global warming of 1.5 °C, and between 1.5 °C and 2 °C. These differences include increases in: mean temperature in most land and