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Soil-degradation zoning of Lviv Oblast

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Abstract. We propose a scheme of soil-degradation zoning of Lviv Oblast, which comprehensively illuminates the problem of degradation and focuses on regional differences in the manifestation and complexity of dominant degradation processes. The highest taxonomic unit of soil-degradation zoning is the soil-degradation country, which in turn is divided into

a soil-degradation zone, province, county and district. This classification is based on the landscape features of the study area, the dominant types and kinds of degradation processes. In accordance with the zoning of Lviv Oblast, we have identified the following soil degradation taxa: 2 countries, 3 zones, 5 provinces, 14 counties and 31 districts. The soil-degradation country of the East European Plain unites two soil-degradation zones: Polissia mixed forests and broad-leaved forest zones. The soil-degradation zone (Polissia mixed forests) is best characterized by the processes of deflation and physical degradations. The processes of water erosion and physical degradation of soils dominate within the soil degradation zone (broad-leaved forest zone). Those zones also manifest pyrogenic and chemical degradations. The Carpathian soil-degradation country within Lviv Oblast (the Ukrainian Carpathian zone) is characterized by the distribution of geo-ecological anomalies, mechanical and physical soil degradations. The complex lithological features and geomorphology of the territory in the context of uneven anthropogenic impact determine the intensity of manifestation of degradation. Disturbing the natural stability of the soil cover in the conditions of the mountainous terrain contributes to the activation of the manifestation of degradation processes of geo-ecological anomalies. The problem of soil degradation in Lviv Oblast in the conditions of long-term, intense, and often consumer-orientated agricultural use is considered one of the most urgent tasks of modern agricultural production, soil science, ecology, land management, and environmental protection in general. In addition to arable land, the soils of the Carpathians are degrading due to excessive and often predatory deforestation, recreation and pressure from tourists. As evidenced by numerous scientific publications and our own research, soils are subject to water and wind erosions, overconsolidation and loss of structure, dehumification, depletion, desiccation and aridisation, pyrogenic degradation, contamination by agrochemicals, domestic and industrial wastes, etc. The status of the soils and land resources of the study area is close to critical.

Keywords: soil degradation zoning, soil degradation, Lviv Oblast, soils.

Ґрунтово-деградаційне районування Львівської області

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Анотація. Запропоновано схему ґрунтово-деградаційного районування Львівської області, яка комплексно висвітлює проблему деградації, акцентує увагу на регіональні відмінності прояву та сукупності домінуючих деградаційних процесів. Найвищою таксономічною одиницею ґрунтово-деградаційного районування є ґрунтово-деградаційна країна, яка в свою чергу поділяється на ґрунтово-деградаційну зону, провінцію, округ та район. За основу даної класифікації взято ландшафтні особливості території дослідження, домінуючі типи і види деградаційних процесів. У відповідності до районування Львівської області нами виділено наступні ґрунтово-деградаційні таксони: 2 країни, 3 зони, 5 провінцій, 14 округів і 31 район. Ґрунтово-деградаційна країна Східноєвропейської рівнини поєднує дві ґрунтово-деградаційні зони: Поліську мішаних лісів, Лісову широколистяну. Для ґрунтово-деградаційної зони (Поліська мішаних лісів) найбільш характерними є процеси дефляційної і фізичної деградації. В межах ґрунтово-деградаційної зони (Лісова широколистяна) домінують процеси водної ерозії та фізичної деградації ґрунтів. Властивим для вказаних зон є прояв пірогенної та хімічної деградації. Карпатська ґрунтово-деградаційна країна в межах Львівської області (зона Українські Карпати) характеризується поширенням геоеконормальної, механічної та фізичної деградації ґрунтів. Складні літологічні особливості та геоморфологія території в контексті нерівномірного антропогенного впливу мають визначальне значення на інтенсивність прояву деградації. Порушення природної стійкості ґрунтового покриву в умовах гірського рельєфу сприяє активізації прояву геоеконормальних деградаційних процесів. Проблема деградації ґрунтів Львівської області за умов тривалого, інтенсивного, а часто споживачького сільськогосподарського використання віднесена до найактуальніших задач сучасного аграрного виробництва, ґрунтознавства, екології, землеустрою, охорони довкілля загалом. Окрім орних земель, деградують ґрунти Карпат через надмірні, а часто хижачькі вирубки лісів, рекреаційне та туристичне навантаження. Як свідчать численні наукові публікації і власні дослідження, ґрунти зазнають водної і вітрової ерозії, переущільнення і втрати

структури, дегуміфікації, виснаження, переосушення і аридизації, пірогенної деградації, забруднення агрохімікатами, побутовими і промисловими відходами тощо. Стан ґрунтів і земельних ресурсів території досліджень близький до критичного.

Ключові слова: ґрунтово-деградаційне районування, деградація ґрунтів, Львівська область, ґрунти.

Introduction

Intense, often imbalanced and mostly scientifically unsubstantiated anthropogenic pressure on natural resources has for many decades led to significant destruction of the environment. Transformation of the natural properties of soil cover manifests as a result of irrational agrotechnology, active erosive processes on surfaces of the slopes, contamination with chemicals and industrial wastes, unreasonable disturbance of the hydrological regime of the territory with dry and irrigative land improvements. As a result, large areas of productive lands have been degraded and abandoned (Voloshchuk, 2017).

Studies of degradation of soil within Lviv Oblast allows us to largely expand the theoretical and practical basics of their genesis, evolution, and evaluate the current agroecological status and design measures for protection (Medvedev et al., 2018). Foreign experience suggests that effective management of land resources first of all requires an accurate data base and systematization of data according to regional signs of degradation. Deterioration of natural properties of soil and gradual decrease in areas of productive lands has to be met with introduction of radically novel regional programs of development of the agrarian sector, which – from the perspective of legal norms – would be most expedient within the administrative units based on the principle of nature conformity (Poznyak, 2019).

The main factors that have led to soil-degradation non-homogeneity of the territory of Lviv Oblast are natural conditions and anthropogenic activities. Natural factors that cause soil-degradation differentiation of soils and soil cover are climatic conditions, patterns of the terrain, lithology, hydrogeologic and hydrologic conditions. Natural conditions are a specific catalizer of such degradation processes as water and wind erosions, oxidation of soils, secondary carbonation, and geocological anomalies. However, the action of anthropogenic degradation factors is much more wide-ranging. They cause water and wind erosion, dehumification, de-structuring and re-densification of soils, contamination, desiccation and aridification, pyrogenic degradation, technogenic destruction, military and tourist-recreation degradations of soil and soil cover. Natural and anthropogenic factors often complement one another, thereby intensifying degradation processes (Haskevych, 2017).

Studies of degradation are relevant from the perspective of regional adaptation of approaches of soil management, optimization of manifestation of degrading processes and formation of accurate integral knowledge of the status of land resources of Lviv Oblast (Haskevych et al., 2019). The significance of the ob-

tained data is increased by the fact that study of degradation processes, their consequences, and also the structure of soil cover, was conducted for the first time.

In the aspect of soil-degradation zoning, we designate territories united by same factors of soil-development, similar soil cover, anthropogenic pressure and its duration that have caused single-type degradation processes and combinations of several types of degradation. Degradation processes were grouped in types and kinds according to the typologies developed in Ukraine (Medvedev, 2013; Pshevlotsky and Haskevych, 2002).

Materials and methods

Soil-degradation zoning in Ukraine was carried out for the first time. While performing it, we utilized the following methods: comparative-geographic, comparative-profile, analytic, cartographic, expeditionary methods. Analytical studies of soils were performed in a certified agrochemical laboratory of soil and natural water analysis belonging to the Department of Soil Sciences and Geography of Soils of Ivan Franko Lviv National University. We partly used archive and fund materials of the Department of Soil Sciences and Geography of Soils of the Ivan Franko National University, the Lviv affiliate of the state institution Scientific-Experimental and Project Institute of Land Development of the National Academy of Sciences, Oblast Center of Management of Geocadaster, and literature sources. Furthermore, we used the results of physical-geographic, agro-soil and soil-geographic and natural-agricultural zoning of Ukraine and Lviv Oblast (Papish and Poznyak, 2012; Papish et al., 2016; Poznyak et al., 2018; Poznyak et al., 2019). The cartographic basis comprised topographic maps of the following scales 1:10 000; 1:25 000 and 1:50 000 and 1:200 000 and geomorphological map of the scale of 1: 1 000 000 (Kravchuk and Zinko, 1989). For the purpose of complex analysis of soil cover, we used soil maps of previous stages of surveying, with the scales of 1:10 000; 1:5 000 and 1:50 000. Lviv Oblast was mapped using licensed software ArcGIS Desktop manufactured by the American Company ESRI.

Results and discussion

Within Lviv Oblast, we designated 2 soil-degradation countries, 3 soil-degradation zones, 5 soil-degradation provinces, 14 soil-degradation counties and 31 soil-degradation districts.

Soil-degradation country **East European plain** with mostly natural-anthropogenic degradation processes, and within Lviv Oblast it unites two soil-degradation zones: Polissia mixed forests and broad-leaved forest zones.

Polissia soil-degradation zone of mixed forests (II) of deflation and current anthropogenic degradations is confined to the territory of the Lesser Polissia and the Nadsianska plain. In general, it is a flat accumulation-denudation plain, comprising aquatic-glacial deposits and eluvium of the Upper Cretaceous rocks. Soil cover is characterized by a complex structure with domination

of sod-podzolic, sod-soils of light granulometric composition, alkaline, sod-carbonate and wetland soils.

Within the Polissia soil-degradation zone, we designated one Lesser Polissia-Above-Sian soil-degradation province (see Table 1).

Table 1. Soil-degradation zoning of Lviv Oblast

Soil-degradation country	Soil-degradation zone	Soil-degradation province	Soil-degradation county	Soil-degradation district		
1	2	3	4	5		
East European soil-degradation plain	Polissia zone of mixed forests	LP – Lesser Polissia-Above Sian deflation	LP.1 Lesser Polissia West	LP.1.1 Ratynsky LP.1.2 Domaschiv		
			LP.2 Lesser Polissia Central	LP.2.1 Toporiv LP.2.2 Brody		
			LP.3 Radekhiv	LP.3.1 Korchyn LP.3.2 Lopatyn		
			LP.4 Pidpodilsky	LP.4.1 Zvenyhora LP.4.2 Olesko		
			LP.5 Above-Sian	LP.5.1 Krakovets LP.5.2 Novoavorivsk		
	Forest zone of broad-leaved forests	VL–Volyn water-erosion	VL.1 Sokal	VL.1.1 Zabuzky VL.1.2 Tartakiv VL.1.3 Shyhtari		
			VL.2 Povchansk	VL.2.1 Horohiv		
		WP – West-Podilia water-erosion	WP.1 Roztocze-Opilia	WP.1.1 Hriadovo-Pobuzky WP.1.2 Roztocze WP.1.3 Horodok-Shchyrets WP.1.4 Holohory-Kremenets WP.1.5 Lviv-Opilia WP.1.6 Peremyshl		
				WP.2 Sian-Dniester	WP.2.1 Rudkivtsi WP.2.2 Krukenychi	
				WP.3 Rohatyn-Opilia	WP.3.1 Hodoriv	
				EF – water-erosive of Eastern Ukrainian Foothills	EF.1 Podnistersky terrace	EF.1.1 Sambir EF.1.2 Stryi-Zhydachiv
					EF.2 Drohobych-Morshyn	EF.2.1 Drohobych EF.2.2 Morshyn
				C – Carpathian geoeconomic anomaly	C.1 Beskids	C.1.1 Staryi Sambir C.1.2 Turka-Skole C.1.3 Stryi-Sian
	C.2 Verhovynsky	C.2.1 Vododil-Verhovynsky				

LP – Lesser Polissia (or Malopoliska) – Above-Sian soil-degradation deflation province occupies the northern and western parts of Lviv Oblast. This is the territory of active development of deflation processes and physical degradation, caused by peculiarities of soil-forming rocks, terrain pattern, soil cover and agricultural use. Within the province, there are designated five soil-degradation counties.

LP 1. Lesser Polissia Western County of the deflation and physical degradation of soils. It occupies the western part of the Lesser Polissia lowland to the border with Poland. It is a flat sandr-accumulative plain, composed of fluvioglacial deposits, somewhat lifted

in the northwest part with Upper Cretaceous marl outcrops. Soil cover is characterized by domination of sod-podzolized soils, sod and alkaline, swamp and peatland soils. There also occur spots of rendzina and carbonate chernozems. It is a territory of ancient culture of arable farming, though agriculture varies across some regions. In general, less than a half of the territories of the Western County of Lesser Polissia is used being for tillage (Haskevych, 2017). Over 25 % of the area is occupied by forests. Within the county, there are designated 2 soil-degradation districts: Ratynsky and Domaschiv (Fig. 1).

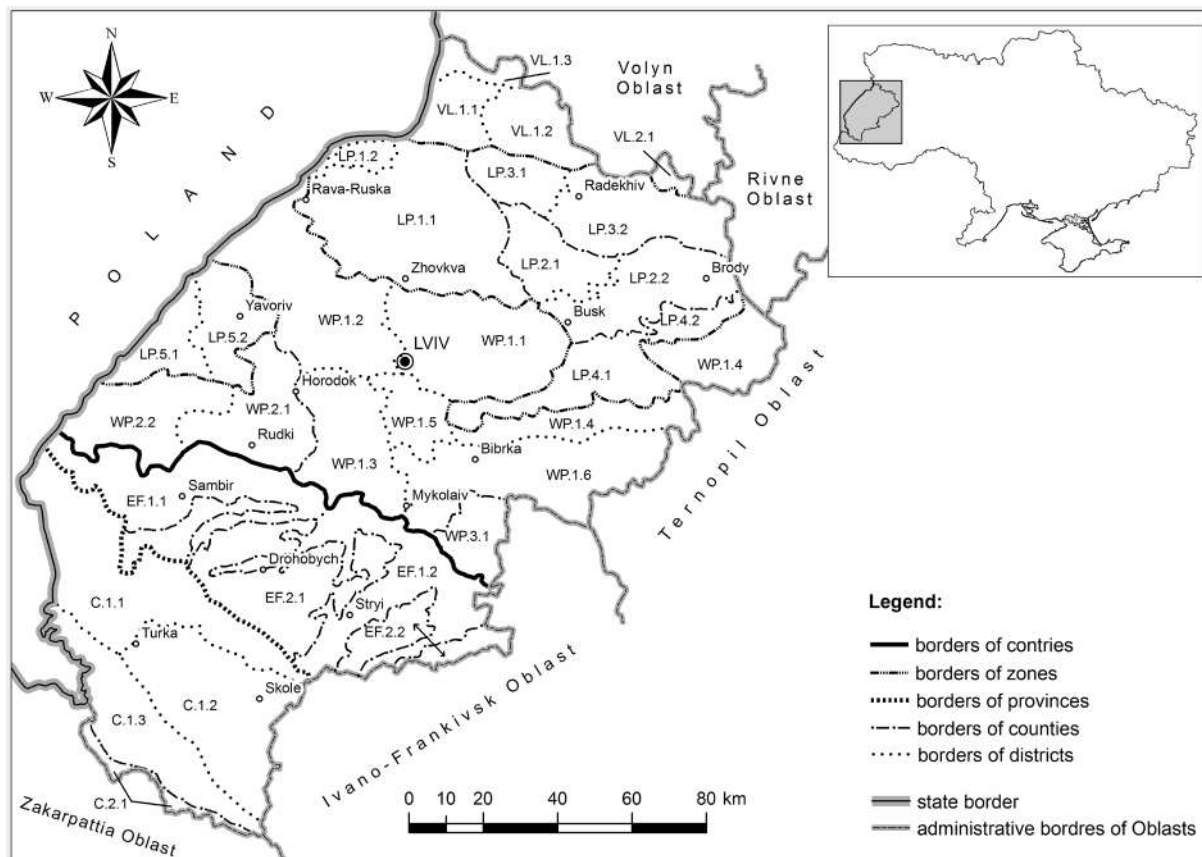


Fig. 1. Scheme of soil-degradation zoning of Lviv Oblast (V.G. Haskevych, N.M. Lemeha, Y.Y. Vitvitskiy, 2021)

LP. 1.1 Ratynsky soil-degradation district of spreading of deflation-intense and technogenic degradations of soils. It occupies the western part of the Lesser Polissia to the border with Poland. It is a typical Lesser Polissia region, constituting a flat, aquatic-glacial accumulative plain, diversified by numerous depressions and hills and dunes of eolian origin. Soil cover is represented by turf-podzolized, mostly sandy and sandy-cohesive soils, large structures of turfy, alkaline and wetland soils and lowland peatlands. West of Kamianka-Buzka city, there is a separate “island” of grey forest soils. Almost all hydromorphic soils across this territory have been dried and are used as agricultural lands.

Among the degradation processes, processes of deflation became especially common, first of all due to light granulometric composition of soils and dry ameliorations. Physical degradation is characteristic for loamy grey loess, sod and alkaline soils and has been caused by excessive compaction, de-structuring, formation of blocks, development of crust, dust formation, etc. In dried soils, granulometric degradation was observed. Dehumification-caused biochemical degradations occur in almost all tilled soils, especially those that have dried. Also, dried soils degrade because of excessive drying. Within the structures of turf soils (valleys of the Rivers Rata, Solokia, Bolotnia), a broadly distributed process is pyrogenic hydrothermal

degradation, and also there is partial degradation due to peat extraction. In the northern part of soil-degradation district, processes of technogenic degradation and secondary waterlogging, soil contamination, became widely distributed due to extraction of bituminous coal.

LP. 1.2. Domashiv soil-degradation district with dominance of physical degradation soils. It is located in the northwest part of Lesser Polissia, confined to slightly undulating denudation plain, composed of Upper Cretaceous marls. In this territory, there have been formed rendzina and chernozems, which are dominant in the structure of soil cover. There are smaller areas of sod, alkaline and alkaline-swamp soils. This region is well developed agriculturally, is intensely used in agriculture, and the anthropogenic pressure on soils is extremely high.

The main degradation process taking place in this soil-degradation district is physical degradation, namely overconsolidation, de-structuring, block formation, fracturing, crust formation, as well as biochemical degradation related to dehumification. Wind erosion is seen on the rendzinas and carbonate chernozems. The slopes of Cretaceous hills have local manifestations of water erosion.

LP.2. Lesser Polissia Central County with moderate wind erosion, pyrogenic degradation of soils. It occupies the central part of Lesser Polissia. It is a flat aquatic-glacial plain, composed of fluvio-glacial de-

posits, and characterized by complex micro-terrain. It is a typical Polissia landscape, where forests occupy over 36% and waterlogged lands account for over 38% (Herenchuk, 1972). Dominating types in the structure of soil cover are sod-podzolized, sand-cohesive and sandy-loamy soils. Large areas are occupied by waterlogged soils and lowland peatlands. In the pre-Podilia part of the county, there are separate structures of redzinas, typical and carbonate chernozems. There also occur “islands” of bright grey forest and grey forest soils. Anthropogenic pressure on soils in different parts of the soil-degradation county varies from low to intense. Two soil-degradation districts are designated in the area: Toporiv and Brody.

LP. 2.1. Toporiv soil-degradation district of mild deflation occupies the western part of the Lesser Polissia-Central district. It is located in the central part of Lesser Polissia and is represented by flat fluvioglacial plain. In the structure of soil cover, sod-podzolized and sandy-loamy soils dominate. Small areas are occupied by sod, alkaline and wetland soils. Large areas there are occupied by forests.

Common degradation processes are mild wind erosion, physical degradation (de-structuring, excessive compaction), biochemical degradation (dehumification).

MP.2.2 Brody soil-degradation district of deflation, physical and pyrogenic degradation. Located in the eastern part of the Lesser Polissia, it is a slightly undulating accumulative-denudation plain. Soil cover is characterized by complex, mosaic structure. There are sod, alkaline, sod-podzolized, wetland and peatland soils and “islands” of bright grey and grey forest soils, typical and carbonate chernozems. Anthropogenic pressure on soils is quite high.

Wind erosion has become common, and within hill-like elevations – water erosion. Soils are being affected by physical degradation due to overconsolidation, de-structuring, block formation, frittering, crust formation, fracturing. Specifically within wetlands, dessication occurs, and pyrogenic and hydrothermal degradations are seen in lowland peatlands.

LP. 3 Radekhiv County of physical degradation and deflation of soils. It is located in the northern part of the Lesser Polissia-Above-Sian soil-degradation province. It is confined to the sandr-denudation plain, composed of eluvium of the Upper Cretaceous marls, outcrops of which are found in most of the territory of the county. Soil cover is represented by rendzinas, carbonate chernozems, small spots of sod-podzolic soils and peatlands. Within the county, there were designated 2 soil-degradation districts: Korchyn and Lopatyn.

LP. 3.1. Korchyn soil-degradation district with dominance of physical degradation. It occupies the western part of the Radekhiv soil-degradation county and is a flat plain, the complexity of which manifests

in presence of depressions and hill-like elevations. The territory is composed of Upper Cretaceous marls, which are partly overlapped by a thin layer of fluvioglacial deposits. In the structure of soil cover, there dominate carbonate chernozems, rendzinas, sod and alkaline soils, and lowland peatlands. Sod-podzolized soils are mostly sandy-cohesive granulometric composition and confined to sandy chains, hills and dunes, composed of fluvioglacial deposits.

In the soil-degradation district, the processes of physical degradation have spread, specifically: overconsolidation, de-structuring, block formation, fracturing. Soils that have been long used for tillage are dehumified (Haskevych, 2018). In the valley of the Bily Stik River and its tributaries, as well as weak-current depressions, where lowland peatlands have formed, there are pyrogenic and hydrothermal degradation, and also technogenic degradation, related to peat extractions. In the western part of the district, processes of technogenic degradation are common, caused by destruction of soils as a result of coal extraction.

LP. 3.2. Lopatyn soil-degradation district of physical, deflation and pyrogenic degradations of soils. It accounts for a part of the Radekhiv soil-degradation county, the most elevated territory within Lesser Polissia, composed of Upper Cretaceous deposits with outcrops. It is an insignificantly swollen denudation plain, contains hill-like elevated Cretaceous rocks and wide waterlogged valleys of rivers and their tributaries, enclosed by low-runoff depressions. The territory has been long and intensively used for agricultural purposes.

There, processes of physical degradation of soils of various intensity have become broadly distributed, particularly overconsolidation, de-structuring, fracturing, block formation, crust formation, and are confined to structures of rendzinas and carbonate chernozems. Common processes of chemical degradation are dehumification and secondary carbonation, agro-soil exhaustion. Within the structures of sod-carbonate soils (redzinas), common processes of mechanical degradation of soils are wind erosion, and water erosion within elevated Cretaceous hills. In the valley of the rivers Sudylyvka, Ostrivka, Berezivka, and also within low runoff depressions – where large areas of peat-containing soils are concentrated – common degradations are pyrogenic and hydrothermal, and also technogenic destruction of soils due to peat extraction.

LP. 4 Pidpodilsky soil-degradation county of physical, water-erosion and partly pyrogenic degradations. It occupies the southern part of the Lesser Polissia-Above Sian soil-degradation province and lies as an extended stripe along the Podilia Upland. Geomorphologically, it is a slightly undulating denudation-accumulative plain, composed of Upper Cretaceous marls, which – as hill-like elevations – are overlapped by loess-like loams.

Soil cover is highly mottled. Dominating types in its structure are podzolized chernozems, typical and carbonate, dark grey, podzolized, alkaline-chernozem, alkaline and sod soils. In the beds of streams and low runoff depressions, wetland soils and lowland peatlands have developed. Typical and carbonate chernozems often form distinct “islands” (“island”-type chernozems). Small spots of sod-podzolized sandy-cohesive and sandy-loamy soils occur. This is a county of long-established agricultural practice, where over 60% of the area is tilled. The soils have been subject to anthropogenic pressure for a long time and the level of this pressure has been too high.

Degradation processes in nature have anthropogenic genesis intensified by natural factors. In the area, degradation most noticeably manifests in physical degradation of different degrees, is related to excessive compaction, de-structuring, block formation, fracturing, crust formation, etc. Erosion degradation is common in slopes of flat interfluvies and hills and affects dark grey podzolized soils and chernozems the most. Processes of biochemical degradation of soils are related to dehumification and exhaustion of peatlands, and chemical degradation manifests in the partial carbonation the soils are undergoing. Within the peatland structures, pyrogenic degradation and mechanical ruination of soils (peat extractions) are common. Within the Pidpodilia soil-degradation county, we distinguished 2 soil-degradation districts.

LP. 4.1. Zvenyhora soil-degradation district occupies the southwest part of the county’s territory. It is a region of Ancient agricultural practice that has been taking place since the time of the Princes. Anthropogenic pressure on the soils has been long and intense. Common degradations in the area are water-erosion degradation and physical degradation, due to overconsolidation and de-structuring and fracturing of soils.

LP. 4.2 Olesko soil-degradation district occupies the northeast part of the county’s territory. Soil cover is represented by rendzinas, peatlands, and sod-podzolized soils. Common processes taking place in the area are water erosion, pyrogenic degradation, dessication, fracturing, and also mechanical disturbance of peat soils due to peat extractions.

LP.5 Above-Sian soil-degradation county of distribution of wind erosion, physical, partly water-erosion, pyrogenic and technogenic degradations. In physical-geographic aspect, it corresponds to the Above-Sian plain. It is a flat, sometimes slightly undulating aquatic-glacial and alluvium-denudation plain. Soil cover is represented by sod-podzolized, podzolized-sod soils of sandy and sandy-loamy granulometric compounds, and also sod and alkaline soils of sandy-loamy and loamy granulometric compounds and wetland soils.

Within the remains of moraine hills, sod-podzolized and grey forest loamy soils have developed. The territory of the Above-Sian plain has been greatly exploited. Around 50% of the county’s area is used for tillage, 20% – for hay and pastures, and 30% is occupied by forests and shrubs. This significantly pressurizes the soils and soil cover. The commonest degradation process within the county is wind erosion of low and average degree. Soils of sandy-loamy and loamy granulometric compounds have undergone overcompaction and de-structuring, dehumification, acidification. Soils that are confined to moraine ridges, as well as hills, experience water erosion ranging from low to excessively high (critical) degree. Processes of pyrogenic and hydrothermal degradation are distributed in dried peatland soils in the valleys of the rivers Vyshnia and Shklo. In the northern and eastern parts of the county, there is geologically-ecologically anomalous degradation due to karst expression (Lutsyshyn, 2013). Also, in the eastern part, large areas of soils have been anthropogenically destroyed by the open and underground extraction of sulfur, which took place earlier. Two soil-degradation districts have been distinguished in this area. Common degradations are deflation, partly water erosion, and pyrogenic degradation.

LP. 5.1. Krakovets soil-degradation district occupies the southwest part of the county’s territory. Soil cover is characterized by the extremely complex structure of soil cover with dominance of sod-podzolized soils and peatlands. A common form of degradation is deflation, partly water erosion, pyrogenic degradation, and overcompaction.

LP. 5.2 Novoiavorivsk soil-degradation district occupies the northeast part of the territory of the county. Soil cover is also characterized by complex structure, where dominants are sod-podzolized and sod soils of light granulometric compound and peatlands. Deflation processes are common, partly water erosion, pyrogenic degradation. The territory of Novoiavorivsk soil-degradation district has been also affected by powerful anthropogenic impact through open and underground sulfur extraction. The soils have been affected by mechanical disturbances, chemical degradation as a result of sulfur contamination. There, due to embedding gypsum-bearing rocks, karst has become common. Within the areas occupied by agricultural land, especially tilled land, deflation processes have become active. In peat soils, pyrogenic degradation is common.

Soil-degradation zone of broad-leaved forests (F) occupies typically highland, elevated and the most segmented parts of Lviv oblast – the Volyn and Podilia uplands. Soil cover is less mottled and homogenous, compared with the Podilia soil-degradation zone. In the structure of soil cover, there dominate bright grey and grey forest, dark grey podzolized, podzolized and

typical chernozems, and less common are sod, alkaline, wetland soils and peatland lowlands.

The territory of the Volyn and Podilia uplands are highly tilled, around 70% of the area is used for agricultural farming. Anthropogenic pressure in the area is extremely high and intense due to the favourable soil-climatic conditions. Natural peculiarities of the territory and long agricultural use have caused active development of processes of water erosion and therefore erosive degradation of soils. As a result, an erosion-tree-like structure of soil cover has developed in most part of the Volyn-Podilia upland (Herenchuk, 1972). In the territory of Lviv Oblast, Volyn and West Podilia soil-degradation provinces have been distinguished.

VL–Volyn soil-degradation water-erosion province. It occupies a part of Lviv Oblast, its borders geomorphologically coinciding with the borders of the Volyn denudation upland on Cretaceous and Neogene deposits. The Volyn upland is not a monolith, being segmented by the valley of the Western Bug and its tributaries into several parts that vary in absolute heights, terrain pattern, and soil cover. Modal soils of this territory are grey forest, dark grey podzolized, podzolized and typical chernozems. Hydromorphological soils occupy relatively small areas (Nazaruk, 2018). The territory of the Volyn Upland is an area of Ancient and high-level agriculture, with over 75% of the land being involved in arable farming. Natural vegetation has been preserved poorly. Intense and prolonged use of this land for agricultural purposes has caused development of degradation processes, first of all water erosion. In the territory of the Volyn Upland, within Lviv oblast, we distinguished two soil-degradation counties: Sokal and Horokhiv.

VL.1. Sokal soil-degradation county of water-erosion and physical degradation. Geomorphologically, the territory of the county corresponds to the segmented accumulative-denudation Sokal chain, which is located in the southwest part of the Volyn upland within Lviv Oblast. It is a wavy elevated slightly swollen upland, segmented by tributaries of the Western Bug, the Spasivka, Drahanka, Sebechivka rivers into a number of chains of sublatitudinal strike. It is composed of loess-like loams of mostly light-loam granulometric content. The light granulometric compound and significant segmentation of the Sokal chain, prolonged and extremely high anthropogenic pressure on soils have contributed to the activation of erosive processes. Soil cover is represented by fertile grey forest, dark grey podzolized, podzolized and typical chernozems, favouring their long use for arable farming, employing 65–75% of the region's area for this purpose. In the north of the region, in the valley of the Western Bug River, sod-podzolized soils have developed (Pshevlotsky and Haskevych, 2002).

Within the Sokal soil-degradation county, common degradation processes are mechanical, physical and biochemical degradation of soils. There are three soil-degradation districts.

VL.1.1 Zabuzky soil-degradation district of physical, moderate water-erosion degradations. It occupies the western part of the Sokal chain and within its borders almost corresponds to the Zabuzky natural district. It is the highest and relatively less segmented part of the Sokal chain, the area's absolute heights reaching 270.5 m.

Currently, the territory has almost no flat interfluvial forests, the arable area accounts for 75%. The dominants in the structure are typical and podzolized chernozems – around 62% – whereas grey forest soils account for 14% of the area. In low terraces of the Western Bug, alkaline-chernozem and sod soils are common. In the western part of the district, significant structures of dark-grey podzolized soils are common. Because of presence of fertile dark grey podzolized soils, podzolized and typical chernozems, alkaline-chernozem soils, a large area of the lands has been tilled and has been experiencing anthropogenic pressure.

Soils undergo greatest mechanical degradation through water erosion in the central and western parts of the soil-degradation district. High anthropogenic pressure has caused development of processes of physical degradation (overconsolidation, de-structuring, crust formation, flooding, etc) and biochemical degradation (dehumification). Also, there are processes of geologically anomalous degradation – formation of suffusion depressions and plates. In the valleys of the rivers Sebechivka and Variashka, where peat soils have been formed, common degradations are pyrogenic and hydrothermal.

VL.1.2 Tartakiv soil-degradation district of intensive water-erosion and physical degradations is located in the eastern part of the Sokal chain. The district is characterized by lower absolute heights (up to 261 m), but is far more intensely segmented, and there often occur remains of old flat interfluvial oak-hornbeam forests. Grey forest and dark grey podzolized soils dominate in the structure of soil cover, accounting for around 75% of the area. Also, there are small areas of structures of podzolized and typical chernozems, alkaline-wetland and peatland soils. The territories involved in arable farming account for 65%, which also indicates high pressure on soils and soil cover. Soils of the Tartakiv soil-degradation district experience intense mechanical degradation through water erosion and physical degradation as a result of excessive compaction, de-structuring, block formation, crust formation and flooding, fracturing. In soils, processes of dehumification are manifested, related to erosive degradation, as well as through insignificant fertilization, especial-

ly organic, dominance of hoe-tilled crops in the crop rotations, etc. In peat soils, processes of hydrothermal and pyrogenic degradations are common (Haskevych and Lemeha, 2020).

VL.1.3 Shyhtari soil-degradation district of strong deflation of soils is located in the marginal northern part of the Sokal soil-degradation county. It is between the Western Bug and Variashanka rivers, within the first above-floodplain terrace. The territory is composed of Ancient alluvium and fluvioglacial sandy deposits, which are intensely being developed by wind, forming eolian forms of relief. Soil cover is composed of sod-hidden podzolized and sod-podzolized soils of sandy granulometric compound. Soil is partly used in agriculture, including for arable farming, vegetable gardens. The land is exposed to strong wind erosion.

VL.2 Povchansk soil-degradation county of intense water erosion and physical degradation. Geomorphologically, it is located in the southern part of the Volyn Upland, ridge-like within the Povchansk, significantly segmented chain. Within Lviv Oblast, it occupies relatively small territory. It is characterized by strong segmentation of terrain which causes active development of processes of water erosion. Soil cover is composed of grey forest and dark grey podzolized soils, and podzolized chernozems occur as small spots. All of them are being actively used for arable farming. In the valley of the Sudylyvka River, wetland and peat soils are common. Soils undergo strong mechanical degradation through water erosion, and also dehumification, overconsolidation, de-structuring, flooding, block formation.

VL.2.1 Horohiv soil-degradation district of intense water-erosion degradation. The basis of the structure of soil cover comprises bright grey and grey forest soils on loess loams. They are confined to narrow erosion-threatened plateaus and slopes varying in steepness. The district has been well developed agriculturally, large areas being used for arable farming where grain and hoe-tilled crops are cultivated, particularly sugar beet. Prolonged and intense anthropogenic pressure on soils has led to water-erosion degradation of strong and average degrees.

WP – Western Podilia soil-degradation water-erosion province is located west of the Podilia upland and occupies the central part of Lviv Oblast. It is characterized by significant absolute heights and segmentation of the territory. The territories between the rivers and near the bank slopes are composed of loess-like deposits of loam granulometric composition. Soil cover is characterized by a complex erosion-tree-like structure, which – depending on physical-geographic conditions of different parts of the Western Podilia – is made of turf-podzolized bright grey and grey forest and dark grey podzolized soils, podzolized chernozems.

Soils mostly have features of surficial or soil gleyifications. Also, there are small spots of typical chernozems. Alkaline, sod and wetland soils have developed within the spacious low runoff depressions in the terrain, valleys of rivers and streams, beds of the banks.

Western Podilia is a territory of Ancient agricultural practice, as evidenced by the large area of arable land – around 75%, and over 80% in some districts. Long and intense agricultural pressure has induced the development of degradation processes, first of all water erosion. Within Western Podilia soil-degradation province, we distinguished three counties: Roztocze-Opilia and Sian-Dniester, Rohatyn-Opilia.

WP.1 Roztocze-Opilia soil-degradation county with dominance of mechanical and physical degradations in soils. The county is stretched from the northwest toward the southeast, located in the central part of Lviv Oblast. It arc-wise surrounds the Lesser Polissia in the north, and borders with the valley of the Dniester in the south. The territory of the county is significantly intersected by steep valleys, the height of vertical segmentation often reaches 100–120 m within relatively small distances. The Roztocze-Opilia county is characterized by steep hilly lands that account for up to 60% of the area. Hills are mostly oriented from the northwest to the southeast, forming low-hill ridges.

Soil cover is composed of turf-podzolized, grey forest, dark grey podzolized, podzolized chernozems, and more rarely typical chernozems. The level of agricultural development in the territory varies in its different parts, being lower in the northwest and more intense in the central and eastern parts. Soils mostly undergo erosion and physical degradations.

Within the Rostok-Opilia soil-degradation county, five soil-degradation districts were distinguished.

WP.1.1 Hriadove (Ridge)-Pobuzky soil-degradation district of water-erosion, physical, pyrogenic degradation of soils. It occupies the central part of Lviv Oblast, and within its borders corresponds to physical-geographic district Hriadove Pobuzhzhia. It comprises six ridges that strike east-southeast to the Western Bug. The ridges are covered by a layer of loess-like loams, in which grey forest, dark grey podzolized, podzolized and typical chernozems have developed. The ridges are divided by wide waterlogged valleys of the Polissia type, where alkaline, turf and wetland soils and peatlands have formed.

The Hriadove Pobuzhzhia is a pre-city region, with agriculturally well cultivated land. Over 2/3 of the area of all the land is used for tillage, indicating high anthropogenic pressure on soils. As a result, soils on slopes undergo erosive degradation. In arable lands, common degradations are physical (de-structuring, overconsolidation, block formation, flooding, formation of crust, etc) and biochemical (dehumification) degradations.

Peat soils have undergone technogenic degradation due to peat extraction, which occurs to this day. Also, peat soils experience pyrogenic and hydrothermal degradations.

WP.1.2 Roztocze soil-degradation district of the development of mechanical, physical degradations, karst, technogenic disturbances. Roztocze is a marginal northwest part of the Podilia upland within Lviv Oblast, which continues in the territory of Poland. It is an upland that sharply rises above the territory of the Lesser Polissia and gradually fuses into the Above-Sian plains. In soil cover, there dominate sod-podzolized, bright grey and grey forest, dark grey podzolized, sod soils and rendzinas. In the valleys of rivers and depressions in the terrain, wetland soils and peatlands have formed. The Roztocze is characterized by its large forest area, which accounts for 56% of the territory, while the tilled area equals around 30%.

Degradation processes that have become common in the Roztocze are mechanical degradation (water and wind erosions), physical degradation in soils of loamy granulometric compound, and dehumification (Bonishko, 2017). Geoecological anomalous degradation – karst – is present. Also, degradation caused by the military is common. Roztocze is an active region of recreation and tourism, there manifest tourist-recreation degradation of soils and soil cover. In places where peatlands are distributed, hydrothermal and pyrogenic degradations are seen.

WP.1.3 Horodok-Shchyrets soil-degradation district of manifestation of physical, erosion degradation, karst. It strikes toward the south of the Roztocze to the Dniester valley. Geomorphically, it is confined to the Horodok-Shchyrets eolian-denudation-karst undulation chain plain. A characteristic peculiarity of this region is its relative flat terrain with alternation of major sublatitudinal ridge formations between rivers, expressed valleys and hollows. Loess-like loams completely cover the water divides and above-floodplain terraces. Soil cover is represented by grey forest, dark grey podzolized soils, podzolized chernozems, mostly gleyey and surface-gleyey chernozems. There occur spots of sod-podzolized, sod, alkaline and wetland soils (Fedotikov and Yamelynets, 2016). The territory has a typical forest-steppe appearance, and is significantly cultivated. Up to 60% of the area is tilled, approximately another 20% is taken up by pastures and hayfields.

Prolonged and intense pressure on soils and soil cover has caused the development of degradation processes. The commonest processes of physical degradation are related to overconsolidation, de-structuring, block formation, flooding, crust formation. On the slopes of the water divides, slopes of valleys and gulleys, mechanical degradation is common due to water erosion, and within the structures of sod-

podzolized soils – they are subject to wind erosion. Biochemical degradation has been caused by dehumification of mineral soils and hydrothermal degradation of peat soils, and chemical degradation – by acidification and decalcification of soils. In places of distribution of peat soils, pyrogenic degradation occurs. In the district's territory, especially in the southeast part, geoecologically anomalous degradations such as karst are common. Within the district, the widespread type of degradation is technogenic destruction, associated with extraction of sulfur, limestones and gypsum.

WP.1.4 Holohory-Kremenets soil-degradation district of manifestation of moderate water-erosion, physical degradations, karst. The territory comprises northwest Podilia and surrounds Lesser Polissia in the south and geomorphologically corresponds to the Holohory-Kremenets structural-denudational, significantly segmented low hill. This is a combination of mountainous-butte (butte), ridge-hilly (ridge), plateau-like massifs, segmented by river valleys and gullies, with the clearly distinct steep-sloped margin of the northern Podilia. In the structure of the soil cover, there dominate bright grey and grey forest, dark grey podzolized soils and podzolized chernozems, which have developed on loess-like loams that lie beneath the limestones. In the river valleys, wetland soils and peatlands have formed, occupying relatively small areas. Agricultural cultivation of the region is non-uniform, manifesting more intensely farther south toward the Podilia (Nazaruk, 2018).

Among the degradation processes, physical degradation is manifested, caused by overconsolidation, de-structuring, crust formation, flooding, fracturing, especially of bright grey and grey forest soils. Due to significant fragmentation of the terrain, water erosion and agrotechnical erosion are common. Dehumification manifests in all types of cultivated soils, acidification and decalcification are also present. Moreover, locally karst, shifts and screes manifest. Partial technogenic destruction of soils has been caused by the construction of the Odesa-Brody oil pipeline.

WP.1.5 Lviv-Opilia soil-degradation district of physical degradation, karst. It is located south of Lviv and has rather low gypsummetric position, geomorphologically it corresponds to the segmented, undulating, denudation-structural Lviv plateau. It combines slightly wavy loess surfaces with denudation and structural-denudation surfaces, largely composed of surficial karst and karst-suffosion forms. Karst sinkholes and suffosion plates develop quite large karst fields. Soil cover of the territory is quite homogenous, with dark grey podzolized soils and podzolized chernozems dominating the soils structure. Small areas are occupied by bright grey and grey forest, sod-podzolized soils. In the depressions of the terrain, wetland soils have de-

veloped. The territory of the Lviv Opillia is characterized by very Ancient agriculture, the area of cultivated land there reaching 75%. Anthropogenic pressure on soils has been prolonged and extremely intense due to the proximity to Lviv. Of negative processes in the soil and soil cover, common degradations are physical degradations (excessive compaction, de-structuring, block formation, flooding and crust formation), mechanical degradation (water erosion), biochemical degradation (dehumification), chemical degradation (acidification and decalcination). Among geoecologically anomalous degradation processes, largely common are karst and suffosion.

WP.1.6 Peremyshl soil-degradation district of distribution of physical, strong water-erosion degradation. Typical Opillia district, confined to the segmented and hilly denudation-structural upland, includes Bibrka-Peremyshl Opillia and Stilske Opillia (Stilske low hill). The territory is characterized by high hills and ridges, stretching from the northwest to southeast, with flat apexes and sloping, as well as steep, hills. The surface of the hills is overlapped by a thin layer of loess-like loams of heavy granulometric compound. In the structure of soil cover, bright grey and grey forest, dark grey podzolized soils and chernozems dominate, and small spots of typical chernozems occur. Sod, alkaline and wetland soils, and also small peatlands are common along the valleys of rivers, beds of wide ravines. Agricultural pressure on soils and soil cover is non-homogenous and depends on geomorphological and soil conditions. Among the degradation processes, the commonest degradation is mechanical due to water erosion varying from low to excessive (critical), and also agrotechnical erosion (Papish, 2017). The heavy granulometric compound and gleyification in the conditions of anthropogenic pressure cause de-structuring, blocks, overconsolidation, crust formation and flooding, especially with grey forest and podzolized soils, silting. Soils are commonly observed to have processes of dehumification, acidification and decalcination. Among geoecologically anomalous degradations, karst, suffocion and shifts occur.

WP.2 Sian-Dniester soil-degradation county of distribution of physical and mechanical degradations. Geomorphologically, the county's territory coincides with the Sian-Dniester segmented wavy and ridged-hilly glacial-water-glacial upland. It is a specific natural region, located at the southwest margin of the Podilia upland, intermediate between typically loess and pre-mountain types. Some scientists classify this territory to the Eastern Carpathian Foothills. Nonetheless, forest-steppe landscapes dominate in area, first of all soil cover. Geomorphologically, it is a flat-undulating, segmented upland, with dominance of distinct hilly-ridgy forms of terrain, with flat or slightly undulating apexes and gentle as well as steep slopes. Surficial

ridges are covered by loess-like loams. The ridges are divided by river valleys, often quite wide.

The Sian-Dniester upland is characterized by the complex structure of its soil cover with domination of grey forest, dark grey podzolized soils, podzolized chernozems. Most of soils are gleyey or surficial-gleyey. In the valleys of the rivers and beds of ravines, common soils are alkaline-chernozem, sod and alkaline soils, partial wetland soils and peatlands. The territory of the county is densely inhabited and well cultivated. Tilled soils account for around 60% of the area. Within the soil-degradation county, two soil-degradation districts were distinguished: Rudkivtsi and Krukenychi.

WP.2.1 Rudkivtsi soil-degradation district of distribution of physical and moderate mechanical soil degradation. It occupies the eastern part of the Sian-Dniester soil-degradation county. Geomorphologically, it is a slightly wavy denudation-accumulative plain. The cuts across the territory are relatively shallow. In the area, elevated slightly wavy flat interfluvies and ridges dominate, which strike from northwest toward southeast and are completely covered by loess-like loams. Soil cover is represented by grey forest, dark grey podzolized soils and podzolized chernozems. There occur different areas of sod, alkaline, wetland soils and peatland depressions, confined to valleys of rivers and streams, and also wide low-runoff depressions in the terrain.

The territory has an Ancient agricultural history, being significantly cultivated, the tilled land accounts for 70% of the area. Pressure on soils is characterized as high. Among the degradation processes, the commonest degradation is physical, related to excessive compaction, de-structuring of soils, formation of blocks, crusts on the surfaces, flooding. There is also mechanical degradation, related to moderate water erosion, and also agrotechnical degradation. In soils, biotechnical (dehumification) and chemical degradations (acidification and decalcination is seen). At some places, karst occurs.

WP.2.2 Krukenychi soil-degradation district of intense water-erosion and physical degradation of soils, shifts. The district occupies the western part of the Sian-Dniester upland. It is a ridged-hilly significantly segmented aquatic-glacial upland, composed of moraine deposits that are overlapped by a thin layer of loess-like loams. The area between the rivers is taken up by ridges, the slopes of which are notably segmented by ravines and hollows. The high degree of terrain segmentation activates the processes of water erosion. In the structure of soil cover, there gleyed grey forest and dark grey podzolized soils dominate, and a small share belongs to podzolized chernozems. The river valleys and wide beds of the ravines often have alkaline and wetland soils and depression peatlands. This territory is also being used in agriculture, the tilled land accounts for up to

60% of the area. At the same time, large loess structures are also common. Among a number of degradation processes, the commonest is mechanical degradation, related to water erosion and agrotechnical erosion on slopes, as well as siltification of soils at the foothills and beds of the ravines. In this territory, common degradations are physical, particularly de-structuring, overconsolidation, block formation, flooding, crust formation, fracturing. Such processes are first of all caused by the heavy granulometric compound of soils, as well as soil-forming rocks, particularly moraine deposits. Soils are seen to have biochemical degradation through dehumification; chemical degradation caused by acidification and decalcination. The characteristics of soil-forming rocks condition shifts, bogs, waterlogging.

W.P. 3 Rohatyn-Opilia soil-degradation county within Lviv Oblast occupies a small territory in its southeast part, including Hodoriv soil-degradation district. The commonest degradation processes are water erosion with dominance of water-erosion degradation, overconsolidation of soils, de-structuring.

WP. 3.1 Hodoriv soil-degradation district of water-erosion and physical degradation of soils, shifts. Soil cover is formed by podzolized and typical chernozems, dark gray podzolized soils. In the area, common degradation processes are water erosion, excessive compaction of soils, de-structuring, and dehumification. The district has long history of agriculture, the soils are being intensely used for tillage, namely for growing sugar beet, leading to overconsolidation and loss of soil structure, and agrotechnical exhaustion of soils is observed. On the slopes of ravines, river valleys, shifts occur. Flat interfluves and slopes of ravines have overmoistened boggy soils (bog-type degradation).

Carpathian soil-degradation country (C) (zone of the Ukrainian Carpathians). Within Lviv Oblast, it occupies its southern part, including soil-degradation provinces of the Eastern Carpathian Foothills and the mountaneous part of the Carpathians. The territory is characterized by complex lithology, geomorphological peculiarities and soil cover. In the structure of soil cover, there dominate sod-podzolized and podzolized-turfy surface-gleyed, turf, alkaline, wetland, brown earth-podzolized soils and brown earth (Andrushchenko, 1970).

Cultivation of this territory varies and is not homogenous across the regions, which is reflected in the development of degradation processes. The commonest degradations in the area are geoecologically anomalous, mechanical and physical degradations.

EC – the Eastern Carpathian Foothills' soil-erosion province of mechanical and physical degradations. It is a specific soil-degradation province, located between the southwest margin of the Podilia upland and northeast margin of the Ukrainian Carpathians. The upland of the Eastern Ukrainian Foothills is character-

ized by significant segmentation with great height amplitudes. The territory is composed of deluvial, Ancient alluvial and contemporary alluvial deposits (Palienko et al., 2012).

In the soil cover, there dominate sod-podzolized and podzolized-sod surficial gleyed, sod, alkaline, brown earth-podzolized, wetland soils and peatlands. Degradation processes are related to water erosion, physical degradation, geoecological anomalies, and technogenic disturbances. Within the province, there were distinguished two soil-degradation counties: the Podnistersky terrace and Drohobych-Morshyn.

EC.1 Podnistersky terrace soil-degradation county of physical, pyrogenic degradations, it occupies low gypsometric levels with the absolute heights of 260–275 m and is geomorphologically confined to the Upper Dniester (Upper Dniester-Stry) alluvium terrace plain. It is a flat, undulating in places and slightly segmented alluvium plain, confined to the floodplain, the first and the second terraces of the Dniester River and its right tributaries. Soil cover is quite homogenous; its basis comprises alkaline and alluvium-alkaline, alkaline-wetland and wetland, depression peatlands, sod soils. The cultivated land accounts for around 45% of the territory, and at the same time large areas are occupied by hayfields and pastures, indicating moderate pressure on soils and soil cover. Degradation processes in soils are associated with physical, chemical, biochemical and pyrogenic degradations. Within the county, there are distinguished two soil-degradation districts: Sambir and Stryi-Zhydachiv.

EC.1.1 Sambir soil-degradation district with dominance of physical and pyrogenic degradations of soils, occupies the western part of the Podnistersky terrace county and geomorphologically correlates with the Upper Dniester structural basin. It is a flat plain, within the floodplain and the first above-floodplain terrace, significantly waterlogged, becoming completely filled with water in wet years. The popular name is Velyke Boloto [Ukr. – Great Bog] and it is used for pastures and hayfields. Plots of the second above-floodplain terrace are being tilled, occupy a relatively small area, pressure on soils may be assessed as low. Soil cover is represented by alkaline, sod soils and depression peatlands. Degradation processes in the tilled lands are mostly related to physical degradation through overconsolidation, de-structuring, block formation, fracturing. Mechanical degradation is conditioned by siltification of surfaces of mineral and organogenic soils. In soils, processes of dehumification, acidification and decalcination take place. In peatland soils, pyrogenic and hydrothermal degradation occur.

EC.1.2 Stryi-Zhydachiv soil-degradation district with dominance of physical degradation and technogenic disturbance. It occupies the eastern part of the county and is confined to the valley of the Dniester and

its right tributaries Tysmenytsia, Kolodnytsia, Stryi and Svicha. Most of this territory is known as the Stryi-Zhydachiv hollow, which is a floodplain and the first-second terraces of the Dniester and Stryi. The territory is represented by a flat alluvial plain, which has been significantly waterlogged in the past. The share of cultivated land in the structure of land fund is relatively small. Soil cover is represented by alkaline and alluvial alkaline soils, sod and sod-podzolized, and small spots of alkaline-chnozem and wetland soils. Peatlands are rare. The most common degradation processes are physical degradation (excessive compacton, de-structuring, fracturing), as well as dehumification, acidification of soils. There are large structures of technogenically disturbed soils due to open extraction of peat.

EC.2 Drohobych-Morshyn soil-degradation county of mechanical, physical and geoecologically anomalous degradation. As a stretch with varying width, it strikes from the northwest to southeast, along the Beskid. It is a pre-mountain, staircase-like segmented denudation-accumulative upland. In the structure of soil cover, sod-podzolized and podzolized-sod, surface-gleyey and brown earth-podzolized gleyed soils dominate. Small spots of sod-podzolized gleyey, sod gleyey and grey forest gleyed soils occur. Exploitation of soils, particularly for tillage, is more intense in this area than in the previously described soil-degradation county. Processes of mechanical, physical, biochemical, chemical, geoecologically anomalous and technogenic degradations have developed. Within the county, two soil-degradation districts are distinguished: Drohobych and Morshyn.

EC.2.1 Drohobych soil-degradation district of distribution of water-erosion, physical degradation, geoecologically anomalous degradations and technogenic disturbances of soils. Geomorphologically, it corresponds to the Drohobych denudation-erosion upland and partly Stryvihorsky (Stryi Mountains) denudation-accumulative upland. Absolute heights reach on average 300–400 m. The terrain of Drohobych upland combines wide waterlogged valleys with deeply cut currents with the hollow-wavy areas between rivers, confined to the fourth, fifth and sixth above-floodplain terraces of the Dniester. The areas between the rivers are cut by a network of ramified gullies. Significant segmentation contributes to the development of erosive processes. Soil cover is characterized by sod-podzolized and podzolized-sod surface-gleyed and brown earth-podzolized gleyed soils with insignificant share of sod and grey forest soils. This part of the Eastern Carpathian Foothills is a territory of Ancient agriculture and livestock farming. Cultivated land accounts for around 45% of the district's area. A broad range of degradation processes has developed in the area, first of all mechanical degradation related to water erosion, pasture-caused and agrotechnological erosions, and also siltification. Physical degradation manifests in overconsolidation, de-structuring, block formation, fractur-

ing. There also is a secondary waterlogging within the depressions of the terrain, caused by peculiarities of lithology. Dehumification-caused processes of biochemical degradation are also common. In Drohobych soil-degradation district, there are geoecological anomalies, karst, and shifts. Processes of technogenic zoning of soils are common due to extraction of potassium salts. Contamination of soils is caused by oil extraction and presence of tailing dams of chemical production facilities. Within and in the outskirts of Truskavets, recreation-touristic degradation of soils and soil cover is seen.

EC.2.2 Morshyn soil-degradation district of mechanical, physical and technogenic degradation of soils and soil cover. The territory is confined to Morshyn and Above-Svicha denudation-accumulation uplands downstream of the Stryi and Svicha. Absolute altitude ranges within 300–350 m. As narrow stripes, the chain of heights stretches northeast, confined to Ancient fifth above-floodplain terrace of the Dniester, mostly with flat segmented surfaces and slopes varying in steepness. Closer to the margin of the mountains, there are fragments of denudation-accumulative and denudation surfaces of the sixth terrace, which is more intensely segmented. In soil cover, there dominate sod-podzolized and podzolized-gleyed, and spots of sod soils occur. The territory is agriculturally cultivated, around 50% of the area being tilled. Pressure on soils and soil cover is significant. Degradation processes are related to water erosion, siltification of soils, their overconsolidation, de-structuring, block formation, crust formation, flooding, etc. Shifts also occur. Technogenic destruction of soil has been caused by sulfur extraction (Podorozhnianske deposits).

C–Carpathian mountaneous soil-degradation province. It occupies the southwest part of Lviv Oblast and corresponds to the mountaneous country of the Carpathians. Two soil-degradation counties are distinguished: Beskyd and Verkhovyna. Soil cover is represented by brown earth mountaneous-forest type.

C.1 Beskyd soil-degradation county of geoecologically abnormal and mechanical degradations. Geomorphologically it corresponds to the region of Skybovi (Outer) Carpathians. The territory of the soil degradation county is occupied by two districts: Saryi Sambir and Turka-Skole.

C.1.1 Saryi Sambir soil-degradation district of distribution of water erosion, screes, shifts, occupies the northeast part of Beskyd, partly coinciding with the borders of geomorphological district of the Upper Dniester Beskyd. The territory is characterized by of low mountainous terrain, with comparatively soft contours. Absolute heights range within 600–800 m. Soil cover is represented by brown earth of mountaneous-forest, brown earth-podzolized, sod and alkaline gleyed soils. Agricultural cultivation of the territory is at a low level, the lands are mostly used for pastures and hayfields. Cultivation is distributed in small structures in

valleys of wide rivers, steep and gently sloping slopes of water divides. Among degradation processes, there occurs mechanical degradation (water and pasture erosion, reclamation, siltification, abrasion of river banks), physical degradation (overconsolidation, de-structuring, block formation). Geocologically anomalous processes are broadly distributed – shifts, windthrows. Touristic-recreation degradation of soils and soil cover is becoming common.

C.1.2 Turka-Skole soil-degradation district of distribution of geoeconomically anomalous phenomena occupies the south and southwest part of Beskids, its borders coincide with geomorphological district Skole Beskids (Marynych et al., 2003). In soil cover, brown earth mountaneous-forest, turfy-brown earth soils, and small areas are occupied by alkaline-brown earth soils dominate. Most areas of the land fund are forests, whereas agricultural lands occupy relatively small areas. Degradation processes are related to geocological anomalies, specifically windthrows, screes, more rarely – shifts, sometimes with avalanches. Erosion degradation is caused by linear and area erosion in tilled areas, abrasion of river banks. Touristic-recreation degradation of soils and soil cover is also common (Saliepova, 1959).

C.1.3 Stryi-Sian soil-degradation district of distribution of geocologically anomalous and mechanical degradation processes. It is located in the basin of the upstream Stryi and Sian. It is characterized by combination of low mountaneous and low mountain-hollow areas with terrace-valleys. Geomorphologically it corresponds to Stryi-Sian Verhovyna. It is an old and densely populated, well cultivated territory. The tilled area accounts for 36.9%, pastures and hayfields – 24.5% and forests – around 30%. The area of agricultural lands is too large for a mountaneous territory, and the anthropogenic pressure on soils and soil cover is evaluated as high. Soil cover of the territory comprises brown earth mountaneous-forest, sod-brown earth podzolized and gleyed soils, and spots of brown earth-podzolized gleyey soils occur. Degradation processes have been caused by the distribution of mechanical degradation, particularly planar and linear erosions. Physical degradation has led to excessive compaction of cultivated soils. Among geocological anomalies, shifts are common, and also screes occur at some places. Recently, tourism and recreation have been developing, leading to touristic-recreation degradation of soils and soil cover.

C. 2 Verkhovyna soil-degradation county with dominance of geocologically anomalous and mechanical degradations of soils, occupies the southern part of Lviv Oblast. Due to structural-lithological peculiarities, low-mountaneous relief has developed in this territory, with dominance of Ancient long valleys, which has received name “Upper Verhovynsky”. Absolute heights range 450–500 to 800 m. Within the soil-degradation county, three districts were distinguished: Stryi-Sian and Volodil-Verhovyna.

C.2.1 Vododil-Verhovynsky soil-degradation district is in the marginal southwest, the highest part of Lviv Oblast. Absolute heights in the area reach 1,408.3 m (Pikui Mountain). Relative elevation above Sian-Stryi Verhovyna reaches 700–900 m. Slopes of the crest are steep, there are often rocky outcrops, accumulations of blocks, stone placers. Soil cover is represented by brown earth montane-forest and sod-brown earth soils, mostly pebbly and stony. Soils are taken over by forest vegetation, montane pastures and hayfields. Among the degradation processes, there are screes, and avalanches occur (Voitkiv and Pozniak, 2009).

All across Lviv Oblast, there occurs such a type of geoeconomical anomaly as neotectonic elevations that lead to change in the basis of erosion, and therefore to activation of erosive degradation of soils and soil cover. In tilled areas, common degradations are related to agricultural exhaustion of soils due to failure to adhere to the norms and doses of introduction of organic and mineral fertilizers. Such phenomena are present in the distinguished soil-degradation districts.

In general, the performed soil-degradation zoning shall contribute to the development of measures to minimize degradation processes, increasing productivity of agricultural lands, protection of agricultural lands, and protection of soils in general.

Conclusions

Soil-degradation zoning of Lviv Oblast has been carried out for the first time. We distinguished 2 soil-degradation countries, 3 soil-degradation zones, 5 soil-degradation provinces, 14 soil-degradation counties and 31 soil-degradation districts. Soil-degradation zoning is considered to be distinguishing certain territories united by the same factors of soil formation, similar soil cover, anthropogenic pressure and its duration, which have caused the development of single-type degradation processes or combination of several types of degradation. Grouping degradation processes into types and kinds was conducted according to the typologies developed in Ukraine.

Common degradations in soils of Lviv Oblast are water and wind erosions, excessive compaction and loss of structure, dehumification, dessication and aridisation, pyrogenic degradation, contamination by agrochemicals, domestic and industrial wastes, acidification, etc. The status of the soils and land resources of the territory of the study is close to critical.

Soil-degradation zoning of the territory shall help in optimizing the use of soils by providing protective measures, conservation of severely degraded lands, allow the fertility of degraded lands to be increased, and most importantly prevent the further activation of degrading processes and protect soils, – our priceless treasure. The soil-degradation zoning we proposed has important methodologic significance. We recommend that this procedure be carried out for other regions, as well as the territory of Ukraine in general.

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