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FUNCTIONING OF FIELD PROTECTIVE FOREST BELTS IN UKRAINE

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Global indicators of the last century confirm the trend of increasing air temperature by 0.74°C and this is one of the reasons of climate change.The consequences of rising temperatures are droughts, a shortened frost period, and a sharp increase in extreme climatic events. Research of the scientists confirms that an increase in the average annual air temperature by 1°C can cause a shift to the north of the latitudinal boundaries of the climatic zones within Ukraine by 160 km. Statistical data for 2018 have confirmed the trend of rapid acceleration of global warming.

During 2011-2022, the average annual temperature ranged from 7.9 to 9.8 °C, depending on the year, which is 0.8-2.7 °C higher than the average multi-year temperature. The warmest years were 2019-2020, and the coolest was 2012. The analysis of the dynamics of the average annual temperature for 2011-2022 showed that from 2011 to 2020, an increase in the average annual temperature was observed from 8.2 to 9.8 °C. During the period from 2011 to 2022, the annual precipitation varied from the long-term average and ranged from 440 mm to 714 mm. The lowest precipitation was recorded in 2015, which was 162 mm less than the long-term average. The highest precipitation was observed in 2013, which was 112 mm more than the long-term average. Over the twelve analyzed years, the average annual precipitation was 595 mm, which was 7 mm less than the long-term average.

The analysis of the results that led to climate change in Ukraine is of a dual nature. On the one hand, with an increase in the average temperature, the agro-resource factor increases, which contributes to the growth of the productivity of the agro-ecosystem. On the other hand, there is a constant increase in the frequency and duration of droughts in Ukraine, which were observed in the second millennium and threaten to reduce the productivity of agroecosystems. Scientists predict that global warming is irreversible, therefore the protection, preservation and reproduction of the system of field shelterbelts, which occupy a special place in the system of measures to adapt modern agriculture to changing climatic conditions, is of crucial importance. Field protective forest belts play a multifunctional role, which is confirmed by observations, the research, and practical activities. Therefore, today the preservation and creation of field protective forest belts is one of the effective areas in an integrated approach to the adaptation of agriculture and crop production to climate change.

Keywords: *protective forest plantations, undergrowth, brushwood, cultivation, environmental problems, climate change, global warming, ecological functions, field protective forest belts.*

Table. 2. Lit. 15.

Statement of the problem. Field protective forest belts, being part of the natural sphere of territorial ecosystems, perform a number of important and specific ecological, economic and social functions.

Field protective forest belts affect water exchange and the state of aquatic ecosystems, prevent water and wind erosion of soils, prevent the formation of landslides and ravines, consolidate sand arenas and regulate the groundwater level, preserve landscapes, perform a multifunctional role in improving the environment, ensure guaranteed crop yields, and increase soil fertility [1].

According to the current legislation of Ukraine, the category of field protection forest plantations includes areas that perform the function of protecting the environment and engineering structures from the negative impact of natural and anthropogenic factors [2].

The creation of field protective forest belts on the borders of fields is part of the system of protective afforestation and forms the basis of agroforestry. In the conditions of global climate warming, which is observed today, the functioning of field protective forest belts and their stability as separate agroecosystems is significantly changing, which affects their performance of their primary functions.

Analysis of recent research and publications. Modern information on the multifunctional significance of field protective forest belts in landscapes is associated with the works of V.V. Dokuchaev on the appropriate ratio of arable land, forests, meadows, and water bodies in them, and the works of G.V. Vysotskyi on “forest pertinence” - the spatial impact of forests on the environment [2].

Theoretical principles, developed practical and analytical material, given in the works of G.M. Vysotskyi, V.O. Bodrov, Y.P. Byalovich, V.I. Koptev, make it possible to see the important ecological significance of field protective forest belts for agroecosystems [2].

The problem of protective afforestation was studied by scientists V. Bodrov, G. Vysotskyi, P. Gerasimenko, S. Dudarets, V. Koptevyi, D. Lavrynenko, F. Levon, G. Lobchenko, V. Nakonechnyi, O. Pylypenko, I. Sazonov, V. Svyrydenko, V. Yukhnovskyi and the other researchers [3].

It is also necessary to mention the scientific research of V.V. Lukish, who drew attention to the problem of the functioning of field protective forest belts in Ukraine under global warming conditions (incompleteness of the programs for the creation and maintenance of field protective forest belts, increase of illegal interventions, loss of their structure and stability) and the justification of ways of their preservation and reproduction.

Introduction of ecological, economic and legal mechanisms for involving land owners and users in the preservation, reproduction and creation of a complete system of field protective forest belts [4].

In their research “Ecological and economic principles of the rational use and protection of lands under shelterbelts” I. Openko and T. Yevsyukov outlined the ecological and economic role of shelterbelts in agricultural landscapes [5].

Cholovskyi Y.M. considers agroforestry and land reclamation measures as a component of land use, noting that the creation of agroforestry and land reclamation plantation systems will increase crop yields, reduce the intensity of soil erosion processes, and restore and stabilize the state of the natural environment [6].

Vysotskyi G.M. proves that today in Ukraine there are approximately 1.2 million hectares of protective plantations on the fields of agricultural enterprises, which have various purposes, in particular 440 thousand hectares of field protection forest belts.

Such a quantity does not ensure stable and high crop yields [7].

Existing agroforestry plantations protect only 40% of arable land and require urgent measures to improve their forest reclamation value. It is advisable to increase them by 2-3 times (up to 800 thousand hectares) in accordance with the specific conditions in the regions. Most of the recommendations, regulatory documents, scientific research are not taken into account and are not implemented in production[6].

The purpose of research – is to analyze the problems of the functioning of field protective forest belts in the agricultural landscapes of Ukraine and to find ways to preserve existing ones, create new ones, and further develop of field shelterbelt afforestation in the context of global climate change.

Materials and research methods. The research was conducted on the basis of the study of literary sources on the specified topic, which are presented in the works of Vysotskyi G.N. [3], Lukish V.V. [4, 7], Pylypenko O.I. [3], Gladun G.B. [6], Stadnik A.P. [8], Furdychko O.I. [3], regarding the ecological problems of the functioning of field protective forest belts in conditions of climate change.

The obtained results were summarized, and the probability of restoring of field protective forest belts in changing climatic conditions was assessed.

Research results. Field protective forest belts form a stable vegetation cover and the climate; they are an ecological factor, have a significant impact on the environment and are a shelter and habitat for plants, animals, fungi and viruses.

However, climate change observed in Ukraine over the past few decades has a significant impact on the performance of their environmental protection functions by forest shelterbelts.

In Ukraine, the surface air temperature has increased over the past fifty years and at the beginning of the 21st century was the highest during the entire period of continuous monitoring of meteorological observations, starting from 1891.

These changes are observed throughout the year. Over the past twenty years (1991-2010), the average annual air temperature in the plain part of Ukraine has increased by 0.8°C in accordance with the climatic norm (1961-1990).

According to scientists' forecasts, further warming will occur and the temperature will increase by approximately 1.0–2.5 °C over the period 2012–2050, and the duration and frequency of severe heat waves will also increase [4].

One of the main manifestations of climate change in the Right-Bank Forest-Steppe in the context of global warming processes is a significant increase in temperature and a decrease in precipitation, the manifestation of extreme weather conditions and a sharp increase in the number of natural meteorological phenomena (downpours, tornadoes, whirlwinds, hurricanes).

Spatial changes in the thermal network are reflected by changes in isotherms. Average annual isotherms of 6-7°C in 1961-1990 were in the southeastern part of Ukraine, isotherms of 8°C were located in the central regions of the country, and 9°C in the southern regions. In 1991-2010, the value of each isotherm became higher by 1°C throughout the territory of Ukraine, but the greatest changes are observed in the extreme northeast: isotherms of 6-7°C are not observed in the region, the isotherm of 8°C has shifted to 300-400 km to the north and passes through the northern regions of the country, in the east an isotherm of 8°C appears instead of 7°C, in the south – isotherms of 9 and 10 °C is instead of 8 and 9°C.

The largest changes in temperature are recorded in winter: in the second half of the 20th and early 21st centuries, the temperature increased throughout the country (Table 1) [4].

Table 1

Range of average monthly absolute temperature by periods on the territory of Ukraine (2020-2100 - forecast), °C

Month \ Period, year	1961-1990	1991-2010	2011 – 2030	2031 – 2050	2081 – 2100
January	-8,1…0,4	-5,5…1,2	-5,5… 1,3	-4,1… 2,7	-2,6… 4
February	-6,9…1	-5,1…1,8	-5… 1,7	-4,3… 2,4	-2,4… 4,1
March	-2…5,3	-1,7…5,4	-1,7… 5,4	-0,9… 6,2	0,9… 7,8
April	3,9…11	4,3…11,3	4,5… 11,5	5,2… 12,1	6,5… 13,3
May	9,1…16,7	9,8…16,6	10,2… 17	10,8… 18,9	12,3… 19,5
June	11,8…20,7	12,9…21,2	13,3… 21,8	14,1… 22,7	15,8… 25
July	13,2…23,2	14,9…24,2	15,5… 24,8	16,2… 25,9	18,5… 28,6
August	12,9…22,6	14,5…23,9	15,2… 24,3	16,1… 25,7	18,5… 28,1
September	9,4…18,1	9,3…18,5	10,2… 19,2	10,6… 20,1	13… 22,3
October	4,6…12,5	5…13,2	5,6… 13,4	6,3… 14,5	7,8… 15,9
November	-0,5…7,4	0,1…7,4	0,4… 7,9	1,5… 8,7	3,3… 10,4
December	-5,2…3,7	-4,9…3,2	-4,2… 4,2	-3,2… 5,1	-1,2… 6,4

Source: [4].

The largest increase in temperature relative to the climate norm was recorded in two decades (1991-2010), and the decade from 2000 to 2010 was marked as the warmest in the period of weather observation.

In most of Ukraine, the average annual temperature has increased by 1°C over the past two decades. An increase of 2°C was observed in the northeast of the country: on the climate maps of 1991-2010, there are no -5°C isotherms in this region. In the south, the -2°C isotherm passes where the -3°C isotherm has previously passed [11].

In spring, a relative increase in atmospheric air temperature can be observed throughout Ukraine and will reach a maximum (3 °C and above) in the east.

On the climate maps of 1991-2010, the isotherms of 6 and 7 °C are absent in the eastern and northern regions in spring. In summer, the temperature increased throughout the territory by 1.0-2.0 °C. The direction of the isotherms remained the same as in 1961-1990, but the temperature field was homogeneous. The temperature increase occurred in the south and the average temperature for the season reached 23°C. It warmed by 1°C in the west, where the air temperature was 19°C. In the far east, the isotherm was 21°C. In autumn, the air temperature has changed insignificantly (0.2-0.4°C) and fluctuated from 7°C in the north to 12°C in the south, both in 1961-1990 and in 1991-2010. The largest increase (0.4°C) is observed in the south and southeast of the country. The temperature field has become more homogeneous over the past ten years. The increase in maximum and minimum air temperatures during the cold period of the year led to a decrease in the duration of the cold period (5-28 days), the number of frosty days, and cold winters. The duration of stable snow cover is also decreasing. In Ukraine, there is a tendency towards an increase in the long warm period, which begins in spring 15-20 days earlier and ends in autumn 1-6 days later [11].

An early warm period accelerates the plant growth, and therefore, with early sowing dates, they are exposed to the negative effects of late spring frosts.The growing season of frost-resistant crops (with an average daily temperature of 10°C) begins and ends 2-6 days later, and the duration of the growing season has increased by 4-13 days [12].

Unlike air temperature, annual precipitation has decreased by5-10%. With minor changes in annual precipitation amounts, there has been a redistribution of seasonal and monthly values: there is a decrease in precipitation in winter and summer and an increase in spring and autumn. In October, precipitation increases by up to 20%, and in winter it becomes smaller. During the cold period, the increase in air temperature caused an increase in the frequency of rain and a decrease in snowfall.

The number of cases of sleet, sleet accumulation, and glazed frost is increasing.

During the warm period, there is an increase in the number of days with precipitation, although the number of days with rain becomes fewer and the duration of the rainless period increases.

The increase and intensity of precipitation in most regions of the country increases the frequency of dangerous and natural snowfalls and rains (Table 2) [13].

Table 2

Range of average monthly precipitation by periods in Ukraine (2020-2100 – forecast), mm

Period, year / Month	1961-1990	1991-2010	2011-2030	2031-2050	2081-2100
January	23,1 - 86,7	16,1 - 60,6	14,3 - 60,2	17,1 - 67,5	19,7 - 72,4
February	23,8 - 76,5	15,1 - 59,1	14,3 - 64,5	13,7 - 62,6	14,8 - 64,5
March	18 - 80,7	21,2 - 52,4	27,2 - 56,8	22,3 - 61,4	22,2 - 70,2
Apri	22 - 91	16,8 - 56,7	19,3 - 64	18,3 - 62,1	16,9 - 76,6
May	23,3 - 128	21,5 - 90,2	22,6 - 99,6	22 - 105,1	19,4 - 104,9
June	29,5 - 165	26,3 - 91,1	26,1 - 103,4	28,4 - 99,1	24,9 - 89,8
July	25,2 - 162,8	20,5 - 110,8	16,1 - 112,1	15,4 - 119,8	12,7 - 120,4
August	20,8 - 124,4	23,1 - 87	16,8 - 85	18,1 - 84,9	11,9 - 79,4
September	19,5 - 97	25,7 - 88,4	22 - 98,8	30,8 - 104,8	29,1 - 97,4
October	17,7 - 85,4	21,2 - 63,2	19,4 - 59,2	20,7 - 62,1	20,4 - 71,1
November	25 - 106,4	25,8 - 68,7	28 - 76,4	23,7 - 78,6	23,2 - 82,1
December	29 - 113	24,6 - 72,5	25,2 - 78,2	23,7 - 91,9	27,3 - 90,2

Source: [4].

Precipitation is torrential in nature during the warm period of the year and does not ensure effective accumulation of moisture in the soil, which leads to an increase in the number and intensity of droughts.Together with anthropogenic factors, this leads to an expansion of the zone of risky agriculture and to desertification (desitrification).

An increase in air temperature during the warm period is observed not only near the surface of the earth, but also up to a height of five kilometers and causes an increase in the intensity of convection phenomena: downpours, hail, squalls, tornadoes, and thunderstorms. In recent decades, in Ukraine has taken place a decrease in average and maximum wind speeds and an increase in the number of dangerous weather phenomena: dust storms and blizzards. In the right-bank forest-steppe zone, the basis of the phytocenosis of the field protective forest belts is made up of poplar, pine, birch, and hornbeam.The main species composition of the field protective forest belts is complemented by trees such as siberian apple, prickly plum, golden currant bushes, and prickly rose hips.

Any biocenosis has its own structure and is characterized by the location of individuals of one species relative to the another in the horizontal and vertical directions - this is a spatial construction. The vertical arrangement of plants is called tiering. Tiering of plants is related with the struggle for light, water, and temperature.

The tiering of plants in field protective forest belts is represented by several tiers. The first tier is represented by dominant species: poplar, pine, birch. The second tier is small trees - undergrowth: Chinese apple, steppe cherry. The third tier is bushes of such species as: currant, gooseberry, rosehip. The fourth tier is represented by small herbs 50 cm high and mushrooms that form leaf litter. In field protective forest belts, it is well developed. The litter is better formed in pine forest belts and less - in poplar. In field protective forest belts, it can still be formed from moss and lichen and is found mainly on tree trunks.

The underground layering is formed in a way that reflects the above-ground layer: the lower layer is represented by the roots of poplar, pine and birch trees, behind it - the roots of the undergrowth are located upwards, behind them - the root system of shrubs, and in the litter - the roots of herbaceous plants. The roots of plants in the shelterbelts are located in the surface layer of the soil. In the horizontal plane of the forest belts there is herbaceous vegetation, shrubs and trees. On the edge of the forest belts there is a forest effect, which is characterized by a great variety of plant and animal species. Grasses grow here: yarrow, wild strawberry, thyme, mouse pea, and sleep grass, and closer to the shrubs you can find plants of the cereal family: meadow fescue, creeping wheatgrass, awnless wheatgrass and a great variety of mushrooms.

In field protective forest belts, the mosaic of plant groups is clearly expressed: light-loving herbaceous plants - in the clearings, shade-tolerant - under the crowns of the trees, moss has grown in spots. Such a spatial arrangement is an indicator of the contrast of ecological niches, the diversity and completeness of human use of the natural environment, the constancy of species diversity and the degree of impact of anthropogenic activity. The most diverse horizontal arrangement and mosaicism are in poplar and birch forest field protective forest belts, and in the depths of the pine forest belt, herbaceous vegetation is poor.

The complexity and differentiation of ecotypes of field protective forest belts depends on the morphology and composition of the forest phytocenosis-edificator. The water regime of the soil under forest belts has a greater amplitude due to the additional moisture input from snow and increased moisture consumption during the growing season [7, 8]. Trophotopes in forest belts change towards the intensification of the accumulation of humus and biogenic elements according to the group profile. The content of active humus significantly increases and the content of seed humus in the 0-20 cm soil layer of chernozems decreases [9]. Under steppe plantations, according to L.P. Travleev (1977), they do not degrade, but acquire new special features, and this allows them to be classified as improved and forest chernozems [14].

In the zone 30 N of the field protective forest belts, climatopes have a decrease in wind speed by an average of 30-50% and an increase in the temperature of the surface air layer by 1-3°C and relative humidity by 3-5%, a decrease in evaporation by 12-35% and a decrease in the transpiration coefficient of cultural biocenoses by 10%. Trophotopes in the zone of the influence are characterized by an increase in moisture reserves in the meter layer of soil by an average of 30-55 mm and an increased content and reserves of humus and biogenic elements due to an increased influx of organic matter and increased humification processes. The integral improvement in soil quality over 30-50 years of the positive impact of field protective forest belts in black soil Forest-Steppe is respectively equal to 25%, and the morphology and fertility indicators of soils shift from the south to north to type I [11]. In the system of field protective forest belts, a synergistic effect is noted regarding the impact on trophotypes and geochemical processes in agrolandscapes.

The value of field protective forest belts as hydrochemical barriers is to retain sediments and pollutants that accumulate in the protection zone and participate in biochemical exchange and prevent territorial migration. Therefore, directly in the field protective forest belts at a distance of 2 N from it, there is a tendency to increase the gross content of metals introduced with mineral fertilizers and ameliorants [12]. The distribution of chemical elements Cu, Co, Fe, Mn, Cr, Cd, Pb, Zn, Al in the zone of influence on chernozems changes the structure of the stands: a non-blowing field protective forest belt retained the bulk of pollutants and sediments under the canopy and the adjacent zone 1-5 N, openwork and openwork-blowing - distributed pollutants in the zone 15 N [13].On erosion-prone arable lands (slopes of 1.5...4°), under the complex influence of field protective forest belts, a “soil protective shadow” is formed with an increased humus horizon thickness of 9-12 cm in the zone 20-30 m up and 60-80 m down the slope due to sediment clogging, increased productivity and anti-erosion resistance in the zone of influence [15].

Scientists have proven that forest stands up to 15 m wide in xerophytic conditions, due to the water regime, have the positive growth, productivity and life cycle indicators compared to massifs. In the Right-Bank Forest-Steppe, the highest productivity on black soil is characteristic of poplar shelterbelts, and the longest life cycle is with common oak and its classic companions - maple, linden, pear 2015. Supplementing of oak stands with common birch and cherry increases productivity and accelerates the entry of stands into operation due to intensive current growth at the young age [15].

Over the past five years, there have been significant changes in natural and hydrological conditions, which have caused rapid depletion of field protective forest belts. If three years ago the drying of field protective forest belts was characterized by the death of individual trees and small groups of them, today there is a sudden drying of entire stands, regardless of their age, type and location [12].

Under the influence of climate change and anthropogenic factors, the area of field protective forest belts, which include gymnosperms (especially pines) and angiosperms (oak), is decreasing. The noticeable drying out of oak in field protective forest belts, which has been observed in the recent years, leads to the changes in plantings and reduces the effectiveness of their value in protecting fields from adverse climatic conditions [2].

A sharp increase in air temperature, an increase in the volume of moisture evaporation from the soil and a decrease in the amount of atmospheric precipitation cause damage to plants by pests, which cause plant diseases. Diseases reduce the resistance of plants to adverse environmental factors and cause the death of vulnerable parts of trees. Common oak, poplar and white acacia suffer most from these processes [1].

Instead, the areas of tree species that are less demanding on soil moisture and fertility are increasing. Also, the species that are tolerate to higher temperatures are ash, acacia, maple, birch. Therefore, without taking adaptive measures, in the medium term we can expect a reduction in the areas of the young vegetation of classes 1 and 2 by two times or more and an increase in the middle-aged stands by 4% and a noticeable increase in mature and over-mature stands. With effective forest management, the productivity of field protective forest belts in Ukraine can be increased by 10% by 2050, and by 25% by 2100 [2]. Field protective forest belts of single location, which exceed scientifically justified (30 N) distances between them, perform their functions in agrolandscapes with low efficiency. Strong winds, which are observed in the winter-spring period, wind flows are able to blow snow and unprotected soil and carry them over considerable distances. Dust storms and annual deflation have confirmed that large snow and dust collecting basins lead to the accumulation of snow tents in forest strips and adjacent territories, as well as to uneven moistening within the fields, which lead to a delay in the start of spring field work, especially in the places of ineffective structures of field protective forest belts with a compacted profile in the lower part [3].

Conclusions and prospects for further research. Global climate changes has a dual impact on agriculture. Assessing various aspects, it should be noted the positive impact of the extended growing season, climate mitigation in mid-latitude regions, which contributes to an increase in the yield of certain crops. In other regions, however, global warming leads to desertification and an increase in localized drought, and exacerbates the problem of floods. Therefore, under conditions of increasing aridity of the climate, it is necessary to take systematic and scientifically based measures to adapt agricultural production to new climatic conditions. Growing of field protective forest belts on the borders of fields is a part of the system of protective afforestation, which is the basis of agroforestry. Maintaining and restoring of field protective forest belts will help to solve the problems of droughts, soil erosion and adverse natural disasters.Given the fact that global warming is currently taking place, agroforestry ameliorators are considering the possibility of reducing the negative impact of the greenhouse effect and dry winds through afforestation and the creation of modern field protective forest belts.

References

1. Dudyak N.V., Pichura V.I., Potravka L.O. (2019). Environmental and economic aspects of afforestation in Ukraine in the context of sustainable land use. *Land management, cadastre and land monitoring*. № 2. 49−63. [in Ukrainian].

2. Mironov V.V. (1998). Protective afforestation. Kyiv: Forest Industry. [in Ukrainian].

3. Vysotskyi G.N. (1990). The study of the impact on the change of the environment of its growth and on the surrounding space. Kyiv: Greenforest [in Ukrainian].

4. Lukisha V.V. (2013). Problems of field protective forest belts in agricultural landscapes of Ukraine in the context of the climate change. *Ecological sciences*. № 2 (25). 56−64 [in Ukrainian].

5. Openko I.A. (2016). Ecological and economic principles of the rational use and protection of lands under field protection forest belts: monograph. Kyiv: "Komprint". [in Ukrainian].

6. Cholovskyi Yu.M. (2010). Agroforestry reclamation measures as a component of rational land use. *Scientific Bulletin of National Technical University of Ukraine*. Issue 20. 58−62. [in Ukrainian].

7. Lukisha V.V. (1998). Reclamation role of narrow water-regulating forest strips. *Forestry*. № 6. 42−44. [in Ukrainian].

8. Pylypenko A.I. (1973). Wind-shielding effectiveness of field protective forest strips of various designs in leafy and leafless condition: author's abstract of dissertation ... candidate of agricultural sciences. Kyiv. [in Ukrainian].

9. Degtyarev V.V. (2006). The content of colloidal forms of humus in virgin and arable black soils. *Bulletin of the Kharkiv National Agrarian University*. № 6. 55−62. [in Ukrainian].

10. Shanda L.V. (2006). Aspects of steppe forestry: biocenotic plots and their periodic ecotypic system. *Soil science*. Vol. 7. № 3 (4). 84−91. [in Ukrainian].

11. Pylypenko O.I. (2004). The system of soil protection against erosion. Kyiv: Zlatoyar. [in Ukrainian].

12. Dovbysh L.L. (2002). Heavy metal contamination of sod-podzolic soils of forest-agricultural landscapes of Polissya: author's abstract of dissertation ... candidate of agricultural sciences. Zhytomyr. [in Ukrainian].

13. Maksimenko N.V. (2009). Agroecological significance of the long-term existence of the forest belt system. *Scientific works of Uman University of Horticulture*. Issue 71. 229−232. [in Ukrainian].

14. Lukisha V.V. (1978).The ameliorative role of narrow water-regulating forest belts. *Forestry*. № 6. 42−48. [in Ukrainian].

15. Yukhnovskyi V.Yu. (2005). Forest-agrarian landscapes of plain Ukraine: optimization, standards, ecological aspects. Kyiv: Institute of Agrarian Economics. [in Ukrainian].

АНОТАЦІЯ
ФУНКЦІОНУВАННЯ ПОЛЕЗАХИСНИХ ЛІСОСМУГ В УКРАЇНІ

Глобальні показники минулого століття підтверджують тенденцію підвищення температури повітря на 0,74°С, і це є однією з причин зміни клімату. Наслідками підвищення температури є посухи, скорочення морозного періоду, різке збільшення екстремальних кліматичних явищ. Дослідження вчених підтверджують, що підвищення середньорічної температури повітря на 1°С може спричинити зміщення на північ широтних меж кліматичних зон в межах України на 160 км. Статистичні дані за 2018 рік підтвердили тенденцію стрімкого прискорення глобального потепління.

Упродовж 2011-2022 рр. середньорічна температура становила, залежно від року, від 7,9 до 9,8 °С, що на 0,8-2,7 °С вище за середню багаторічну температуру. Найтеплішими були 2019-2020 рр., а найпрохолоднішим – 2012 рік. Аналіз динаміки середньорічної температури за 2011-2022 рр. показав, що з 2011 по 2020 рр. спостерігалось зростання середньорічної температури з 8,2 до 9,8 °С.

За період з 2011 по 2022 рр. річна кількість опадів відрізнялась від середньої багаторічної кількості і коливалась у межах від 440 мм до 714 мм. Найменша кількість опадів зафіксована у 2015 році, що на 162 мм менша за середню багаторічну кількість. Найбільша кількість опадів спостерігалась у 2013 році, що на 112 мм більше за середню багаторічну кількість опадів. За дванадцять проаналізованих років середня кількість опадів за рік становила 595 мм, що на 7 мм менше за середню багаторічну норму.

Аналіз результатів, які призвели до зміни клімату в Україні, має подвійний характер. З одного боку, з підвищенням середньої температури збільшується агроресурсний фактор, що сприяє зростанню продуктивності агроекосистем. З іншого боку, в Україні постійно зростає частота та тривалість посух, які спостерігалися у другому тисячолітті та загрожують скороченням продуктивності агроекосистем. Вчені прогнозують, що глобальне потепління є незворотнім, тому охорона, збереження та відтворення системи полезахисних смуг, які займають особливе місце в системі заходів з адаптації сучасного сільського господарства до мінливих кліматичних умов, є надзвичайно важливими. Полезахисні лісосмуги відіграють багатофункціональну роль, що підтверджено спостереженнями, дослідженнями та практичною діяльністю. Тому на сьогодні збереження та створення полезахисних смуг є одним із ефективних напрямів у комплексному підході до адаптації

сільського господарства та рослинництва до зміни клімату.

Ключові слова: *захисні лісові насадження, підріст, підлісок, вирощування, екологічні проблеми, зміна клімату, глобальне потепління, екологічні функції, полезахисні лісосмуги.*

Табл. 2. Літ. 15.

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