Chapter 9

CLIMATE CHANGE AND SPATIAL TRANSFORMATION OF AGRICULTURAL SPECIALIZATION IN KIROVOHRAD REGION

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INTRODUCTION

The modern world is on the verge of a global climate catastrophe. Industrial greenhouse gas emissions continue to rise, reducing the chances of limiting warming to 1.5°C under the Paris climate agreement. In recent years, many countries have been facing unprecedented climatic and hydrological changes that have a significant impact on all spheres of life, including agriculture. One of these countries is Ukraine. At the regional level, this problem is most noticeable in the agricultural regions of the Steppe, in particular in the Kirovohrad region.

The spatial transformation of agricultural specialization is becoming a necessity in the face of a changing climate, which is making adjustments to traditional farming methods, crop choices and approaches to resource management. The increasing frequency of extreme weather events, such as droughts, floods and changes in rainfall patterns, requires the agricultural sector to adapt and implement innovative solutions.

Agriculture, as one of the key sectors of the economy, is not only dependent on climatic conditions, but also has a significant impact on environmental sustainability. In the face of global change, it is necessary to rethink approaches to specialization in order to ensure food security and sustainable development. This includes not only the selection of more climate-resilient crops, but also the introduction of new technologies, irrigation and soil management methods, as well as the integration of ecological principles into agricultural practices.

Thus, the study of the transformation of agricultural specialization in the context of climate and hydrological changes is becoming a relevant and important area that contributes to the formation of sustainable agricultural systems that can adapt to the challenges of our time and ensure food security for future generations.

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1. The Global Climate Crisis

The global climate crisis is one of the most serious threats facing humanity in the 21st century. It manifests itself in the form of an increase in the temperature of the planet, changes in precipitation patterns, an increase in the frequency and intensity of extreme weather events such as hurricanes, floods and droughts. These changes are having a devastating impact on ecosystems, agriculture, water resources and human health. The main cause of the climate crisis is the increase in the concentration of greenhouse gases in the atmosphere caused by human activities, including the burning of fossil fuels, deforestation and industrial production.

A high level of uncertainty about the consequences of climate change increases the likelihood of it becoming the strongest global catastrophic risk to civilization[1]. At the same time, the analysis and assessment of possible losses of ecosystem services faces a lack of information on the impact of modern hydroclimatic changes[2]. The multidimensional impact of climate change on agriculture manifests itself through extreme weather events, such as water shortages, heat waves, erratic rainfall, flooding and pest outbreaks.[3] In addition, most regions of the planet are experiencing both abrupt warming and atmospheric desiccation, which has significantly affected the global yields of three of the five main food crops[4]. In Ukraine, there are regional differences

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[2] Ahlen I., Vigouroux G., Destouni G., Pietron J. et al. Hydro-climatic changes of wetlandscapes across the world. Scientific Reports. 2021. № 11. DOI: https://doi.org/10.1038/s41598-021-81137-3

[3] Verma K. K., Song X. P., Kumari A., Jagadesh M. et al. Climate change adaptation: Challenges for agricultural sustainability. Plant Cell Environ. 2025. 48(4). P. 2522–2533. DOI: 10.1111/pce.15078. Epub 2024 Aug 13. PMID: 39136256.

[4] Lobell D. B., Tommaso S. Di. A half-century of climate change in major agricultural regions: Trends, impacts, and surprises. Proceedings of the National Academy of Sciences. 2025. 122 (20). DOI: https://doi.org/10.1073/pnas.2502789122.

in the temperature regime[5]. Increase during 1992−2022. global average annual temperature by only 1°C caused it to increase significantly more in Ukraine by an average of 1.81°C[6].

One of the most vulnerable sectors is agriculture, which depends on stable climatic conditions. Climate change can lead not only to lower crop yields, deteriorating soil quality and increasing the prevalence of pests and diseases. These changes can negatively affect the entire food system. developing countries. Therefore, in recent years, the impact of climate change on global agriculture has been considered taking into account adaptation to various development strategies[7]. Applying transformative adaptation to manage climate-induced change can improve the effectiveness and sustainability of climate solutions[8].

Food systems around the world are thus facing a crisis of resilience. Addressing the many interconnected challenges requires a fundamental transformation that must go beyond incremental improvements to individual elements and focus on broader and deeper systemic change[9]. Adapting the agricultural system to global climate challenges will largely depend on the quality of regulatory measures aimed at improving the efficiency of the agricultural sector and supporting the research and development necessary to improve its sustainability[10].

2. Climate change in Kirovohrad region

The temperate continental climate in the Kirovohrad region, which is located in the central part of Ukraine, has changed significantly over the past few decades. This is closely related to global trends in climate change, which are undoubtedly caused, among other things, by anthropogenic economic activity. In 2024, for the first time in several decades, there was a prolonged

[5] Tarariko O. H., Cruse R. M., Ilienko T. V., Kuchma T. L. et al. Impact of climate changes on agroresources of Ukrainian Polissia based on geospatial data. Agricultural science and practice. 2024. 11(2). P. 3–29. DOI:10.15407/agrisp11.02.003

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[7] Hultgren A., Carleton T., Delgado M., Gergel D. R., et al. Impacts of climate change on global agriculture accounting for adaptation. 2025. Nature. № 642. P. 644–652. DOI: https://doi.org/10.1038/s41586-025-09085-w

[8] Fedele G., Donatti C.I., Harvey C. A., Hannah L. et al. Transformative adaptation to climate change for sustainable social-ecological systems. Environmental Science & Policy. 2019. Vol. 101. P. 116–125. DOI: https://doi.org/10.1016/j.envsci.2019.07.001.

[9] Qaim M., Parlasca M. C. Agricultural Economics and the Transformation Toward Sustainable Agri-Food Systems. Agricultural Economics. ICAE 2024 Special Issue Article. 2025. 56(3). P. 327–335. DOI: https://doi.org/10.1111/agec.70023

[10] Vigani M., Fellmann T., Capkovicova A. P., Ferrari E. Harvesting resilience: adapting the EU agricultural system to global challenges. npj Sustainable Agriculture. 2024. 2(21). DOI: https://doi.org/10.1038/s44264-024-00028-y

drought from May to August. In Figure 1, you can see Copernicus satellite data on the distribution of the normalized difference vegetation index (NDVI) as of 5.06.2024 and 5.06.2025.

NDVI is a common remote sensing measurement used to assess green biomass in addition to nutrient, pest, and water stress[11]. This index is actively used to study and monitor vegetation status, as accurate and reliable NDVI time series play an important role in understanding the complex relationships between vegetation conditions, plant health, and plant performance in the ecological environment[12].

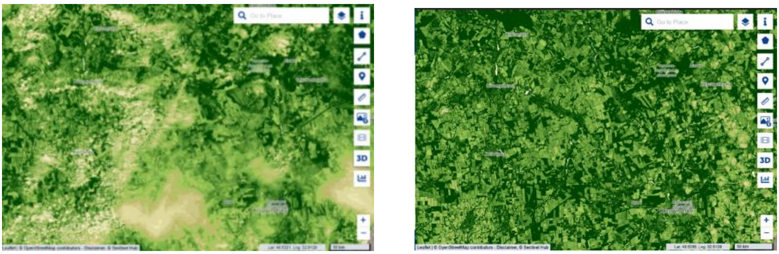

Fig. 1. Index NDVI in the Kirovohrad region (5.06.2024 and 5.06.2025)[13]

The NDVI level is an effective indicator for quantifying green vegetation. It is an indicator of the state of vegetation based on how plants reflect light of a certain wavelength. The NDVI value range is -1 to 1. Negative NDVI values (values approaching -1) correspond to water. Values close to zero (-0.1 to 0.1) usually correspond to barren areas. The shows the dynamics of the abnormal deviation of the average temperature. Long-term data confirm climate change in the region.

Based on the analysis of long-term data from NOAA National Centers for Environmental Information[14] anomalous deviations of the average temperature in the Kirovohrad region in the period 1945-2025 were studied. Coordinate temperature anomalies are with respect to the 1991-2020 average

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[11] Glenn D. M., Tabb A. Evaluation of Five Methods to Measure Normalized Difference Vegetation Index (NDVI) in Apple and Citrus. International Journal of Fruit Science. 2018. 19(2). P. 191–210. DOI: https://doi.org/10.1080/15538362.2018.1502720

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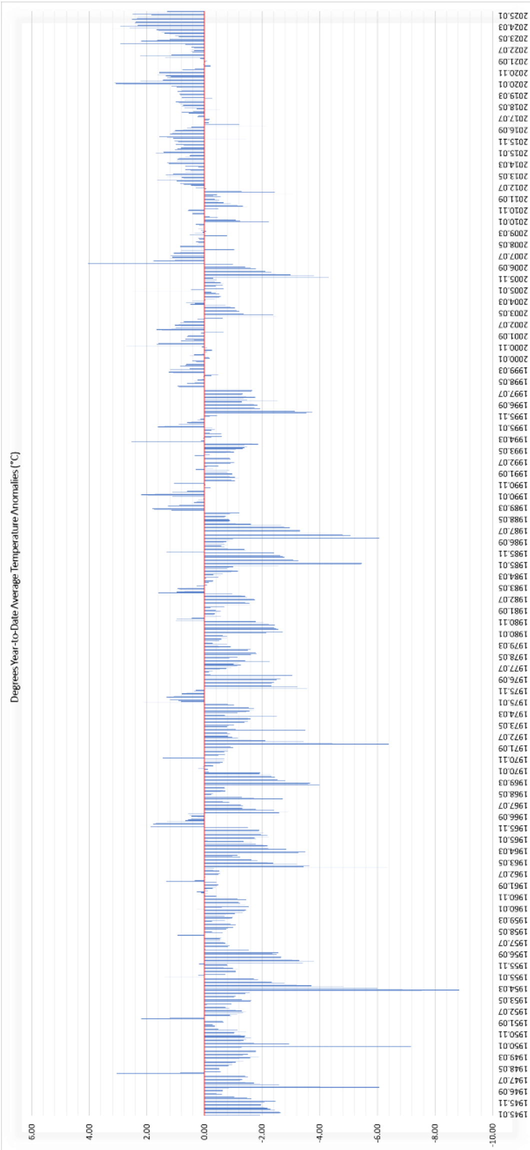
[13] The normalized difference vegetation index. Credit: ESA/Copernicus Sentinel data. URL: https://browser.dataspace.copernicus.eu. (accessed June 20, 2025).

[14] NOAA National Centers for Environmental information, Climate at a Glance: Global Time Series, published June 2025. URL: https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/global/time-series (accessed June 20, 2025).

were used. Analysis of these data revealed several trends. Between 1945 and 2005, the region experienced a predominantly negative deviation from the long-term average temperature (Figure 2).



After 2005, there was a deviation from the average long-term temperature. The shows the results of the statistical analysis of temperature anomalies for 965 months of observations (Table 1).

Table 1

Descriptive statistics of temperature anomalies

	Indicators
Number of months of observation	965
Median	-0.610
Mean	-0.604
Std. Deviation	1.534
Coefficient of variation	-2.541
Range	13.650
Minimum	-8.840
Maximum	4.810

For the entire observation period, a maximum deviation of 4.81°C (January 2025) was recorded, and a minimum deviation was -8.84°C (February 1954). The median temperature deviation was -0.61°C.

The analysis of precipitation was carried out for the period 1979-2024 and also included incomplete data for 2025. For the entire observation period, a maximum of 506 millimetres and a minimum of 46 millimetres were recorded (Table 2).

Table 2

Descriptive statistics of precipitation

	Indicators
Number of years of observation	46
Median	678.000
Mean	680.196
Std. Deviation	99.269
Coefficient of variation	0.146
Range	420.000
Minimum	46.000
Maximum	506.000

The monthly dynamics of precipitation distribution is shown in Table 3. These data cover the period from January to December as precipitation accumulates.

Table 3

Amount of precipitation by cumulative summation, mm

	January	February	March	April	May	June	July	August	September	October	November	December (year)
1979	115	145	208	298	328	367	448	519	533	598	681	741
1980	76	109	223	279	345	480	574	628	668	701	819	926
1981	79	150	207	250	306	374	443	488	537	635	751	874
1982	37	73	82	153	182	281	403	466	486	510	531	589
1983	40	94	135	171	227	282	367	465	479	500	528	560
1984	61	136	193	242	286	431	496	542	609	641	688	736
1985	91	160	170	209	277	403	543	575	643	664	734	777
1986	70	134	149	180	188	255	332	370	381	418	438	508
1987	90	104	145	187	238	316	355	444	476	485	553	603
1988	27	73	162	200	264	376	468	530	586	623	658	738
1989	15	60	95	135	172	270	302	363	491	543	585	629
1990	23	85	95	186	228	359	431	480	538	579	621	719
1991	30	82	88	135	247	322	439	531	544	606	631	667
1992	34	66	118	148	219	318	343	364	399	470	540	560
1993	31	81	154	207	272	373	443	492	577	586	619	694
1994	59	82	123	164	229	283	317	397	404	450	474	532
1995	57	101	157	221	284	403	440	518	631	641	707	772
1996	44	101	142	185	206	265	298	351	474	504	558	598
1997	22	53	79	138	196	323	436	546	588	648	704	793
1998	37	55	132	166	210	280	398	478	504	589	672	697
1999	66	128	190	242	282	341	402	440	464	498	588	697
2000	64	109	163	214	264	335	453	502	627	627	694	728
2001	40	93	184	234	301	436	509	520	588	610	698	737
2002	22	54	89	114	172	268	343	417	514	597	649	663
2003	104	147	182	216	242	290	380	428	445	556	578	615
2004	126	199	222	241	312	346	478	591	662	688	773	807
2005	58	170	204	244	286	390	455	547	548	594	634	738
2006	35	92	184	218	286	397	440	495	554	591	618	633
2007	68	121	149	163	191	254	301	385	444	473	553	599
2008	36	51	104	176	233	294	404	425	552	568	614	692
2009	48	139	201	204	251	313	400	416	450	519	543	662
2010	121	230	267	301	369	462	544	570	631	677	734	834
2011	58	94	104	143	183	325	432	468	478	526	528	602
2012	92	138	172	222	255	297	363	406	457	532	568	708
2013	88	163	253	282	336	412	479	509	629	642	674	689
2014	66	81	103	171	307	386	443	479	512	543	570	618
2015	56	103	189	238	298	385	442	455	489	514	583	603
2016	121	195	246	291	408	506	529	581	584	706	783	836
2017	50	98	118	165	193	233	333	366	392	451	491	632
2018	82	151	261	276	303	388	483	487	566	583	631	724
2019	90	124	147	193	249	315	367	391	407	426	448	506
2020	24	103	129	148	247	312	352	358	389	440	465	521
2021	98	179	229	280	358	467	563	642	674	693	726	841
2022	41	54	68	135	168	213	259	333	424	440	509	601
2023	16	60	107	209	237	277	391	410	418	467	579	654
2024	70	116	208	271	292	357	374	403	426	513	562	636
2025	24	51	83	110	188	-	-	-	-	-	-	-

Since 1979, there has been a clear trend of decreasing annual precipitation. The total amount of annual precipitation is shown in December. A comparison of annual data for 2024 and 1979 shows a decreasing trend in precipitation (Table 4).

Table 4

Descriptive statistics of precipitation

	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December (year)**
Median	58	103	156	206	253	330	432	473	513	574	616	678
Mean	60	110	158	203	258	343	417	469	519	562	615	680
Std. Deviation	30	43	53	50	57	69	75	77	84	81	93	99
Coefficient of variation	0.5	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.1
Range	111	179	199	187	240	293	315	309	293	288	381	420
Minimum	15	51	68	114	168	213	259	333	381	418	438	506
Maximum	126	230	267	301	408	506	574	642	674	706	819	926
2024 to 1979, %	60.9	80.0	100.0	90.9	89.0	97.3	83.5	77.6	79.9	85.8	82.5	85.8

The most significant decrease in precipitation was recorded in January. In 2024, only 60.9% of the 1979 level fell. In general, for the year this figure was 85.8%. This decrease in precipitation can lead to a deterioration in water resources and an increase in dry periods, underscoring the need to take measures to adapt to changing climatic conditions. A decrease in precipitation may have a negative impact on the region's agriculture. It could also lead to an increase in the frequency and intensity of droughts, which in turn would affect food security and the sustainability of regional development.

Reduced rainfall can also have a catastrophic impact on biodiversity, as many plant and animal species depend on stable moisture levels in local steppe ecosystems. This underscores the importance of continuous monitoring of climate change and its impacts. Comprehensive climate change mitigation measures are needed, including sustainable water management and additional scientific research. It is also important to develop and implement innovative technologies that contribute to the efficient use of water in agriculture.

3. Transformation of agricultural specialization in the region

The concept of "transformative adaptation" explores the patterns of climate change impacts on agriculture in the future, which can provide a basis for analyzing where and when to make changes[15]. Agricultural intensification negatively affects biodiversity, contributes to climate change and degrades ecosystem services. To achieve sustainable development and ensure food security, it is necessary to introduce transformational changes in society and politics, as well as to revise the consumer model for the development of regional food systems[16]. In the current context of intensifying global climate change, it becomes necessary to support the transformation of agriculture aimed at introducing climate-resilient smart farming methods in different regions of the planet[17]. Current strategies need to be reconsidered to facilitate a more sustainable transition to climate-smart regenerative agriculture[18].

The spatial transformation of agricultural specialization in the context of climate change is an important and relevant topic that requires in-depth analysis. Climate change has a significant impact on the agricultural sector, leading to the need for adaptation and changes in specialization. Agriculture, as one of the key sectors of the economy, is facing new challenges related to changes in temperature regimes, precipitation and the frequency of extreme weather events. As a result, regions previously favorable for certain crops may become less suitable for growing them. This requires farmers to rethink their strategies and choose crops that are more resilient to climate change. For example, in some regions, there may be an increase in interest in drought-tolerant plant varieties that are better able to survive in conditions of limited water supply. It is also worth noting that climate change can lead to a shift in the boundaries of agricultural zones, which opens up new opportunities for agricultural production. This can be seen in the example of the Kirovohrad region, where until 1990 the area under soybeans and rapeseed was insignificant.

However, on the other hand, it also poses risks to traditional farming methods and crops. It is important to take into account that adaptation to climate change requires not only changes in crop choices, but mainly in the introduction of new technologies and management methods. For example, the use of drip irrigation systems can significantly improve water use efficiency. In addition, it is necessary to actively work on the creation of new varieties of plants that will be more resistant to changing conditions. The need to improve the knowledge and skills of farmers so that they can adapt effectively to new conditions is also an important aspect.

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[15] Panda A. Transformational adaptation of agricultural systems to climate change. Wiley interdisciplinary reviews: Climate Change. 2018. 9(4). DOI:10.1002/wcc.520

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[18] Gosnell H., Gill N., Voyer M. Transformational adaptation on the farm: Processes of change and persistence in transitions to 'climate-smart' regenerative agriculture, Global Environmental Change. 2019. Vol. 59. DOI: https://doi.org/10.1016/j.gloenvcha.2019.101965.

In the face of climate change, sustainable agriculture is also becoming increasingly important, which aims to preserve ecosystems and biodiversity. This can include practices such as crop rotation, agroforestry, and organic farming. In addition, the social and economic aspects associated with the transformation of agriculture need to be taken into account. For example, a change in specialization can affect employment in rural areas, which requires the development of support programs for local communities. It is also important to consider that changes in agriculture can have implications for food security. Therefore, it is necessary to develop strategies aimed at ensuring sustainable food production.

In this context, cooperation between government agencies, scientific institutions and agricultural producers becomes particularly important. Joint efforts can lead to better solutions and innovations that contribute to adaptation to climate change. Therefore, the spatial transformation of agricultural specialization in the context of climate change is a complex stage of adaptation and coordination of interests, requiring an integrated approach and the active participation of all parties.

Thus, the transformation of agricultural specialization in the context of climate change is a multifaceted process of actions and management decisions that requires a deep system analysis and adaptation to existing problems. Climate change is affecting the agrobiological and hydrological conditions of production activities, forcing farmers to reconsider their approaches to crop revision. Table 5 shows the spatial changes in the area of crop cultivation in the Kirovohrad region between 1990 and 2024.

In 1990, the areas of grain corn, sunflower, soybeans and rapeseed occupied an insignificant area in the region. Climatic conditions during this period were more favorable for the cultivation of traditional cereals, sugar beets and fodder crops. Since 2000, the acreage of sunflower, soybean, rapeseed and grain corn has increased dramatically. This disrupted the optimal regional spatial specialization. These changes have been driven in large part by globalization and increased demand for these crops. However, climate change has also affected a significant spatial transformation of regional agricultural specialization.

In the face of rising temperatures and changing rainfall patterns, it is necessary to look for resistant plant varieties that can adapt to new conditions. The introduction of precision farming technologies can significantly improve resource efficiency and reduce the negative impact on the environment. Agriculture needs to become more integrated with ecosystems, which will preserve biodiversity and improve soil quality. The development of agroecology as an approach can help to create sustainable agricultural systems that are less dependent on external factors. It is also important to consider the social aspects of transformation, including training farmers in new methods and technologies. Cooperation between government agencies, academic institutions and the private sector will be a key factor in success. It is necessary to develop systems for monitoring and forecasting climate change so that farmers can adapt to new conditions in advance. Adopting innovative practices such as vertical farming and hydroponics can be a solution for regions with limited resources. It is also worth paying attention to the processing of agricultural waste, which will create closed cycles and reduce the burden on nature.

Table 5

Transformation of sown area size by main types of agricultural crops (thousands of hectares)

Years	Cereal and leguminous crops	Sugar beet (for processing)	Sunflower	Soya	Winter rapeseed and colza (spring rapeseed)	Potatoes	Vegetables	Fodder crops	Area of fruit and berry plantations (total)	Grapes
1990	822.9	127.4	148.9	2.0	0.1	43.2	17.7	527.5	27.7	0.1
2000	747.5	52.5	244.1	3.3	6.7	58.0	24.9	249.6	12.8	0.1
2001	870.0	52.4	213.0	6.2	2.1	57.8	23.1	211.6	11.5	0.1
2002	880.4	52.8	248.2	10.5	1.6	57.7	23.9	183.3	11.3	0.1
2003	675.4	48.3	379.8	26.8	2.5	57.6	23.2	152.8	9.1	0.1
2004	907.8	39.2	330.5	33.4	4.6	57.4	21.7	115.4	7.9	0.1
2005	869.9	28.7	371.8	65.3	8.1	53.7	19.9	94.8	7.1	0.1
2006	882.7	41.3	354.2	128.8	23.3	50.7	18.6	78.7	6.9	0.1
2007	941.2	23.0	308.7	91.2	67.6	48.2	18.1	73.2	6.6	0.1
2008	844.5	14.5	412.7	49.7	149.4	45.0	17.5	62.0	6.5	0.1
2009	881.3	11.9	411.8	74.0	52.6	42.6	17.0	60.3	6.2	0.1
2010	855.3	18.2	420.6	115.7	77.4	42.2	17.0	55.6	6.2	0.1
2011	859.8	20.6	465.5	125.3	50.1	42.4	17.0	53.6	6.0	0.1
2012	823.5	17.8	490.1	171.5	23.6	42.0	16.8	60.9	5.8	0.1
2013	863.8	8.4	509.7	125.5	53.0	40.4	16.8	51.2	5.8	0.1
2014	798.9	14.9	545.4	152.2	50.5	40.2	16.3	47.8	5.8	0.1
2015	811.7	13.6	546.1	175.8	23.7	40.2	16.7	46.5	5.7	0.1
2016	813.2	17.1	577.8	151.8	23.4	40.8	17.0	45.7	5.5	0.1
2017	818.0	15.3	553.2	159.8	35.7	43.8	18.4	47.6	5.3	0.1
2018	832.1	10.7	590.6	116.2	42.3	43.5	18.2	45.0	5.2	0.1
2019	863.6	10.0	569.3	94.0	61.1	41.9	17.9	42.2	4.8	0.1
2020	861.7	11.6	609.8	76.1	45.4	41.6	17.8	41.0	4.7	0.1
2021	900.1	10.4	607.7	64.6	28.8	39.4	17.0	39.1	4.4	0.1
2022	861.6	9.0	603.9	76.9	68.0	39.9	16.7	36.7	4.4	0.1
2023	793.1	10.1	634.0	97.7	83.5	41.4	17.3	38.1	4.4	0.1
2024	754.8	9.9	648.8	149.2	66.3	0.0..	0.6	39.3	1.2	-

Developing local markets and shortening supply chains will help increase the resilience of agriculture to external shocks. It is important to take into account the cultural and historical characteristics of the regions when introducing new technologies. Agriculture needs to become more flexible and adaptive to cope with unpredictable climate change. The development of new policies and strategies at the state level will help create an enabling environment for transformation. Climate and soil data should be actively used to optimize agronomic practices. The adoption of digital technologies such as blockchain can increase the transparency and efficiency of supply chains. Rural populations need to be involved in decision-making to take into account their needs and knowledge. The development of agritourism can become an additional source of income for farmers and contribute to the popularization of sustainable climate-optimized agribusiness practices. It is important to support research in plant genetics to create new varieties that are resistant to the stressful conditions of rising temperatures and lack of moisture.

Agriculture must be part of the solution to global challenges such as climate change and food security. It is necessary to develop programs to restore degraded land in order to increase productivity and preserve ecosystems. Implementing smart agroforestry systems can help control soil erosion and improve the microclimate. Agriculture must take into account not only the economic, but also the environmental and social aspects of its activities. The development of new forms of cooperation between farmers can facilitate the exchange of knowledge and resources. It is important to create conditions for innovation and experimentation in the agricultural sector. The rural population must be ready for change and actively participate in the transformation process. It is necessary to develop programs to increase resilience to climate risks, including insurance and financial support. Agriculture should become more consumer-oriented, taking into account his preferences and needs. It is important to develop international cooperation for the exchange of experience and best practices. The transformation of agricultural specialization in the context of climate change is a challenge that requires an integrated approach and the active participation of all stakeholders.

Education and public awareness of climate change play a key role in adapting to new conditions. New approaches are needed in curricula that should contribute to the development of environmental thinking and competencies in students.

It is important that governments and international organizations cooperate in the fight against climate change not only at the interstate level, but also at the regional level as well. In addition, it is necessary to develop strategies aimed at reducing greenhouse gas emissions and protecting ecosystems. Sustainable development must be a priority for all countries to ensure a future for future generations. In conclusion, it is important to note that the analysis of climate change shows a sharp decrease in precipitation in the Kirovohrad region and an increase in the abnormal deviation of the average temperature.

This is a serious problem and a threat to sustainable development that requires immediate attention to this problem.

CONCLUSIONS

Climate change has a significant impact on agriculture in the Kirovohrad region, which requires careful analysis and adaptation. Changes in temperature and precipitation are necessitating a revision of traditional farming practices. The specialization of agriculture in the region is beginning to transform in response to new climatic conditions. This creates challenges for farmers, who must adapt to changing conditions. It is important to note that some crops are becoming less resilient to new climatic realities, which requires the search for alternative solutions. Farmers are faced with the need to introduce new technologies and sustainable practices in order to maintain yields at a high level. In the face of climate change, research aimed at developing sustainable models for the development of food systems is becoming increasingly important. It is also necessary to take into account the impact of climate change on soil resources, which can be degraded by extreme weather conditions. It is important that strategies for spatial adaptation to climate change and the transition to optimal specialization be developed at the regional level. These strategies should include training farmers in new techniques and technologies. Applying innovative approaches can help improve the sustainability of agriculture. In addition, it is necessary to develop systems for monitoring climate change and its impact on the agricultural sector. This will allow you to quickly respond to emerging problems and adjust strategies. It is also important to take into account social aspects, such as changes in lifestyles and habits of the population in response to climate challenges. Sustainable agricultural development requires an integrated approach that includes economic, environmental and social factors. It is also important to develop local markets and support farmers in their quest for sustainable production. In the context of climate change, it is necessary to take into account not only the economic, but also the environmental consequences of agricultural activities. This requires a revision of approaches to natural resource management. Farmers should be aware of their role in preserving ecosystems and biodiversity. Applying sustainable practices can help not only adapt to climate change, but also mitigate its effects. Investments in research and development aimed at improving the sustainability of agriculture are needed. This may include financing projects to implement climate-smart agriculture. Climate change requires agriculture in the Kirovohrad region to be flexible and ready for change. The transformation of agricultural specialization should be aimed at sustainable development and adaptation to new environmental conditions. This will ensure not only food security, but also the preservation of the region's ecosystems.

SUMMARY

This scientific work is devoted to the study of the impact of climate change on the spatial transformation of agricultural specialization in the Kirovohrad region. In the context of global warming and changing climatic conditions, the agricultural sector faces new challenges that require adaptation. The analysis shows that climate change is affecting crop choices, farming practices, and the distribution of farmland. The paper examines the key factors contributing to the transformation of specialization, including economic, environmental and social aspects. Attention is also focused on the need to introduce sustainable practices and technologies to increase the adaptability of agriculture. The study is based on data on climate change and its impact on the region's food system. The results show that during the observation period, the maximum deviation of the average temperature in the Kirovohrad region by 4.81 °C was recorded, and the minimum deviation was -8.84°C. Comparison of the annual precipitation data for 2024 and 1979 shows a decreasing trend. Successful adaptation requires an integrated approach and collaboration between different stakeholders. In conclusion, the importance of developing strategies aimed at sustainable agricultural development in a changing climate is emphasized. The results obtained can become the basis for further research in the field of sustainable development and climate-smart agriculture.

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