

Ecologically dangerous phenomena and processes on the territory of Ivano-Frankivsk Oblast

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Vol. 29 / 2019, 109-117



ABSTRACT: Negative ecological processes that develop on the territory of Ivano-Frankivsk Oblast are observed. The qualitative and quantitative indexes of anthropogenic transformations of natural complexes of area are described. The average monthly variations of air temperatures of months such as January and July are analysed for the investigated territory and the prognostic tendencies of climate changes are shown until 2023. The volumes of emissions of separate contaminants are given in atmospheric air and water bodies. Influence of Burshtyn TEPS on environment is analysed.

Published:

28 September 2019

KEY WORDS: climate, temperature of air, precipitations, contaminants, erosion.

1. Introduction

The territory of the Ivano-Frankivsk region is characterized by historically ancient economic development of landscapes, accompanied by centuries of significant changes in their ecological status, violations of natural integrity and equilibrium. To a certain extent, this affected the choice of the region of research, although the priority in this case was the specificity of its spatial position, namely, the contact position in the area of interaction of foothill landscapes with mountain and forest-steppe plain complexes.

At this time more than a half of territory of oblast is used as agricultural lands, the area of that in a region reaches over 59 %. The most scale anthropogenic converting into the structure of agricultural land-tenure took place in the second half of the XXth century, when on the considerable areas of the swamped and underproductive lands was conducted complex of diverse ameliorative measures with their improvement and bringing into agricultural turnover. It assisted the intensive increase of areas of croplands, without regard to ecologically possible norms in the conditions of dismembering relief of area. A relatively small amount of natural vegetation was saved. An index of wooded area is considerably below from his optimal size and presents at about 30 %. From the ecological point of view their area had to arrive at 35-37 % (Belova, 2015). It

resulted in forming of several negative ecological consequences among that the degradative processes of the ground cover come forward as near-term, in particular erosion of lands, landslides, destructions of river banks and other harmful phenomena.

2. Methods

For finding out of the set tasks served fund materials of the Ivano-Frankivsk Oblast center of hydrometeorology; Main administration of Derzhzemahentstva Department of Ivano-Frankivsk Oblast; data of regional managements of statistics, land melioration and water economy, forest and hunting economy, guard of natural environment; current materials of Departments of agroindustrial development, ecology and natural resources; State inspection of defence of plants and technological center of guard of soil fertility of "Obldzhrodyuchist" and also the personal researches of authors. For the decision of the put tasks the traditional and modern methods of research were used, in particular historical, comparative, geoinformative, statistical and mathematical, methods of systematization and districting.

3. Results

After a geographical location and climatic terms territory of the Ivano-Frankivsk Oblast is located in the zone of the developed thundershower activity, for that there are characteristic high winds, precipitations, heat and others like that. For the investigated region most inherent are such dangerous and elemental meteorological phenomena (Kalutskiy, 2007):

-wind at a speed of 15-24 m/s;

-strong precipitations as rain (15-29 mm by duration 12 hours) and thundershower (30 mm and anymore by duration to 1 hour); the rainiest are summer months - June-July;

-convective phenomena - thunderstorms that is accompanied by a hail (a diameter is a 6-19 mm) observed from April to the end of October;

-strong and protracted heat in a summer period (+35°C and higher) it is fixed during 2011-2018. In a period of absence of precipitations and permanent warm weather a high (4th class) and extraordinarily high (5th class) fire hazard is marked;

-worsening of visibility to 500 m and less than (fog) it is observed mainly in an offseason (spring, autumn), and also in a summer period, when a dramatic change of temperature condition is;

- in a winter period there are strong precipitations as snow (7-19 mm, rarer are 20 mm and anymore, by duration 12 hours) that is accompanied by formation of such dangerous phenomena as ice-storm and sticking of wet snow.

From data of regional center from hydrometeorology (Ivano-Frankivsk regional center ..., Electronic resource), during the last decades the steady growth of temperature of air is registered in the understrata of troposphere. This tendency is characteristic for a year, except for such months as September, October and December. The middle annual temperature of air from 1991 to 2017 grew on 0,7°C in relation to a climatic norm. In obedience to the requirements of Worldwide meteorological organization, climatic norms and climatic conclusions can be carried out not less than for 30-years-old period. For today climatic norms are taken from data of 1991-2020.

A tendency is marked to the increase of amount of days with a rain in winter and, accordingly, reduction to the amount of days with snow. Repetition and intensity of wet snow increase also, and, in particular, part of thundershower wet snow increased. The amount of days with a

thunderstorm and thundershower and intensity of their flowing increased in a warm period of year. The amount of dangerous squalls considerably grew at speed of wind a more than 15 m/s.

Last ten years there is proof reduction of precipitations, especially in summer and autumn seasons. The increase of temperature of air promoted to low snow winters during the last six years. For example, in a winter period 2015-2016 fixed the anomalous phenomenon - absence of snow-cover.

On territory of research all average annual temperatures of air are higher than norm, and in recent year they exceed 9°C. The value of sum of precipitations for a year very hesitates from anomalously small to very large (from 403 to 958 mm), but however years prevail with less, for a climatic norm, by the sum of precipitations (table 1).

Table 1 Dynamics of average annual temperatures of air and sum of precipitations from 2000 to 2017.

Year	Average annual temperature of air (climatic norm of 7.4°C)	Sum of precipitations for a year (climatic norm 689 mm)
2000	9.1	473
2001	7.9	895
2002	8.8	669
2003	7.7	467
2004	8.0	582
2005	7.7	630
2006	7.8	728
2007	9.3	662
2008	9.1	903
2009	8.6	639
2010	8.0	958
2011	9.7	403
2012	8.3	732
2013	8.8	602
2014	9.1	698
2015	9.7	482
2016	9.3	723
2017	9.2	725

From data of average monthly temperatures of air of July and January for 2010-2018 a prognosis is made until 2023. As evidently, the average monthly temperatures of July will go down (table 2). It will take place due to the increase of average monthly temperatures of August, and also seasons will be displaced on one month forward (it means August will be the warmest month, and February - the coldest). In January an average monthly temperature will constantly grow as a result of general rise in temperature of climate (table 3).

In a time of active rise in temperature 1991-2017, comparatively with a previous 30-years period, the average annual amount of precipitations on Ukraine increased on 0,7 % and in a warm period - on 2,7 % mainly due to precipitations for September-October (to 20-30 %). In spring and in summer they change insignificantly, however on this time there is an increase of amount of strong thundershowers that are ineffective, and often and unprofitable for farmers. It is calculated, that climatic resonances carry after itself a threat a more than 60% spending in agriculture, mainly through droughts, hail and other natural cataclysms. Predicted, that the amount of summer droughts on a next decade can increase on 15-30 %.

Table 2 Prognosis of average monthly temperatures of air of July until 2023.

Year	Average monthly temperature of July	Prognosis	Lower limit	Top limit
2010	20.8			
2011	19.6			
2012	21.3			
2013	19.4			
2014	19.8			
2015	20.2			
2016	20			
2017	19.2			
2018	19.8	19.8	19.8	19.8
2019		19.5	18.3	20.8
2020		19.4	18.2	20.7
2021		19.3	18.1	20.6
2022		19.2	17.9	20.4
2023		19.1	17.8	20.3

Table 3 Prognosis of average monthly temperatures of air of January until 2023.

Year	Average monthly temperatures of January	Prognosis	Lower limit	Top limit
2010	-8			
2011	-2.4			
2012	-3.6			
2013	-4.2			
2014	-2.6			
2015	0			
2016	-2.9			
2017	-5.6			
2018	-0.9	-0.9	-0.9	-0.9
2019		-1.6	-6.8	3.5
2020		-1.2	-6.9	4.6
2021		-0.8	-7.1	5.5
2022		-0.4	-7.2	6.4
2023		0	-7.3	7.3

The global changes of climate cause changes and adaptation of all sectors of economy and society. Based on materials of management of hydrometeorology of Government service of Ukraine, from emergencies it is possible to predict consequences from the changes of climate in the sectors of economy (table 4).

Table 4 The forecast consequences of change of climate in the Ivano-Frankivsk Oblast.

№	Sphere of influence	Consequences
1.	Electro-energy	A requirement diminishes in heating in winter, but a cooling necessity grows in summer; efficiency of production and distribution of electric power diminishes; industry during the short interval of time must adapt oneself to the changes of climate and invest in an infrastructure
2.	Agriculture and foodstuffs	Higher temperatures in winter and less frosty days diminish the loss of harvests; possible increase of the productivity of wheat; potential is for the increase of production of foods at the terms of the proper management; the increase of floods results in the loss of harvests, it is necessary to have more irrigational systems
3.	Water	More floods through the increase of amount of precipitations, especially in a winter period; frequent floods in combination with high temperatures will result in the flashes of infectious diseases; a water level in the rivers in summer grows short on 50% will result in strong droughts
4.	Ecosystems and biological variety	The change of climate will strengthen many existent threats for a biological variety and will become principal reason of disappearance of biological kinds in the future; the deficit of water can result in reduction of areas of the forests
5.	Health of people	The increase of temperature and frequent periods of emergency heat will result in the greater number of diseases and deaths of especially elderly people from thermal shots, cardiovascular diseases and diseases of pulmonary system; cases of diarrhoea and other bacterial diseases will be more often on the measure of increase of temperature and intensifying on problem of quality of water; at the same time, more warm winters will mean less deaths from supercooling

The emissions of contaminants in atmospheric air from stationary sources in 2018 diminished on 0,8 % in comparison with 2017 (Statistical yearbook..., 2018). This is not a high enough index, in fact in 2016 the amount of emissions diminished on 12,2 % in 2015. And here the emissions of carbon dioxide, that is basic greenhouse gas that influences on the change of climate, increased on 6,2 %. It is explained that in 2018 amount of enterprises and movable sources of contamination of atmospheric air increased on 44 and 31779 units accordingly, than in 2017. The closeness of emissions on a kilometre square of territory of area remains high and presents at 14240.3 kg.

The basic pollutants of atmosphere are enterprises from a production and distribution of electric power, water and gas. Their part makes 92,3 % of general volume of emissions. The radiation background of atmospheric air for areas does not exceed the set norms. For more exact idea about the emissions of contaminants into atmosphere around to territory of the Ivano-Frankivsk Oblast data are brought in tables 5-6.

Among the basic pollutants of atmospheric air on the first place is industrial enterprises of Burshtyn, that throw out 88,4% of general emissions on the Ivano-Frankivsk Oblast, part of Kalush presents 4,3% of general emissions, Dolyna, Nadvirna and Bohorodchany Raions are 1,9-1,1%, other cities and districts less than 1%.

Table 5 Emissions of separate contaminants into atmospheric air within the territory of Ivano-Frankivsk Oblast in 2018, tons.

No	Administrative units	Volumes of emissions of contaminants	Dioxide and other connections of sulphur	Connections of nitrogen	Methane	Carbon monoxide	Substances as the suspended particulate matters	Unmethane light organic compounds
1	Ivano-Frankivsk oblast	196669.4	137745.6	14132.6	6566.5	2945.917	31504.86	3686.5
Cities								
1	Ivano-Frankivsk	447.6	8.448	114.360	78.663	103.419	48.307	92.766
2	Bolekhiv	192.9	0.218	5.172	75.567	5.601	4.547	101.77
3	Burshtyn	168490.5	127097.6	10874.5	94.321	979.835	27960.2	1446.7
4	Kalush	12804.2	10324.9	368.417	14.385	86.729	1976.539	27.461
5	Kolomyia	145.3	10.250	18.655	0.196	101.238	4.028	10.749
6	Yaremche	100.7	26.296	10.112	0.970	17.311	41.274	4.718

Table 6 Volumes of emissions of contaminants, as of 01.01.2018.

Administrative unit	Amount of enterprises	Volumes of emissions		
		Thousands of tons	In % until 2017	in % until result
Ukraine	11295	2584.9	84.0	100.0
Ivano-Frankivsk oblast	363	198.3	100.8	7.7

Burshtyn thermal electric power-station – the emissions of harmful substances in the atmosphere of that present over 80 % of all stationary sources of the Ivano-Frankivsk Oblast. From atmospheric air contaminants get in the structural elements of geobiocenosis. There is washing of pollutants with atmospheric precipitations, gravitational settling and adsorption of contaminants by a laying surface. As a result of it there are destructive changes of the ground and biocenotic covers, contamination of superficial and underground waters (Horova, 2013). During incineration of coal next to the emissions of harmful substances such waste appear also, as an ash and slag. They are warehoused in the specially taken places – ashes and slag dumps, that are anthropotechnical, and do not have analogues in nature.

Ashes and slag waste dumps of Burshtyn TEPS have tier structure. As spun tiers of dumps in a phytorecultivation relation are difficult. On dry windy weather is observed the dusting of mainly overhead tiers of dumps, that is less characteristic of the lower tiers that is covered by a vegetation. For prevention of formation of dustborne clouds the dump is irrigated, and also conducted different phytomeliorative measures – reinforcement of these areas by herbs, trees and bushes. Ashes and slag waste dumps are the source of an increase ecological danger, negatively influence on the state of objects of environment and health of population, and also are reason of withdrawal of land from agricultural use.

The pattern of the economic use of territory and intensity of the anthropogenic loading on natural complexes are predefined by the presence of favorable natural terms, feature of resettlement of population, and also specialization of separate districts of the Ivano-Frankivsk Oblast on raising of certain kinds and sorts of agricultural cultures. Old history of mastering and culture of agriculture in combination with local development of industrial production resulted in destruction of

vegetation cover. It is predefined, first of all, by development of degradative processes - flat and linear erosion, collapses, landslides, and also violation of earth as a result of building, gasket of roads, oil and gas pipelines and another infrastructure. Presence of such ecologically destabilized earth in all administrative districts of Precarpathia is the certificate that in the past while using land the difficult morphological structure of landscapes was not taken into account (deep dismemberment of relief, display and steepness of slopes), and also erosive firmness of soils, antierosive and ameliorative functions of forest and meadow grouping. Elimination of natural vegetation leads not only complete degradation of the ground cover but also it is to influence on forming of river flow, decline of local bases of erosion, drying up of small riverheads.

Excessive anthropogenic loading on sloping ground stipulated wide development of ravine erosion that takes place on all territory. Most widespread are the sloping ravines that worsen the terms of till of sloping earth and increase density and depth of dismemberment of the relief. As a result, from agricultural till high-performance earth is withdrawn, transformed in useless for the use. As researches show (Belova, 2015), on this time approximately 40 % of ravines systems of region slow down the growth and gradually transform into balks.

Considerably such dangerous exogenous processes as landslide worsen the ecological state of landscapes of area. Activations of landslide development in a region was caused by internal and external factors, and especially they are intensified by anthropogenic factors - technogenic agricultural loading on to the slope of earth, slicing soles of slopes at building and operating works, creation of temporal cart-roads and other unfavourable economic works. The processes of landslide are timed, in most cases, to the erosive-staggered localities. More intensive in all they show up on areas with clay breeds in the conditions of significant amount of precipitations, and also in places, where in a geological cut the layers of sand happen among clays, that well shown in relief (Belova, 2016). Such areas of landslide are characteristic for Kosiv, Kolomyia, Nadvirna, Kalush and Bohorodchany Raions that developed on the clay and sand-clay sedimentations of molasse and flysch of Carpathians (Vaschik, 2010).

The issue of the day for a region remains a presence of the degraded and underproductive earth, re-cultivation of that in recent year is not conducted through the shortage of financing, and their further use in agriculture is ineffective. The areas of such earth are taken under canning that in a region comes true by their alkalizing and afforestation. The most volumes of canning of the degraded earth are counted in Tysmenytsia and Kolomyia Raions of area.

The economic-mastered catchment territories yield considerable transformations, that changed character of flow and water mode forming of many water objects of the Ivano-Frankivsk Oblast substantially.

Substantial transformations undergo economic development of catchment areas, which significantly changed the nature of the formation of runoff and water regime of many water objects in Ivano-Frankivsk region. Unsatisfactory position of the overflow-pipe systems and absence in many settlements of the centralized overflow-pipe are one of contamination reasons of water resources in area. Principal reasons of contamination of surface water is an upcast of muddy communal-household and industrial effluents directly in water objects and through the system of the municipal sewage system, and also receipt to the water objects of contaminants in the process of superficial flow of water from build-up territories and farmlands (Water fund..., 2006). According to table 7, volumes of upcast of contaminants in the water objects of area are insignificant.

Table 7 Volumes of contaminants that brush off with effluents in superficial water objects, as of 01.01.2018.

Administrative unit	Oil products, tons	Iron, tons	Magnesium, tons	Phosphates, tons	Calcium, tons
Ukraine	260.67	411.49	568.3	4291.05	2539.74
Ivano-Frankivsk Oblast	1.5	4.7	23.4	138.3	171.9

Not less important remained a problem of handling domestic waste. The volume of domestic waste accumulation increases, as a result there is appearance of unauthorized dumps (An environment..., 2017). The growing amount of waste and increase of the danger related to them renders substantial influence on an environment, state of natural resources, health of population, on a local economy and terms of life. The dynamics of waste formation within the limits of area is driven in table 8.

Table 8 Dynamics of waste formation (thousands of tons).

Administrative unit	2010	2014	2015	2016	2017
Ukraine	425914.2	355000.4	312267.6	295870.1	366054.0
Ivano-Frankivsk Oblast	1278.5	1815.0	2124.8	1935.4	1948.8

4. Conclusions

For maintenance and rational use of modern landscapes it is needed to carry out the row of urgent near-term measures. In particular, for the protection of land from erosion processes, construction and adjustment of hydrotechnical structures should be continued. Especially expedient in the conditions of dismembering relief of the investigated region is shore protection, creation of the field defence and water control forest planting, alkalizing and afforestation of strongly eroded earth (on slopes more than 7°C) and erosive-dangerous territories, and also realization of anti-erosive agrotechnical measures is ploughing, cultivating and supervision upon sowing across the slopes. With the aim of weakening of growth and development of ravine and balks it is necessary to create lustful and biking stripes. The same touches river banks - creation of riverbed and coast guard of forest stripes will give an opportunity to protect them from washing out and numerous landslides.

Ashes and slag waste dumps of Burshtyn TEPS is the source of contamination of superficial and underground waters, atmospheric air, soils and, on the whole, worsen a sanitary-hygienic and ecological situation, for reduction of negative influence on these territories it is expedient to conduct monitoring on the state of environment.

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