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FIELD SHELTERBELTS: CURRENT STATE, LAND USE ISSUES AND PERSPECTIVE IN UKRAINE

Andrii KOVALENKO[1], Oksana SAKAL[1], Nataliia TRETIAK[1], Ihor SKOLSKYI[2], Halyna SHTOHRYN[1], Roman TRETIAK[3]

[1]PI IEESD NAS of Ukraine, 60 Tarasa Shevchenka Blvd, Kyiv, Ukraine
[2]Ukrainian National Forestry University, 103 Henerala Chuprynky Street, Lviv, Ukraine
[3]Public association GIS-association of Ukraine, 42 Acad. Hlushkova Blvd, Kyiv, Ukraine

Corresponding author email: o_sakal@ukr.net

Abstract

The paper aimed to present the evolution of policy on the maintenance and preservation of field shelterbelts in Ukraine. Analysis of the current state and dynamics of areas of field shelterbelts indicates an unsatisfactory trend of this type of land use in terms of their ecological and economic suitability and socio-economic needs, and funding for measures to create protective forests and forest shelterbelts is insufficient. It is based on statistical data of the State Statistics Service of Ukraine, the Ministry of Environmental Protection and Natural Resources of Ukraine, the State Service of Ukraine for Geodesy, Cartography and Cadastre, the Accounting Chamber, etc. It is proposed to take into account not only the field shelterbelts on non-agricultural territories of agricultural lands, but also the field protection role of forests in the strategic planning decisions on land use. This approach determines the reflection in the land policy of measures for the maintenance and preservation of field shelterbelts located on agricultural lands, as well as measures to promote protective afforestation.

Key words*: afforestation, field shelterbelt, land use, land policy, land protection.*

INTRODUCTION

One of the key factors that comprehensively determines the productivity of agricultural land, in particular, in areas with high level of agricultural risk, is the presence and condition of field shelterbelts. The protective effect of the field shelterbelts on agricultural lands is explained by the protective properties of forests. Protective stabilizing properties of forests are extremely positive, having a positive impact on objects of special interest to mankind: industrial enterprises, cities and other settlements, transport infrastructure, agricultural lands, water sources and reservoirs, sanitary zones, recreation areas, places with undesirable climate change. However, the problems of environmental protection, as well as increasing the fertility of agricultural land are directly related to the protective impact of forests. For example, reducing the level of forest cover from 5 to 1% causes damage to crops by wind erosion to 55%. Forests play an equally important role in protecting soils from water erosion. There is no soil erosion in the areas adjacent to forests. However, if hydro-technical structures and agro-technical methods can be used to combat water erosion, while forests provide a comprehensive result of wind erosion control. Forests, creating an actual obstacle to the movement of air masses, increase the cross-section (unevenness) of the terrain, reducing wind speed in the surface layer, redistributing air flows at high speeds. By regulating the structure of field shelterbelts and the distance between them, it is possible to provide reliable protection of soils from wind erosion. The protection of agricultural fields by forests is reflected in the fertility of agricultural fields. In protected fields, the yield is higher by 15-25% (Sinitsyn, 1980). The worse the climatic conditions, the higher the increase in crop yields in fields protected by forests or forest shelterbelts, compared with the increase in unprotected fields (Sinitsyn, 1980; Tribunskaya, 1990).

The positive protective effect of field shelterbelts in general should be considered as a set of organizational and economic, agro-technical, forest reclamation, hydro-technical and other measures. The effectiveness of field shelterbelts and the protective function of

forests as an organizational and economic measure takes place only under the condition of rational land structure and ecological stability of land use, and only then depends on other factors.

Field shelterbelts are an important factor in stabilizing land use, in particular in arid regions. Thus, field shelterbelts of various designs possess various protective and reclamation properties. The degree of protection of the fields mainly depends on the length of the shelterbelt and the height of the stand in them (Tribunskaya, 1990).

Forest shelterbelts of landscapes Hladun (2004) calls one of the most important parts of the complex of rational land use, which in combination with other measures will ensure the inexhaustible use of the resource potential of the landscape, promote its self-regulation and self-restoration of the biological system of the modified landscape. He points out that protective forest shelterbelts have a clear spatial impact on the agricultural area protected by them. The sphere of the greatest positive influence of shelterbelts extends on distance of 30 heights of planting in system, and as a whole shows the microclimatic influence on 50-100 heights. The main influence is manifested at a height of 2-3 m in the surface layer of air, and in the soil - within its thickness and occasionally - in the parent rock (Hladun, 2004). The optimal area of all forest areas for every 100 hectares of agricultural land should average 17.47 hectares. With such an area of forests, the level of gross output will reach its maximum value (Hladun, 2004; Tovma, Hrechko & Malynska, 2000). Mishenin (1998) notes that a meaningful classification of the functions of forest resources in combination with the long-term target orientation of lands can be used as a basis for optimizing the forest cover of the territory (region). Among the important and global studies that provide data on the dynamics of the area of protective forests, designed primarily for the protection of soils and water resources, is the FAO Global Forest Resources Assessment (FAO, 2020).

Recent trends in research of field shelterbelts and other protective forests take place in the context of the implementation and improvement of opportunities for organic production (Piddubna, 2016).

An interesting perspective on the role of field shelterbelts linked to the appreciation of the cultural function of the landscape, particularly in the Netherlands and Poland, is shown in the paper by Schaller et al. (2018).

Important from the point of view of mitigation and adaptation to climate change and the role of field shelterbelts are the results of the study Amadi, Van Rees and Farrell (2016), where farm shelterbelts are described as a management tool to reduce erosion, conserve moisture, protect crops and buildings, and sequester carbon.

According to the statistical reporting of the State Service of Ukraine for Geodesy, Cartography and Cadastre (form No. 6-land) for 2016, the area of field shelterbelts was 446.7 thousand hectares. Researchers consider official statistics to be unreliable, citing the fact that forest shelterbelts are subject to illegal logging, and state registration of shelterbelts has not been carried out since 1976. Experts currently estimate the actual area of forest shelterbelts is about 350.0 thousand hectares, and to achieve the normative indicators it is necessary to create another 700.0 thousand hectares (Zhelezna, Bashtovy & Heletukha, 2016).

As Yukhnovskiy, Maluga, Shtofel & Dudarets (2009) point out, the existing forest shelterbelts are in unsatisfactory condition. As a result of land reform, agricultural land has been largely transferred to private ownership (unbundled), and unprofitable field shelterbelts are mainly part of reserve lands, reserve fund and public lands.

Also moments of legal gaps in the disposal of land under forest shelterbelts and unsatisfactory regulatory influence in Ukraine are noted (Zhelezna, Bashtovy and Heletukha, 2016; Piddubna, 2016; Dudiak, Pichura & Potravka, 2019; Mykolayko, Kyryliuk & Kozynska, 2020).

The analysis by Stupak (2016) suggests that having destroyed the elaborate Soviet soil protection system, Ukraine did not manage to develop a new set of legal rules, nor their enforcement mechanisms, to enable soil protection in the new political and economic setting.

In unprotected field shelterbelts, protection, care and reproduction are not carried out,

which makes it impossible for stand to perform their protective functions. As a result of liquefaction of plantations by unauthorized felling, processes of turfing and compaction of soils, emergence of undergrowth and shrub vegetation develop. Forest shelterbelts often become places for grazing cattle, garbage dumps, weed nurseries, suffer from fires while burning stubble, and so on. Lack of silvicultural care leads to the fact that field shelterbelts lose purge (windbreak) and water-regulating properties (Yukhnovskiy, Maluga, Shtofel & Dudarets, 2009).

Due to underfunding of forestry, work on the creation of new field shelterbelts on unproductive and degraded lands, including protective forest shelterbelts, is being carried out in insufficient quantities (State Agency of Forest Resources of Ukraine, 2020). The afforestation area by stand species in 2019 was only 137 ha, of which pine - 59 ha, oak - 51 ha, other hardwoods - 22 ha, birch - 5 ha (State Statistics Service of Ukraine, 2020). Another aspect of the deterioration of the quality of forest shelterbelts is the spread of diseases and pests. Thus, in 2020 there was a deterioration in the sanitary condition of ash, ash-acacia and ash-oak stands of forest shelterbelts in some districts of Luhansk region due to their population by a dangerous pest - emerald ash borer (*Agrilus planipennis*) (State Agency of Forest Resources of Ukraine, 2021).

The issue of reproduction, use and maintenance of field shelterbelts is inextricably linked with the issues of achieving the Global Sustainable Development Goals by 2030 proclaimed by the Resolution of the United Nations General Assembly of September 25, 2015 No. 70/1 and their adapted version taking into account the specifics of Ukraine's development in the National Report "Sustainable Development Goals: Ukraine", compliance with which is provided by the Decree of the President of Ukraine "On Sustainable Development Goals of Ukraine until 2030" (President of Ukraine, 2019). Thus, the issues of field shelterbelts are directly covered by Sustainable Development Goal No. 15 "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss". Although related to the use and operation of field shelterbelts are also Sustainable Development Goal No. 12 "Ensure sustainable consumption and production patterns" (in terms of using a rational model of agricultural production, which includes measures for agroforestry, protection of soils and plantations), and Goal No. 13 "Take urgent action to combat climate change and its impacts" (in terms of preventing adverse climatic effects on soil conditions, etc.). According to the above Decree of the President of Ukraine, the Sustainable Development Goals of Ukraine for the period up to 2030 are guidelines for the development of draft forecast and program documents, draft regulations to ensure a balanced economic, social and environmental dimension of sustainable development of Ukraine. Therefore, the issues of reproduction, use and maintenance of field shelterbelts can be effectively solved if their solution is provided by the documents of the state strategic planning with the use of its inherent scientifically based tools and the implementation of appropriate measures.

MATERIALS AND METHODS

To study the content of the main regulatory and legislative acts, the evolution of policy on the maintenance and preservation of field shelterbelts in Ukraine is used the method of document analysis. The same method is used for retrospective analysis of the creation of field shelterbelts on the territory of Ukraine.

Comparison and content analysis are used to study the implementation of the Sustainable Development Goals in Ukraine, the essence and practice of land use and its planning.

Analysis of the dynamics of land distribution in Ukraine by type of land, assessment of eroded lands of Ukraine in terms of regions and natural areas, characteristics of the ecological state of land use in terms of regions of Ukraine, assessment of the dynamics of arable land in Ukraine are based on statistical data of the State Statistics Service of Ukraine, the Ministry of Environmental Protection and Natural Resources of Ukraine, the State Service of Ukraine for Geodesy, Cartography and Cadastre, the Accounting Chamber, the State Agency of Forest Resources of Ukraine.

RESULTS AND DISCUSSIONS

In agriculture, there is a complex result of the impact of forests on the quantity and quality of water resources, climate, as well as the anti-erosion effect. This result is a change in crop yields. Most often, this complex effect is referred to as the protective function of the forest.

Agricultural lands are the most valuable lands in Ukraine, which occupy a fairly large share of the total area of the country. Thus, as of January 1, 2019, the largest share is arable land, which occupies 54.2% of the country, conversions - 0.3%, perennial plantations - 1.4%, hayfields - 3.8% and pastures - 8.8% (Table 1).

Table 1. Distribution of land in Ukraine by land as of 2018

Type of land	Land area		± 2018/2016, thousand ha
	thousand ha	%	
Lands for agricultural, including	42,682.0	70.7	-44.4
Agricultural land	41,329.0	68.5	-178.9
arable land	32,697.2	54.2	+155.9
conversions	190.5	0.3	-43.2
perennial plantations	863.0	1.4	-29.4
hayfields	2,294.4	3.8	-112.0
pastures	5,282.6	8.8	-151.5
Under outbuildings and yards	584.4	1.0	-2.7
Under roads and runs	715.1	1.2	+278.7
Forests and other forest areas	10,685.6	17.7	+52.3
Constructed land	2,549.8	4.4	-3.1
Earth under water and open wetlands	3,397.8	5.6	-10.9
Other lands	905.93	1.5	-127.9
Total	60,354.9	100.0	-

Source: Data by the State Service on Geodesy, Cartography and Cadaster of Ukraine.

The data in Table 1 show a significant increase in the area of arable land with a reduction in the area of other agricultural lands. This distribution of land is characterized by agricultural development and high ploughing of the territories of Ukraine, which significantly exceeds the ecologically justified limits.

The situation with the aggravation of tendencies of erosion processes and soil degradation, as well as the decrease of soil fertility is threatening. The main factors reducing soil fertility, to date, include: low rates of mineral and, especially, organic fertilizers; reduction of measures for chemical reclamation of soils (liming, plastering); non-compliance with crop rotations; non-compliance with anti-erosion measures; use of heavy agricultural machinery, etc. (Ministry of Agrarian Policy of Ukraine et al., 2010).

Soil erosion can be caused by soil and landscape characteristics (slope steepness, soil type, rainfall), which are difficult to adjust, and the nature of land use, which can be changed quite quickly through the use of terracing, creating wind barriers (including forest shelterbelts), as well as changes in factors such as type, density and age of vegetation. In turn, soil erosion is the most obvious indicator of the adverse effects of unacceptable agricultural measures, which lead to reduced crop productivity and often irreversible soil losses (UNECE, 2007). The average annual soil loss from water and wind erosion in Ukraine is 15 t/ha. In absolute terms, this is 15.9 million hectares of land, including 12.9 million hectares of arable land. In some oblasts, the percentage of eroded lands is much higher than the national average (Table 2) (Ministry of Agrarian Policy of Ukraine et al., 2010).

Table 2. Areas of eroded lands of Ukraine in terms of regions and natural areas, thousand hectares (excluding Kyiv and Sevastopol)

Oblasts / natural areas	Eroded lands			
	agricultural land	% of agricultural land	of which arable land	the total arable land
Volyn	362.4	34.5	225.4	33.4
Zhytomyr	87.8	5.8	60.7	5.6
Transcarpathian	39.6	8.7	35.5	17.7
Ivano-Frankivsk	133.7	21.2	98.4	25.8
Lviv	525.0	41.4	380.1	47.7
Rivne	323.3	34.6	224.2	34.1
Chernihiv	81.0	3.9	53.3	3.8
Polissya	1,552.8	19.6	1,077.6	20.7
Vinnytsya	687.5	34.1	593.1	34.3
Kyiv	157.9	9.5	128.8	9.5
Poltava	517.7	23.8	420.3	23.8
Sumy	305.1	17.9	176.3	14.3
Ternopil	244.0	23.2	239.7	28.1
Kharkiv	996.3	41.2	791.2	41.1
Khmelnytsky	628.4	40.1	501.9	40.0
Cherkasy	326.6	22.5	286.1	22.5
Chernivtsi	124.2	26.4	88.5	26.5
Forest-steppe	3,987.7	27.5	3,225.9	27.5
Autonomous Republic of Crimea	999.3	55.6	919.3	72.6
Dnipropetrovsk	1,104.8	43.9	914.7	43.0
Donetsk	1,757.4	85.9	1,080.0	65.2
Zaporizhzhya	1,212.5	53.9	640.8	33.6
Kirovohrad	1,102.4	54.0	886.7	50.3
Luhansk	1,372.3	71.8	1,237.9	97.5
Mykolayiv	964.5	48.0	914.8	53.9
Odesa	1,214.0	46.8	1,081.6	52.3
Kherson	686.2	34.8	961.0	54.1
Steppe	10,413.4	54.4	8,636.8	55.6
Total in Ukraine	15,953.9	38.4	12,940.3	39.9

Source: (Ministry of Environmental Protection and Natural Resources of Ukraine, 2017).

According to the operative information of the territorial bodies of the State Service on Geodesy, Cartography and Cadaster of Ukraine, in 2018, 24.76 hectares of land were conserved by afforestation, and 22.7 thousand hectares of land are under conservation.

Despite the measures taken, the characteristics of the ecological state of land use in the context of the regions of Ukraine are defined as stable and not stable with an average level of load. The structure of land use and ecological imbalance of the land fund in Ukraine since 1991 has not changed significantly. Thus, the assessment of ecological stability of land use within the regions of Ukraine by calculating the coefficients of ecological stability and anthropogenic load (Table 3) shows that the ecological stability of land use in Ukraine remains a stable unstable (Kec.st. = 0.40) and the average level of load (Ka.l. = 3).

The following limits of values according to the Methodical recommendations by Tretiak, Tretiak and Shkvyr (2001) are accepted:

coefficient of ecological stability of the territory (Kec.st.): less than 0.33 - the territory is ecologically unstable; 0.34 to 0.50 - the territory is stable unstable; 0.51 to 0.66 - goes to the limit of moderately stability; if it exceeds 0.67 - the territory is ecologically stable;

coefficient of anthropogenic loading of the territory (Ka.l.): 5 points - high degree of anthropogenic loading (lands of industry, transport, settlements); 4 points - anthropogenic loading (arable land, perennials); 3 points - average anthropogenic loading (natural forage lands, tinned beams); 2 points - insignificant anthropogenic loading (forest shelterbelts, shrubs, forests, swamps, underwater); 1 point - low anthropogenic loading (micro-reserves).

Retrospective

The creation of protective forest shelterbelts in Ukraine has a long history, in particular, since Soviet times. Although one of the primary acts that directly regulated the protection of forests, which performed a protective function, can be considered issued by the Government of the Russian Empire in 1888 Regulations on the conservation of forests. In accordance with this Regulation, forest protection committees were formed under the chairmanship of governors, who were in charge of regulating the use of forests (Forestry, 1991b).

Table 3. Characteristics of the ecological state of land use in terms of regions of Ukraine as of 2018

Oblasts	Kec.st.	Ecological stability	Ka.l.	Anthropogenic load
Autonomous Republic of Crimea	0.41	stable unstable	3	average
Vinnytsya	0.33	ecological unstable	4	significant
Volyn	0.57	moderately stable	3	average
Dnipropetrovsk	0.28	ecological unstable	4	significant
Donetsk	0.29	ecological unstable	4	significant
Zhytomyr	0.55	moderately stable	3	average
Transcarpathian	0.71	ecological stable	3	average
Zaporizhzhya	0.27	ecological unstable	4	significant
Ivano-Frankivsk	0.62	moderately stable	3	average
Kyiv	0.43	stable unstable	3	average
Kirovohrad	0.27	ecological unstable	4	significant
Luhansk	0.41	stable unstable	3	average
Lviv	0.53	moderately stable	3	average
Mykolayiv	0.28	ecological unstable	4	significant
Odesa	0.31	ecological unstable	4	significant
Poltava	0.33	ecological unstable	4	significant
Rivne	0.60	moderately stable	3	average
Sumy	0.42	stable unstable	3	average
Ternopil	0.34	stable unstable	4	significant
Kharkiv	0.34	stable unstable	4	significant
Kherson	0.34	stable unstable	3	average
Khmelnytsky	0.35	stable unstable	4	significant
Cherkasy	0.36	stable unstable	3	average
Chernivtsi	0.51	moderately stable	3	average
Chernihiv	0.47	stable unstable	3	average
Ukraine	0.40	stable unstable	3	average

Source: calculated according to the data by the State Service of Geodesy, Cartography and Cadastre of Ukraine in accordance with the Methodical recommendations (Tretiak, Tretiak and Shkvyr, 2001).

By the Regulations of 1888, all the forests of the European part of Russia were divided into protective and unprotected. Protective forests were subject to mandatory protection. Such forests included forests and shrubs, which:

restrained loose sands on the sea coast, banks of floating and other rivers, canals and other artificial reservoirs;
protected from sand drifts of the city, settlements, railways, highways and postal roads, cultivated lands and various lands;
protected the banks of navigable rivers, canals and water sources from cliffs, erosion and damage by ice drift;
grow on mountains and slopes, if they precede the formation of avalanches and rapid flows (Forestry, 1991a).

One example of a planned solution to the problems of reproduction and protection of the environment in the USSR was approved by a government decree in October 1948, the Plan of field-protective afforestation, the introduction of grass-field crop rotations, the construction of ponds and reservoirs to ensure high and stable yields in the steppe and forest-steppe regions of the European part of the USSR (Council of Ministers of the USSR & the Central Committee of the CPSU(b), 1948).

Developed by scientists to implement the ideas of prominent soil scientists Dokuchaev, Kostychev, Williams, this Plan was aimed at combating drought, climate change, increasing soil fertility, obtaining high and sustainable yields, stopping washing and blowing of soils, consolidation of sands and the most correct use of lands. Central to this long-term plan, which covered the period up to 1965, was field afforestation and irrigation (Kovalenko, 2018).

In foreign countries, similar problems are solved by creating green ecological frameworks.

The Forest Fund of the USSR divided forests into categories of protection, in particular, allocated the following categories and the corresponding purposes of forest use:
protective forest shelterbelts of the state (allocated since 1973; in 1973 amounted to 0.1 million hectares, in 1988 - 0.2 million hectares) - the preservation of forests created earlier in the implementation of the Plan for the transformation of nature, providing prevention of development erosion and preservation of field fertility in steppe and forest-steppe areas;
field and soil protection forests, forest shelterbelts, steppe forests, riparian forests (allocated since 1966; in 1973 they amounted to 19.2 million hectares, in 1988 - 20.2 million hectares) - preservation of natural forests that perform preventive functions and the emergence of erosion, preservation of field fertility, improvement of the microclimate of the environment in areas with extreme weather, climatic and hydrological conditions (Forestry, 1991a).

In general, in the USSR from 1971 to 1983 constant observations and researches of degree of influence of field protective (and stock-regulating) forest shelterbelts on productivity of arable land in various regions of the country were conducted (Tribunskaya, 1990). Forest shelterbelts in the structure of production fixed assets of agricultural production in the USSR accounted for about 3% of their value (Spiridonov, Moreva, Sharaeva et al., 1986).

A unique forest reclamation facility in Ukraine is the so-called Dokuchaev field shelterbelts, which by the decision of the Kirovohrad Regional Executive Committee in 1968 were recognized as a botanical natural monument of local significance. According to the data provided by the State Enterprise “Onykiyeve Forestry” (Onykiyeve village, Kirovohrad oblast, Ukraine), the nature protection object consists of 4 field shelterbelts, which were created in 1896-1898 on the idea of Dokuchaev V. and are of great value for the study of the protective properties of the forest, its impact on increasing yields and as an experience of creating field shelterbelts in the steppe:

Field shelterbelts No. 1 - area 14.0 ha, width 46 m, length 3259 m - main species: oak (*Quercus robur* L.), ash (*Fraxinus excelsior* L.), elm (*Ulmus carpinifolia* Suckow).

Field shelterbelts No.2 - area 16.0 ha, width 46 m, length 3492 m - main species: oak, acacia yellow (*Caragana arborescens* Lam.).

Field shelterbelts No.3 - area 9.4 ha, width 40 m, length 2497 m - main species: oak, ash.

Field shelterbelts No.4 - area 4.1 ha, width 40 m, length 1131 m - main species: - oak, ash, elm.

The distance between shelterbelts No. 1 and No. 2 is 1370 m, No. 2 and No. 3 - 700 m and between No. 3 and No. 4 - 700 m. At the time of creation of the land under the shelterbelts belonged to the peasant holdings.

Field protection effect of the Dokuchaev field shelterbelts was studied at different times by

many scientists and commissions (for example, the Board of Scientists, 2004). The most complete in the context of our study are the conclusions about the field protective effect of these shelterbelts by Sviridenko (1966), which have not lost relevance. According to Sviridenko (1966), the impact on crop yields in the fields of the collective farm "Pobeda" in the Malovyskiv district is significant on average during the period 1961-1965 (Table 4). It is important to note that during Sviridenko's research in 1961-1965, forest shelterbelts were part of the state forest fund and the agricultural collective farm, the fields of which were affected by the shelterbelts, did not incur any forest protection costs. These costs were covered by revenues from felling in the shelterbelts.

Table 4. Influence on the yield of agricultural crops of the Dokuchaev field shelterbelts, which were created in 1896-1898

Agricultural crops	Fields without forest shelterbelts		Fields with forest shelterbelts		Yield increase in fields with forest shelterbelts, centner/ha
	Area, ha	Yield, centner/ha	Area, ha	Yield, centner/ha	
Wheat winter	557	26.1	768	28.4	2.3
Barley	281	29.8	208	38.1	8.3
Maize for grain	1,403	45.3	584	50.9	7.4
Pea	457	16.7	433	21.8	5.1
Sunflower	413	20.6	566	22.9	2.3
Sugar beet	811	279	817	322	43.0

Source: Sviridenko, 1966.

The general conclusions of Sviridenko (1966) indicate the following. Forest shelterbelts, which are located in Onykiyeve forestry and created during the expedition of Dokuchaev V., in terms of growth efficiency, impact on adjacent fields, location on the territory and valuable selection of trees and shrubs are unique forest reclamation objects. The studied field shelterbelts created during the emergence of field protection afforestation do not meet all the requirements of forest reclamation science, in particular, regarding their design (their effective width can be much smaller). The best areas are 23 meters, oak and ash, with Tatarian maple trees (*Acer tataricum*) and elm in the second tier. Some areas of forest shelterbelts have different growth rates, due to the composition of stand, other things being equal. Sviridenko's research (1966) testifies to the effectiveness of oak in field afforestation. Under the influence of forest vegetation, the physical properties of the soil have changed over the years, the horizon of the humus layer has risen, the soil structure has risen, water permeability under forest strips has increased, and the physicochemical composition of the soil has changed. The forest cover of protected fields with the available width of forest shelterbelts is 3.2%. 31.4 ha of fields are under the protection of 1 ha of forest shelterbelts.

Thus, Ukraine has a long experience of creating and operating the potential of field shelterbelts. However, their legal status and quality are unsatisfactory.

Field shelterbelts

Field shelterbelts within state programs (for example, the Verkhovna Rada of Ukraine, 2000) were also considered in terms of increasing the area of the national ecological network. The National program for the formation of the national ecological network of Ukraine for 2000-2015 (Verkhovna Rada of Ukraine, 2000) provided for the creation of forest shelterbelts and protective forests, land reclamation: forest shelterbelts as land - components of the national ecological network were to be 645.5 thousand hectares, or 1.07% of the total area of the country.

The creation of field shelterbelts and protective forests was also envisaged by the General scheme of planning of the territory of Ukraine in early 2002 within the framework of expanding the area of the national ecological network in order to form it as a component of the Pan-European Ecological Network and maintain vital environmental functions, creating the necessary conditions for restructuring and reducing the anthropogenic impact on it to an environmentally acceptable level (Verkhovna Rada of Ukraine, 2002).

Unfortunately, funding for the National Program for the formation of the national ecological network of Ukraine for 2000-2015 in recent years was insufficient, which does not allow to draw correct conclusions about the effectiveness of its implementation and its achievement of forecast parameters. In addition, it, as well as the above-mentioned the General scheme of planning of the territory of

Ukraine, has now expired and needs immediate updating and continuation, taking into account new principles and objectives.

Creation of 107.7 thousand hectares of forest shelterbelts and protective forests on lands not occupied by forests (degraded, unproductive, etc.) was provided by the State Target Program "Forests of Ukraine" for 2010-2015 as part of the task of increasing forest cover by various managers budget funds-permanent forest users (Cabinet of Ministers of Ukraine, 2009).

A productive attempt to solve the problems of reproduction, use and maintenance of forest shelterbelts by means of state strategic planning was made by the Government approval in 2013 of the Concept of agroforestry development in Ukraine, efficient management in them and will be an ecological prerequisite for the balanced development of agricultural landscapes. In turn, this should allow solving the problems of soil protection from degradation and pollution, increasing crop yields, increasing the production of environmentally friendly products, ensuring food security, preserving landscape and biological diversity, creating environmentally safe living conditions (Cabinet of Ministers of Ukraine, 2013). The strategic nature of this document is ensured by the fact that it has a long-term implementation horizon during 2014-2025. However, the relevant action plan for the implementation of the Concept was approved by the Government only a year later, and one of the documents developed in line with the implementation of the Concept - Rules for maintenance and preservation of field shelterbelts located on agricultural land - was approved by the Government only in 2020 (Cabinet of Ministers of Ukraine, 2020), which slows down the scientifically based conceptual and legislative support of the state strategic planning of reproduction, use and maintenance of field shelterbelts in Ukraine.

Calculations according to the actual data of the form No. 6-lands of the State Service of Geodesy, Cartography and Cadastre of Ukraine for 2016 indicate that the area of field shelterbelts is 0.74% of the total area of the country.

The long history of field afforestation and land reform in Ukraine only in 2019 acquired a fuller institutionalized form of regulatory influence on the use of land under field shelterbelts - the Law of Ukraine (Verkhovna Rada of Ukraine, 2018) regulated the issue of collective land ownership, improved land use rules in agricultural lands, defined the list of lands that are subject to transfer to the communal property of the territorial community of the village, settlement, city on the territory of which they are located, among which lands under field shelterbelts are also marked.

In 2020, the Rules for the maintenance and preservation of field shelterbelts located on agricultural lands were approved (Cabinet of Ministers of Ukraine, 2020). These Rules define the basic concepts:

field shelterbelts are artificially created stands of linear type for protection of agricultural lands from negative influence of natural and anthropogenic factors;

maintenance of field shelterbelts - a set of forestry and agro-technical measures aimed at improving the condition or composition of stands, maintenance of appropriate structures;

preservation of field shelterbelts - a set of measures to organize the protection and protection of plantations from fires, illegal logging, damage, weakening, protection from pests and diseases and other harmful effects (Cabinet of Ministers of Ukraine, 2020).

The Land Code of Ukraine (2002) stipulates that field shelterbelts and other protective forests, except for those classified as lands of other categories, are part of non-agricultural lands and belong to agricultural lands. Land plots under field shelterbelts, which limit the mass of agricultural land, are transferred for permanent use to state or municipal specialized enterprises or leased to individuals and legal entities with mandatory inclusion in the land lease agreement of conditions for maintenance and preservation of such shelterbelts and ensuring that they perform the functions of agroforestry reclamation. The obligation to maintain and preserve field shelterbelts is defined as a restriction on the use of land, which may be established by law, regulations adopted in accordance with it, the contract, the court decision. At the same time, the lease of land plots under field shelterbelts serving an array of agricultural lands is not subject to sale on a competitive basis (land auction) of land

plots of state or communal ownership or the right to them (Land Code of Ukraine, 2002).

The dynamics of the area of field shelterbelts in Ukraine (Table 5) during 2001-2016 indicates a slight increase in this indicator in the country as a whole. In spatial terms, the dynamics are very uneven. The increase in the area of field shelterbelts by more than 10% during the study period took place only in two oblasts - Luhansk and Odesa (with some reservations about the scale of changes - in Volyn oblast).

Table 5. Dynamics of the area of field shelterbelts in Ukraine, thousand hectares

Regions\oblasts of Ukraine	2001	2010	2014	2015	2016	2016/ 2001 (%)
Autonomous Republic of Crimea	23.7	23.8	23.9	23.9	23.9	100.8
Vinnytsya	17.1	17.5	17.6	17.6	17.6	102.9
Volyn	0.1	0.2	0.2	0.2	0.2	200.0
Dnipropetrovsk	39.5	42.6	42.5	42.5	42.5	107.6
Donetsk	31.4	31.9	31.9	31.9	32.5	103.5
Zhytomyr	5.1	4.7	5.0	5.0	5.0	98.0
Transcarpathian		0.2	0.1	0.1	0.1	
Zaporizhzhya	55.0	52.5	51.8	51.9	51.9	94.4
Ivano-Frankivsk	0.1					0.0
Kyiv	12.3	13.0	12.3	12.3	12.3	100.0
Kirovohrad	28.1	27.9	28.1	28.1	27.9	99.3
Luhansk	26.8	30.2	30.3	30.3	30.4	113.4
Lviv		0.1	0.1	0.1	0.1	
Mykolayiv	34.1	34.3	33.7	33.8	33.8	99.1
Odesa	42.7	49.8	49.9	50.0	50.0	117.1
Poltava	20.3	19.8	20.0	20.0	20.0	98.5
Rivne		0.1				
Sumy	12.1	13.3	13.0	13.0	13.0	107.4
Ternopil	1.2	1.2	1.1	0.9	1.1	91.7
Kharkiv	25.4	26.1	26.6	26.5	26.3	103.5
Kherson	29.8	29.0	29.0	29.0	29.0	97.3
Khmelnytsky	4.2	4.3	4.2	4.2	4.3	102.4
Cherkasy	14.0	14.0	14.1	14.1	14.1	100.7
Chernivtsi	0.1					0.0
Chernihiv	10.1	10.3	10.3	10.3	10.3	102.0
Kyiv city						
Sevastopol	0.5	0.5	0.4	0.4	0.4	80.0
Ukraine	433.7	447.3	446.1	446.1	446.7	103.0

Source: the form No. 6-lands of the State Service of Geodesy, Cartography and Cadastre of Ukraine.

Types of field shelterbelts depending on their location and purpose in accordance with the Rules for maintenance and preservation of field shelterbelts located on agricultural land (Cabinet of Ministers of Ukraine, 2020) are: field protective (longitudinal and transverse) forest shelterbelts; stock-regulating forest shelterbelts; ravine field shelterbelts; balk forest shelterbelts; roadside forest shelterbelts; garden forest shelterbelts; other field shelterbelts.

According to this approach to the classification of types of field shelterbelts located on agricultural lands, the data of quantitative land accounting are currently limited.

Forestry and field shelterbelts

As can be seen from the above, in the Ukrainian legislation there is a division of categories of land by purpose into agricultural and forestry, which includes forested areas that perform a protective function, and field shelterbelts. Due to the fact that forestry measures play a significant role in the creation of field shelterbelts, we consider it necessary to show some aspects of it. No less important argument is that the positive impact on agricultural production is exerted by forests regardless of their distance from agricultural land (Sakal and Vrublevska, 2010), and not only field shelterbelts of a certain structure and shape.

According to the Forest Code of Ukraine (2006), forests are divided into the following categories according to their ecological and socio-economic significance and depending on the main functions they perform: protective forests, recreational and health forests, forests of environmental, scientific, historical and cultural purposes, operational forests.

Protective forests perform mainly water protection, soil protection and other protective functions. All forests on the territory of Ukraine, regardless of the categories of lands for which they grow for the main purpose, and regardless of the right of ownership, constitute the forest fund of Ukraine and are under state protection. The forest fund of Ukraine includes forest plots, including protective stands of the linear type, with an area of at least 0.1 hectares. The forest fund of Ukraine does not include, in particular, individual trees and groups of trees, shrubs on agricultural lands, homesteads, country houses and garden plots. It is important to emphasize that forest lands do not include lands on which field shelterbelts are located (Forest Code of Ukraine, 2006).

The Land Code of Ukraine (2002) clarifies that forest lands do not include lands occupied by field shelterbelts on agricultural lands. This clarification was made only in 2018.

The category of protective forests includes forest areas that perform the function of protection of the environment and engineering objects from the negative impact of natural and anthropogenic factors. In general, the use of

elms in the artificial stands of the Western Forest-Steppe is expedient: on the lands of the water fund - in the riverbed protection shelterbelts along rivers, around ponds and reservoirs, on well-moistened slightly washed steep banks of the ancient hydrographic network; to create shelterbelts along highways; to create artificial forest shelterbelts with the participation of elms of operational direction. The functions of noise absorption and dust absorption of forest shelterbelts along highways, as well as near crops, are manifested due to the roughness of *Ulmus* L. leaves (Skolskyi, 2011).

To create artificial forest stands on the lands of the water fund, it is necessary to use such rock mixing schemes to prevent erosion of the shores in the future, especially after floods and inundations. To this end, tree species with a strong root system, such as elm (*Ulmus* L.), should be incorporated into the shoreline, using a wood-shade type of mix. Another species with a very well-developed root system is oak, to ensure the successful growth of which should be introduced buffer rows of the accompanying species - maple. Protective plantings should be created with 1-2-year-old seedlings of *Ulmus* L. and other species (Skolskyi, 2011).

To reduce the effects of these adverse events, it is recommended to create a coastal forest strip (Kalinin & Melnyk, 1991).

Another important task in terms of improving the environmental situation is the creation of forest shelterbelts along railways and highways. Exhaust gases emitted into the atmosphere by transport contain heavy metals and carcinogenic substances that pollute the adjacent fields 100-150 m on both sides of the road in the absence of forest shelterbelts. Adverse phenomena on highways are also snow and sand deposits, strong winds, water erosion, etc. To combat these adverse phenomena, it is necessary to create forest shelterbelts on highways. They must consist of fast-growing tree species, resistant to gas and dust, and which come into operation in the shortest possible time. An example of shelterbelts with the participation of the elm. The success of the growth of *Ulmus* L. is determined by the participation in the stand of the faster-growing ash. It is also advisable to include oak in the shelterbelts plantings, and the participation of elm should not exceed 60% in the composition of the plantation (Skolskyi, 2011).

CONCLUSIONS

The problem of field shelterbelts in Ukraine has several sections: institutional definition of this land, its assignment to a certain category of lands, ownership (disposal) of lands under the shelterbelts, it forests reclamation properties, positive impact on yield, and forestry aspect of the shelterbelts structure and composition. Thus, increasing the productivity of field shelterbelts and protective forests in general is a cross-sectoral problem, primarily of agricultural and forestry, which has an organizational, economic and financial nature. All these sections for the proper management of field shelterbelts according to a systematic approach should be reflected in the state planning documents.

Solving the problems of reproduction, use and maintenance of field shelterbelts in the context of achieving the Sustainable Development Goals by 2030 and their adapted Ukrainian version is possible through the use of scientifically sound instruments of state strategic planning and taking into account the rich domestic experience of planning and environmental protection. Existing unresolved issues in this area are the need to update the the General scheme of planning of the territory of Ukraine, the legislation on the formation of the national ecological network, as well as the full implementation of the the Concept of agroforestry development in Ukraine.

An important measure to intensify the reproduction of forest shelterbelts is the reconstruction of stands, it is necessary to increase the completeness of destroyed, replace low-value, low-yielding stands and shrubs with resistant species that have a dust-capturing effect and noise protection efficiency.

Skolskiy (2011), studying the experience of cultivating elms (*Ulmus* L.) in Ukraine, which have a good dust-catching effect due to the roughness of the leaves, summarizing the data of Padiy (Padiy, 1955; 1993) and Knyazeva (1978), notes that to create sustainable protective stands, it is required that the share of

elms in forest and field shelterbelts does not exceed 10% with an even distribution of trees in the area. Care should be taken to ensure that elms do not displace other species. In such plantations there are no favourable conditions for the spread of Dutch disease (drying of elms). On the other hand, even when the elms are completely dry, the plantings will not become noticeably liquefied. At the same time, in addition to protective properties, species of the genus *Ulmus* L. are characterized by valuable wood, are a desirable component of mixed stands, and their precipitation improves the properties of forest soils.

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