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Article

Methodological Approaches For Assessing the Impact of Global Climate Change on Vegetable Production

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Abstract: The article analyzes methodological approaches to the assessment of the impact of global climate change on the cultivation of vegetable products. Specific features of the APSIM (Agricultural Production Systems Simulator) model, which is widely used in the analysis of agricultural systems in various aspects, are described.

Keywords: Global Climate Change, Climate Models, Global Climate Models, Regional Climate Models, Agricultural Climate Models, Productivity Models, Biophysical Models, Expert Assessment, Statistical Methods, Regression Analysis

1. Introduction

Global climate change has become one of the most urgent problems of the 21st century, causing many social, economic and environmental consequences in any society. It should be noted that the agricultural sector is one of the sectors most affected by climate change. In this context, the organization of agricultural production adapted to climate change has become one of the important tasks of the world economy.

The primary issue of solving this task is the assessment of the impact of climate change on agricultural production and the identification of its consequences, mitigation and the implementation of adaptation measures in accordance with this change, i.e. measures to adapt to climate change.

Therefore, in the last years of the last century, in science, a number of studies were conducted in the direction of assessing the impact of climate change on production, and various models and methods were created. In particular, based on various scientific literature and research results, existing methods for determining the impact of climate change on agricultural production can be divided into economic, climatic, biophysical models and expert evaluation and statistical methods. Of course, these models and methods were created in the process of researching problems in the scope of different directions and fields of science, and in the process of conducting interdisciplinary research in the organization of production adapted to climate change in the regions, that is, it creates opportunities for comprehensive assessment (Fig. 1).

while agro -economic models are used to analyze the relationship between agricultural production and climate change.These models mainly focus on assessing the socio-economic impacts of climate change on agriculture and include a range of models. One of them is the Ricardian model, the essence of this model is that the value of agricultural land, which is considered the main tool for agricultural production, is selected as primary data. That is, to assess the impact of climate change on agricultural production in different regions, the value of agricultural land is analyzed and the impact of climate

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change on land value is studied. Based on the results of this research, the efficiency of agricultural production in different climatic conditions is comparatively evaluated.

2. Materials and Methods

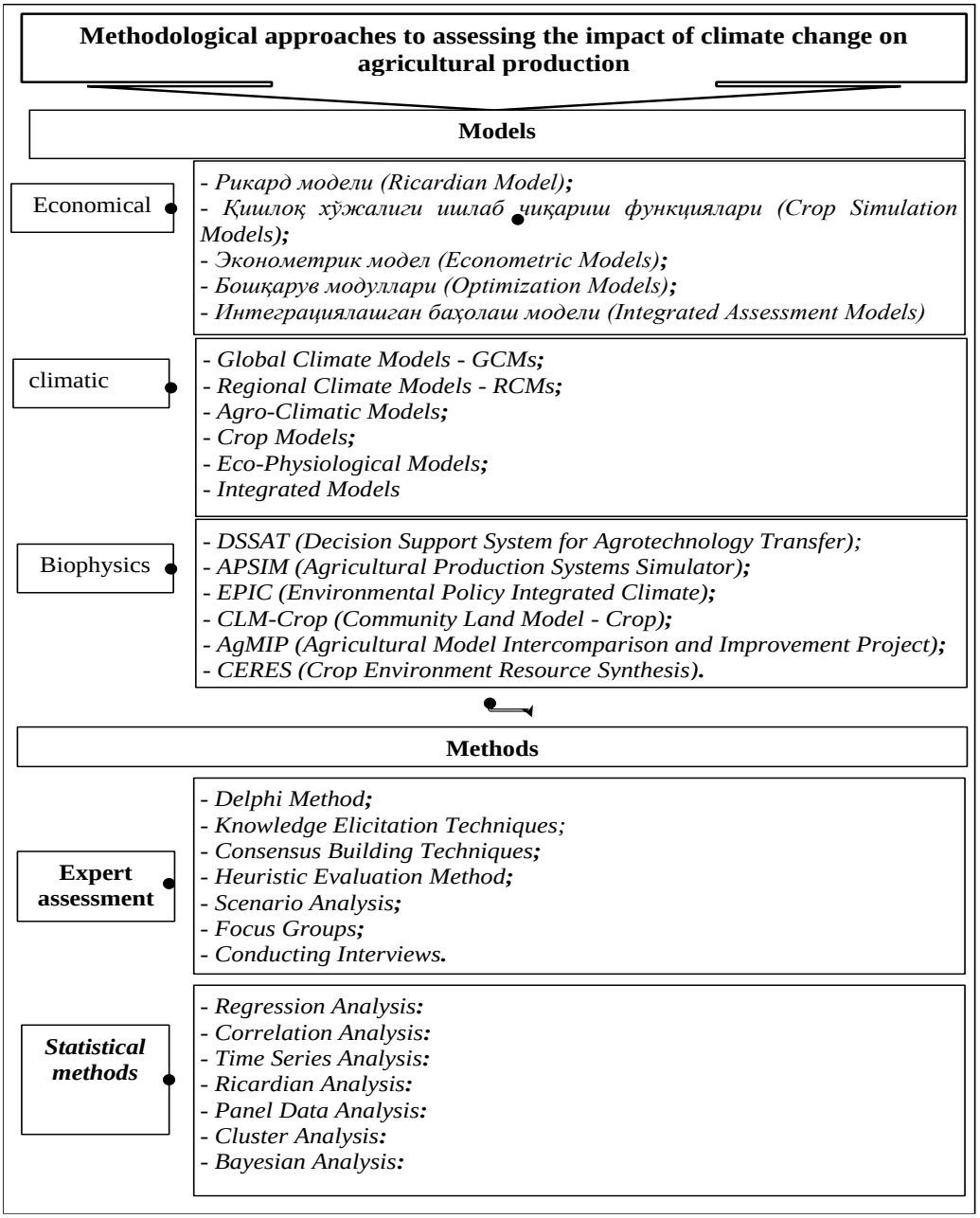

Figure 1. Existing methodological approaches for assessing the impact of climate change on agricultural production.

This model was created by the American scientist Robert Mendelssohn and has been widely used in assessing the impact of climate change on agricultural land, the impact on agriculture in developing countries and the importance of adaptation, and the impact on the economy of economically rich and poor countries [1].

Of course, the impact and consequences of climate change on agricultural production are evident, first of all, in the trend of dynamic changes in product yield. Based on this, Agricultural Production Functions (Crop Simulation Models) The model is important and focuses on researching various factors affecting productivity and determining their impact levels. Finally, taking into account the dynamics of changes in long-term climate indicators, water resources supply, changes in soil reclamation and other factors, it

provides an opportunity to develop trends and scenarios of productivity changes in the future.

This model has been widely used by the world's leading scientific institutions and centers, various scientists, and has obtained recognized scientific results for the purpose of simulating and forecasting the production process of agricultural products. These scientific institutions include the Australian Agricultural Research Organization (CSIRO) [2], the French INRA (National Institute for Agricultural Research). An example is Wageningen University & Research (WUR) [3] in the Netherlands.

Based on this model, mainly for the research of economic indicators Econometric models are referred to. These models aim to estimate the impact of climate change on agricultural production based on the analysis of economic indicators. They examine the relationship between climate change and agricultural production. This model has been widely used by major scientific institutions and scientists of the world, and a number of scientific conclusions have been obtained. For example, the American scientist Schlenker and his colleagues, due to climate change, "...predicting a decrease in the yield of crops in the United States, it has been proven that the yield will drop sharply when the number of abnormally hot days increases" [4], and Marshall Burke has proven that climate change affects agriculture, the national economy, and human health. studied the effect.

It should be noted that the above models mainly draw general conclusions based on the study of the impact levels of various factors on agricultural production, and finally, based on these conclusions, Management Modules (Optimization Models) are widely used to analyze climate change adaptation strategies. These models are aimed at optimizing agricultural activities and are widely used to create scenarios on how agricultural production processes can be improved under different climatic conditions.

These models are widely used in economics, engineering, logistics, finance and many other fields to help make decision-making processes efficient and accurate. One of the founders of the model is the Soviet mathematician Leonid Kantorovich, a Nobel Prize laureate , and his research results create wide opportunities for solving the problems of efficient allocation of resources. Even today, this model is widely used by world scientists.

In general, in the generalized version of the above models, there is a possibility of a comprehensive assessment of the relationship between climate change and agricultural production based on Integrated Assessment Models . That is, as mentioned above, it creates the need to conduct interdisciplinary research in this process. These models examine the impacts of climate change, economic development, and social factors on agricultural production. These models make it possible to develop generalized conclusions on the development of various strategies for adaptation to climate change and increasing the efficiency of agricultural production.

Also in assessing the impact of climate change on agricultural production climate models are also widely used. These models include the analysis of two major, namely global climate change scenarios in order to Global climate models (GCMs) predict climate change on a global scale, taking into account the interactions between the atmosphere, oceans, land, and glaciers. GCMs use large amounts of data to estimate future climate change and are composed of regional climate models (RCMs) . Regional climate models (Regional Climate Models - RCMs) Data from GCMs are used to refine regional scale and forecast local climate changes. RCMs provide more accurate information and are used to assess the impact of climate change on agriculture in specific regions.

There are also other climate models, including Agro-Climatic Models. These models aim to study the impact of climate change on agricultural productivity. They analyze how different climate parameters (temperature, precipitation, humidity, etc.) affect agricultural production. Crop models that complement this model are also widely used in science. These models examine the relationship between climate change and agricultural productivity. They analyze the growing conditions of various agricultural crops and how they adapt to climate change.

For example , models such as DSSAT (Decision Support System for Agrotechnology Transfer) and APSIM (Agricultural Production Systems Simulator) are widely used in science . Both of these models are useful tools in agronomy and agricultural research, which are used for the purposes of optimizing farm practices and solving problems of efficient allocation of resources. American scientists led by J. Jones and the University of Florida , International Food Policy Research Institute (IFPRI) in the USA contributed to the development of this model.

APSIM team CSIRO Agriculture and Food , University of Queensland , and University of Southern [5] Queensland like organizations with who conducted research on the development of this model in cooperation . Also, how temperature, precipitation, CO2 concentration and other climate factors affect the development of plants is being studied based on Eco-Physiological Models.

Integrated models, which form a generalization of the above-mentioned climate models (Integrated Models) while is widely used to assess the complex effects of climate change on agricultural production by integrating various climatic, economic and social factors. These models are important tools for further studying the impact of climate change on agricultural production and developing strategies for adapting to future climate conditions.

The third type of models are biophysical models, which are important tools for studying the impact of climate change on agricultural production and developing strategies for adapting to future climate conditions. One of the most widely used of these models is the DSSAT (Decision Support System for Agrotechnology Transfer) model, which differs from other models in that it incorporates yield models for a number of agricultural crops. These models are used to study the effects of climate, soil and agrotechnology on productivity.

APSIM (Agricultural Production Systems Simulator) model is widely used in the analysis of agricultural systems in various aspects . Because APSIM is an integrated model that studies the interactions between plants, soil, climate and agro-technologies. A similar task is EPIC (Environmental Policy Integrated Climate) It is also possible to use with the model.

CLM-Crop (Community Land Model – Crop) models provide an opportunity to study the impact of climate change on plant growth and productivity based on the modeling of matter and energy circulation between the atmosphere and the earth's surface . The AgMIP (Agricultural Model Intercomparison and Improvement Project) model is very useful for comparing several of the above-mentioned different models and studying the impact of climate scenarios on agricultural production as a result of these analyses .

CERES (Crop Environment Resource Synthesis) models are crop yield research models that analyze climate and agrotechnological factors affecting yield. They are used to study the relationship between climate change and agricultural productivity.

Expert assessment methods are important in assessing the impact of climate change on agricultural production. These methods are aimed at learning the knowledge and experience of experts in various fields. The most widely used of them is the Delphi Method. The initiators of this method were Oscar Van Norts, Raymond S., Farr and Charles D. who worked at the Rand Corporation of the United States in the 1950s. Morgans are considered.

In this method, a multi-stage survey is conducted to anonymously obtain opinions and assumptions from a group of experts. At each stage, the results are analyzed and presented back to the experts at the next stage. This process is repeated several times, experts update their opinions, and a final agreement is reached.

World scientists note that the Delphi method is effective in determining the impact of climate change on the agricultural sector, and major scientific conclusions have been drawn from it. That is, it is recognized by world scientists that the opinions and forecasts

obtained from experts through this method are widely used in determining how climate changes affect the production and efficiency of vegetable production [6].

Of course, this method has its advantages and disadvantages. For example, this method has an advantage in terms of summarizing the knowledge and experience of experts in different fields, developing and forecasting various scenarios based on general opinions, but it also has disadvantages such as the fact that it takes a lot of time, and the knowledge and experience of experts affect the quality of the results.

Also, there are many types of expert assessment methods, and in general, they are all based on the knowledge and experience of experts in the field, they differ in the use of respondents in the process of this assessment, different treatment technologies, individual or group work processes.

And statistical methods provide great opportunities in determining the degree of impact of climate change on agricultural production. A number of statistical methods are available to assess the impact of climate change on agricultural production. These methods help analyze data to identify and predict the impact of climate change on agricultural production. Below are the main statistical methods:

3. Results and Discussion

Regression Analysis : This method is used to study the relationship between climate change and agricultural productivity. The effect of climate factors such as temperature, precipitation, CO2 concentration on productivity is evaluated through regression analysis. Multiple regression and time series regression methods are often used.

Correlation Analysis : This method is used to study the relationship between climate parameters and agricultural productivity. Correlation coefficients help determine the degree of correlation between temperature, precipitation, and yield.

Time Series Analysis : This method is used to study the relationship between climate change and agricultural productivity over time. Models such as ARIMA (AutoRegressive Integrated Moving Average) are used for time series analysis.

Today, this model is widely used in the analysis of economic processes and setting prospects in our republic. Because this model is a convenient method for forecasting future values based on the values of the economic process or factors studied on the basis of long-term periodic data.

Land Value Method (Ricardian Analysis) : This method is used to analyze the impact of climate change on the value of agricultural land. This analysis examines the relationship between climate change and land values, assessing the economic efficiency of agricultural production under different climate scenarios.

Panel Data Analysis : This method is used to analyze data from different time periods and different regions. Emergence analysis facilitates a comprehensive study of the relationship between climate change and agricultural productivity. The advantage of this model is that each process includes many years of data collected over time across countries, regions, or manufacturing entities . These data provide continuity and help illuminate changes over time. It also makes it possible to take into account changes over time and their individual distributions when determining the impact of climate change (eg, temperature, precipitation) on agricultural production.

The trends of using these modern economic models by local scientists have been expanding year by year, and a number of scientific results have been obtained. In particular, M.Bobojonova identified areas prone to climate change based on the "Climate Change Susceptibility Index" taking into account the factors of temperature, precipitation and salinity in the cross-section of republics, and Sh.Boboholov " using panel data and a (fixed effect) model of climate change in the cross-section of farms a method of evaluating the effect of changes in factors, i.e., average weather and rainfall, on the gross yield of wheat and cotton" [5].

Another Uzbek scientists A.Mirzabaev [6] and I.Bobojonov used panel data in the economic assessment of the impact of climate change on agricultural production, while a

group of foreign scientists (Thurlow et al. 2009; Sommer et al., 2013; Gupta et al. al., 2014. [7]) have extensively studied the multi-year and seasonal effects of changes in climate factors on agricultural production and gross income of farms on the basis of survey, panel and periodical data in the case of developed and developing countries.

Of course, the results of this research are important in the economic assessment of the effects of climate change on agricultural production in the agriculture of our republic, the assessment of the knowledge and perceptions of agricultural producers about climate change and its effects, and the development of methods for the implementation of adaptation measures against climate change and the evaluation of their results.

Cluster Analysis : This method is used to identify regions with similar climatic and agricultural conditions. Through cluster analysis, it is possible to study the impact of climate change on agriculture in different regions.

Bayesian Analysis : This method combines various data to estimate the relationship between climate change and agricultural production. Bayesian analysis is used to make probabilistic estimates and predictions.

4. Conclusion

The above-mentioned models and methods are important tools for studying the impact of climate change on agricultural production, determining their impact levels, and developing strategies for adapting to future climate conditions. Of course, the use of breeding achievements in reducing the impact of climate change in the cultivation of vegetable crops is of great importance. The creation of varieties and hybrids of vegetable crops resistant to diseases and pests, adverse environmental factors is one of the main factors in reducing the impact of climate change on the cultivation of vegetable products.In addition, in order to reduce the impact of climate change on the cultivation of vegetable products, it is necessary to effectively organize a set of measures that include technical and technological factors such as the use of new technology, fertilizers, plant protection products, improvement of cultivation technology, use of resource-saving production technologies of vegetable crops. It is also important to effectively organize organizational activities such as improving the management of vegetable production, using innovative methods of labor organization and incentive mechanisms.

REFERENCES

[1] Mendelsohn, R., Nordhaus, W. D., & Shaw, D. (1994). "The Impact of Global Warming on Agriculture: A Ricardian Analysis." The American Economic Review , 84(4), 753-771. ; Mendelsohn, R., & Dinar, A. (1999). "Climate Change, Agriculture, and Developing Countries: Does Adaptation Matter?" The World Bank Research Observer , 14(2), 277-293. ; Mendelsohn, R., Dinar, A., & Williams, L. (2006). "The Distributional Impact of Climate Change on Rich and Poor Countries." Environment and Development Economics , 11(2), 159-178.

[2] Keating, BA, Carberry, PS, Hammer, GL, Probert, ME, Robertson, MJ, Holzworth, D., ... & McCown, RL (2003). "An overview of APSIM, a model designed for farming systems simulation." European Journal of Agronomy , 18(3-4), 267-288.

[3] Brisson, N., Gary, C., Justes, E., Roche, R., Mary, B., Ripoche, D., ... & Delécolle, R. (2003). "An overview of the crop model STICS." European Journal of Agronomy , 18(3-4), 309-332.

[4] Supit, I., Hooijer, AA, & van Diepen, CA (1994). "System description of the WOFOST 6.0 crop simulation model implemented in CGMS." Volume 1: Theory and Algorithms . JRC, European Commission.

[5] Schlenker, W., & Roberts, MJ (2009). "Nonlinear temperature effects indicate severe damages to US crop yields under climate change." Proceedings of the National Academy of Sciences .

[6] Burke, M., & Emerick, K. (2016). "Adaptation to Climate Change: Evidence from US Agriculture." American Economic Journal: Economic Policy .

[7] Thurlow James, Tingju Zhu and Xinshen Diao (2009). The Impact of Climate Variability and Change on Economic Growth and Poverty in Zambia. ; Sommer, R., Glazirina, M., Yuldashev, T., Otarov, A., Ibraeva, M., Martynova, L., Bekenov, M., Kholov, B., Ibragimov, N., Kobilov, R., Karaev, S., Sultanov, M., Khasanova, F.,

Esanbekov, M., Mavlyanov, D., Isaev, S., Abdurahimov, S., Ikramov, R., Shezdyukova , L., de Pauw, E. ., (2013). Impact of climate change on wheat productivity in Central Asia. Agric. Ecosyst. Environ. 178, 78–99. ; Gupta,

[8] R., K. Kienzler, C. Martius, A. Mirzabaev, T. Oweis, E. De Pauw, M. Qadir, K. Shideed, R. Sommer, R. Thomas, K. Sayre, C. Carli, A. Saparov, M. Bekenov, S. Sanginov, M. Nepesov, and R. Ikramov (2009). Research prospects: A vision for sustainable land management in Central Asia. ICARDA Central Asia and Caucasus Program. Sustainably agriculture in Central Asia and Caucasus Series No.1. CGIAR-PFU, Tashkent, Uzbekistan.

[9] Искандаров С.Т. Развитие в Узбекистане системы обеспечения выращивания тепличных овощных культур кредитными ресурсами. // "ACADEMY", 2019 й., №6(45), июнь.

[10] Искандаров С.Т. Развития рынка плодоовощной продукции в Узбекистане. "Обозрование и наука в России и за рубежом", 2019 й., - №9 vol.57.

[11] Искандаров С.Т. Оценка экономической эффективности производства овощей в теплицах. "The way of science", 2019 й., №6(64), июнь.