

## DIFFERENTIATION OF LAND COVER DEGRADATION IN UKRAINE AND LATVIA

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**Abstract.** Transformation of land cover is one of the global ecological problems. It causes fall of land resources productivity and loss of biodiversity of the territory. Important tasks of the ecological policy of Ukraine and Latvia include cease of the processes of land degradation and support for rational land use. However, in these countries differentiation of land cover degradation is not sufficiently studied. Particularly, in Ukraine great attention is paid to degradation of the land cover of agricultural land, while in Latvia there are no approved criteria for classification of land degradation processes. Thus, the goal of the research is to improve the methodical approaches to determination of the degradation factor of such types of land cover as water, agricultural land and forests. Differentiation of the factors of degradation of the studied types of land cover is made according to the following criteria, particularly for agricultural land – by linear erosion and growing of scrubs; for forests – by drying and deforestation; for water – by overgrowing and drying. To achieve the set goal the authors of the research used expert, cartographic, abstract and logical methods. Results of the research are of practical importance both for Ukrainian and for Latvian institutions of environmental protection and management of land use. Application of the presented approach will provide information support and determine measures concerning reclamation of land cover by means of planning of sustainable development of territories at local level.

**Keywords:** criterion of assessment, degradation factor, land cover, reclamation.

### Introduction

Transformation of land cover is one of the negative effects of anthropogenic impact. It causes loss of biodiversity, destruction of natural landscapes, land degradation, etc. Land cover is a biological or physical type (class) of land surface, including natural vegetation cover, abiotic surfaces and inland water [1]. On the global scale, there are different classifications of land cover types. For example, in the System of Environmental-Economic Accounting Central Framework (SEEA CF) there are 14 classes of land cover. That classification is developed on the basis of the UN Land Cover Classification System (LCCS) and is grounded on the information from publicly available global land cover maps (GLC) [2]. According to the classification of land cover, which is developed within the international geosphere-Biosphere Programme (IGBP) and combination of the information about land cover on the basis of Moderate Resolution Imaging Spectroradiometer (MODIS), there are 16 classes of land cover, which have been adapted to the UN Land Cover Classification System (LCCS) [3-5]. Basing on the initial data of Clouds and the Earth's Radiant Energy System (CERES) there are 18 types of land cover [6]. In spite of the fact that the mentioned classifications differ in the number of classes/types of land cover, there are still common categories of land cover: water, wetlands, forests, pastures, arable land, built-up land, and others.

Since analysis of conditions and tendencies of land cover transformation is an important information for making managerial decisions concerning development of tendencies, protection of landscapes and biodiversity, there is a necessity to make diagnostics of the land cover transformation by its physical and biological features at a local level - at the level of a municipality, community [7].

For Ukraine and Latvia, the issue of reclamation of degraded territories is an important component of regional and municipal programs of integrated development. However, investigations of the problem of land cover transformation in the mentioned countries are not developed at the appropriate level. Particularly, in Ukraine the attention is mainly paid to degradation of land cover, while in Latvia there are no criteria and classifications for identification of land and soil degradation.

Studying the problem of land degradation, researchers in Latvia have developed criteria of determination of some types of degraded territories: non-recultivated territory of mining of mineral deposit, unmanaged agriculture and forestry activity territory degraded built-up territory [8-9]. These works are of great importance for the diagnostics of land cover transformation. However, it is necessary to continue the investigation of the problem, particularly concerning such types of land cover, as forest, water bodies, arable land and pastures. It requires determining of the classifiers, which

can differentiate transformation of land cover of the above-mentioned types by degradation factors, arguing timeliness of the current research.

The aim of the research is to improve methodical approaches to determination of the factor of degradation of some kinds of land cover through differentiation of the features characterizing their transformation. To perform the task, the authors have developed criteria of assessment of land cover degradation according to definite classifying features. Such assessment will distinguish weak, medium and heavy factors of degradation, considering a neutral level of land cover degradation as a standard one.

### **Materials and methods**

The scope of the research includes land cover of agricultural and forestry land use, as well as water bodies. The object of the research is presented by land cover transformation, which is considered as a different factor of degradation within one type. The studied types of land cover include:

- type A: water (lakes, water bodies, inland rivers);
- type B: agricultural land (arable land, pastures and meadows);
- type C forests (broad-leaved deciduous forests, needle-leaved forests).

Factor of land cover degradation is considered as deterioration of its physical conditions. The authors of the work recommend to make differentiation of the factors of degradation of the studied types of land cover according to the following criteria: for agricultural land – by linear erosion and growth of scrubs; for forests – by drying and deforestation; for waters – by overgrowing and drying. Degradation of land cover according to each indicator is characterized by three factors, i.e. weak-degraded; medium-degraded; heavy-degraded. A non-degraded factor of land cover is considered as Land Degradation Neutrality.

To perform the task, the authors have consolidated the information (analysis of publications, results of researches, legal norms, experience, etc.) concerning the issue of land degradation and specification of degraded territory. Visualization of the factors of land cover degradation is made with application of the cartographic method. The abstract and logical method has been used for theoretical generalization and conclusion making.

The study was conducted as a part of municipal and state institutions competent specialists' survey to find the opinion of the respondents on land degradation types, identification and prioritization of degraded land areas and information about the maintenance of degraded territories. The quantitative research method was used to prepare a questionnaire (mostly multiple choice questions, evaluation scales, answer stratification, avoidance of open-ended questions etc.) [8].

The information about land use and conditions of land cover is found in materials of the land inventory in Ukraine and Latvia, field observations of the territory, data of the Public Cadastre Map of Ukraine, and orthophotomaps.

### **Results and discussion**

Analyzing the problems of land degradation in Ukraine and Latvia, it should be noted that both countries have common and different features. For example, in Ukraine degradation of land cover due to appearance of active ravines is a common phenomenon on agricultural land and is observed on the area of 157 thousand ha. In Latvia water erosion on agricultural land is observed from 0 % in the central part to 45 % in the eastern part of Latvia. However, in Latvia there is the Baltic Sea seacoast erosion on the distance 345 km or almost 70 % of the total seacoast length. The problem of forest drying is common for both countries. In Latvia, the accumulated amount of dry wood averagely makes 18 m<sup>3</sup> per hectare, including fallen wood making 11 m<sup>3</sup> per hectare, standing dead trees – 7 m<sup>3</sup> per hectare. In Ukraine, the area of forest drying takes 440 thousand ha or 5 % of the total area. Inland water bodies suffering from physical degradation in the form of overgrowing and drying are more common for Ukraine. Degraded land cover under unfinished and left buildings is found in both countries [11; 12].

Supporting the goals of sustainable development, Ukraine and Latvia focus their policy on sustainably managed land, contributing to food safety, economic growth, protection of the territory from degradation. It also creates a basis for economic, social and technological progress in harmony with the nature. For introduction of effective measures concerning environmental protection and development of the strategy for cease of the territory degradation, as well as for reclamation of natural landscapes and increase of natural resources productivity, it is important to make monitoring of land cover transformations not only on the global and state scale, but also at a local level. However, diagnostics of land cover degradation should be done on agricultural land and forest land, water stock, industry and built-up land. Without differentiation of degradation processes, which force land cover transformation, it is impossible to make appropriate determination of the degree of land use impact on the physical cover, including natural and planted by people vegetation, constructions (buildings, roads and others). Thus, the land cover and land use are the integrated elements making a crucial impact on the global systems of our planet, particularly on the atmosphere and climate.

Applying the complex approach and considering the conditions of Ukraine and Latvia, the authors propose improvement of the methodical approaches to determination of degradation factors of the land cover types, which are common for the territory. It will provide information and define the measures concerning land cover reclamation depending on the degree of their deterioration. It can be achieved through planning of agricultural land use, sustainable forest management and reclamation of anthropogenic landscape.

To differentiate the degradation factors, it is necessary to take a definite criterion for consideration of the share of the degraded land in the total area of the studied territory at a local level on land parcel level. It is necessary to point that the authors have used expert estimates for comparative evaluation of the criteria for assessment of the factors of degradation of land cover on a land parcel level in the region. The group of experts included representatives of the departments of the State Service of Ukraine for Geodesy, Cartography and Cadastre, Department of Ecology and Natural Resources, as well as competent specialists in public institutions of Latvia (Ministry of Agriculture, Ministry of Environmental Protection and Regional Development, State Plant Protection service, etc.). Generally, the research engaged 25 leading Ukrainian experts, officials, lawyers, representatives of non-governmental sector, who worked in the field of land resources management, and 15 Latvian experts. Table 1 presents the weighted average of the grade assessment according to the mentioned methodical approach.

Table 1

**Differentiation of the factors of land cover degradation by the share of degraded territory,  
% of the total area of the studied territory at a land parcel level**

Type of land cover and the corresponding classifier	Criterion of assessment of land cover degradation	Neutral factor of land cover degradation (NFLCD)	Factor of land cover degradation		
			weak	medium	heavy
A – Water	Growing of scrubs	Under 5 %	5-20 %	21-50 %	above 50 %
	Drying	Under 5 %	5-30 %	30-70 %	above 70 %
B - Agricultural land	Gullying	Under 0.1 %	0.1-5 %	5-25 %	above 25 %
	Growing of scrubs	Under 1 %	1-20 %	21-50 %	above 51 %
C - Forests	Drying	Under 5 %	5-15 %	15-60 %	above 60 %
	Deforestation (felling of trees)	Under 5 %	5-15 %	15-60 %	above 60 %

For visual comparison of the factors of land cover degradation, the authors of the research have made field observations of the degraded territory. The results of such comparison serve as an additional proof of the proposed methods. Figures 1-3 present differentiation of degradation factors of some types of land cover according to the mentioned criteria.

The research confirms that for Ukrainian and partially Latvian conditions drying and even drying up of water bodies are common phenomena, as well as overgrowing of streams and appearance of dead water spaces. Such problems are caused by natural cycles, such as anthropogenic activity, which contribute to increase of the greenhouse effect.

Moreover, both in Ukraine and Latvia, soil erosion and gullying are some of the most common and dangerous geomorphological processes, causing degradation of land cover, destruction of communications, deterioration of economic and living conditions of people (Fig. 1).

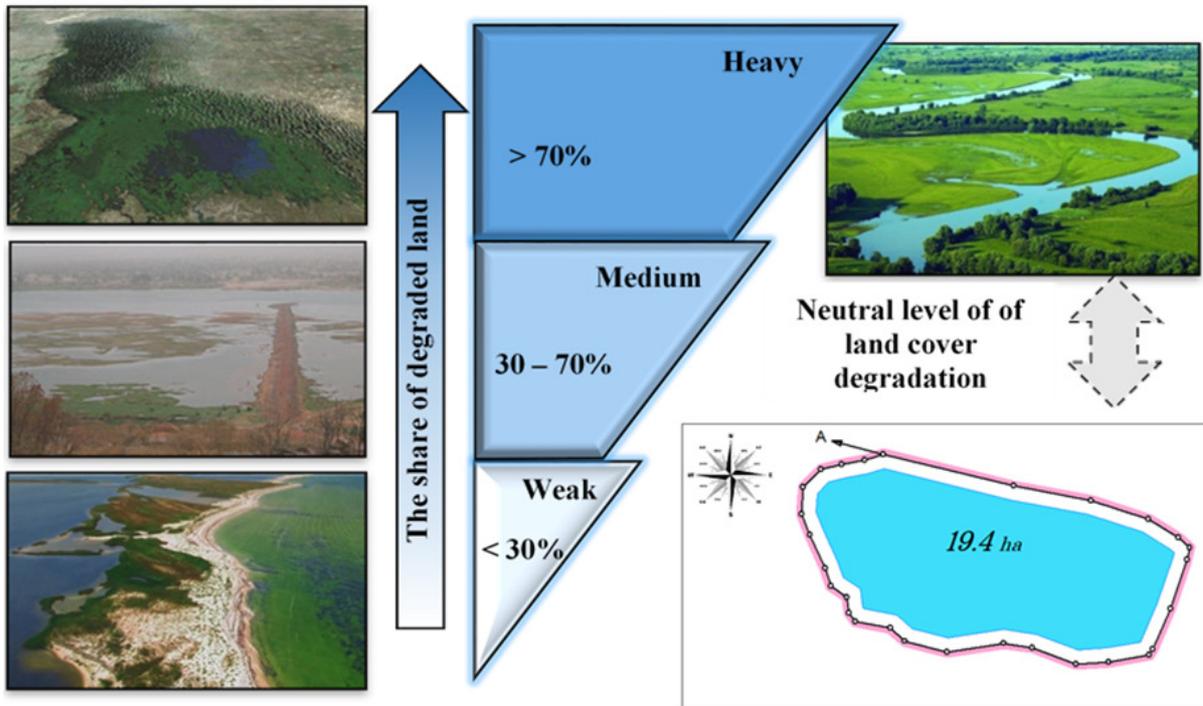


Fig. 1. Visual representation of classification of factors of degradation of land cover of type A “Waters” according to criterion “Drying”

Differentiation of the factors of degradation of agricultural land cover according to the criterion “Gullying” is illustrated in Figure 2. There is proposed modelling of development of the degradation processes at that type of land cover and argumentation of the system of anti-erosion measures.

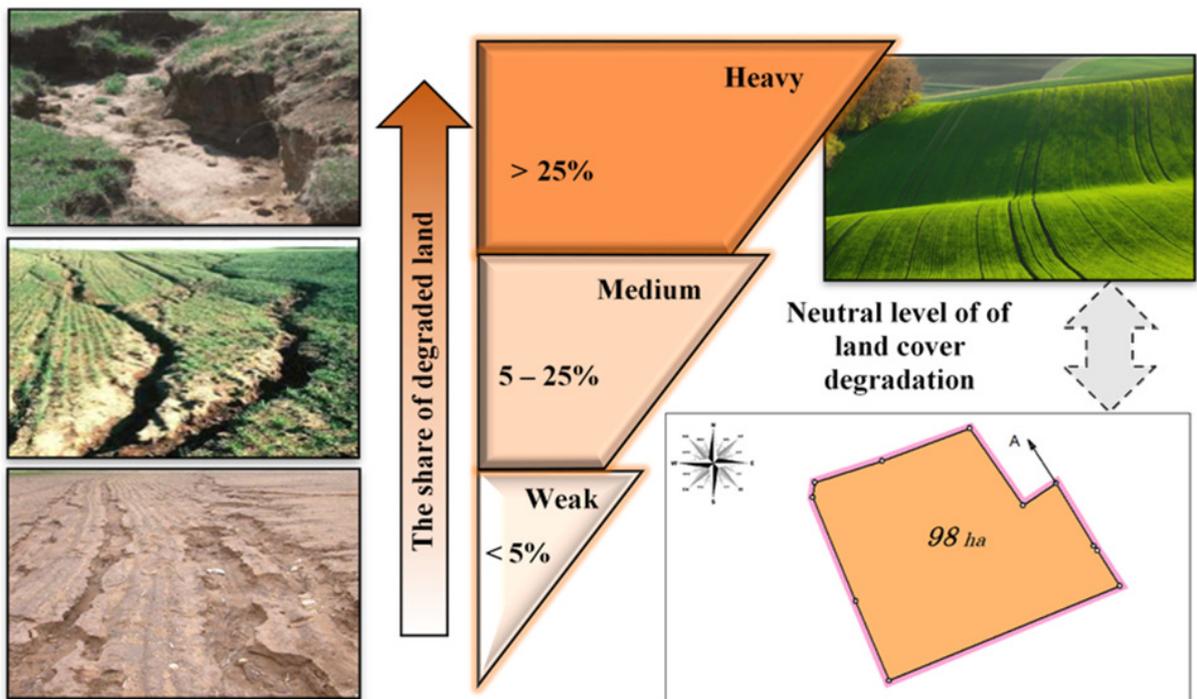


Fig. 2. Visual representation of classification of factors of degradation of land cover of type B “Agricultural land” according to criterion “Gullying”

Lately considerable increase has been observed of the volume of drying forests due to fall of the level of ground waters and development of the population of secondary insects. Visual presentation of the process of differentiation of degradation of the mentioned type of land cover is supplied by Fig. 3.

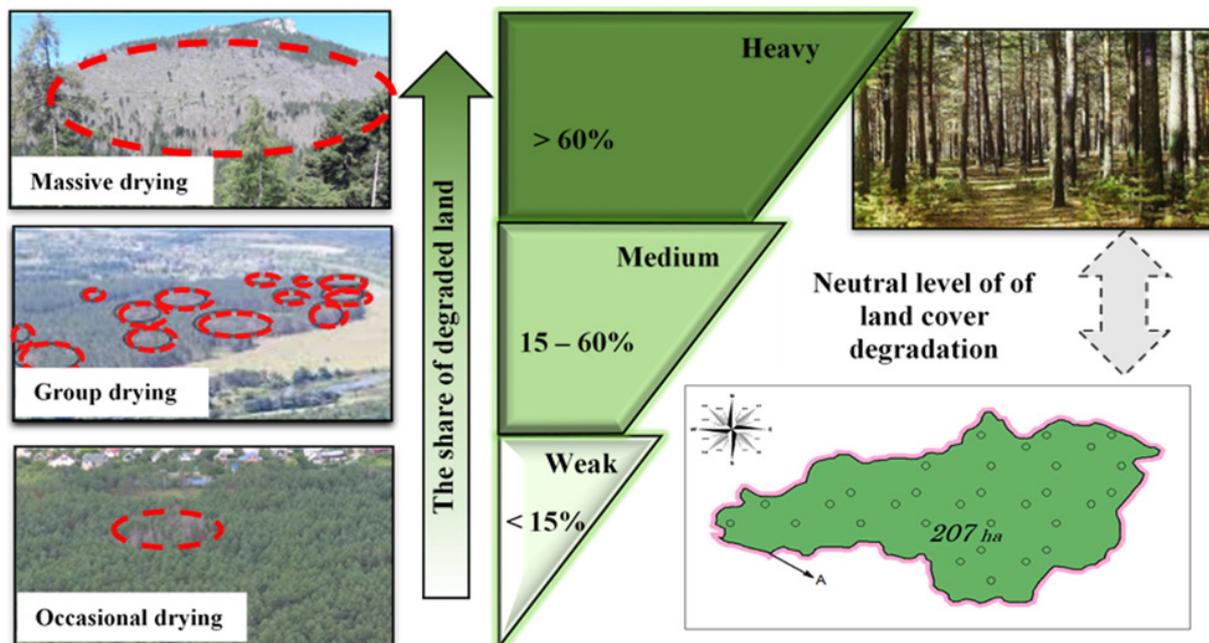


Fig. 3. Visual representation of factors of degradation of land cover of type C “Forests” according to criterion “Drying”

Forest degradation is also manifested in the form of deforestation, caused by economic use of timber or occupation of the territory for the purpose of arable farming, animal breeding and building.

Considering the strong tendency of manifestation of the processes of land cover degradation, which is intensified both by extensive way of agriculture running and by natural conditions (relief, soils, climate), it is necessary to make analysis of the factors of its appearance in the future. It should be done in order to develop adaptive methods of fixation of the destructive process intensity as a constituent of natural processes monitoring.

## Conclusions

1. Land cover degradation is a negative factor of land use in Ukraine and Latvia. Degradation causes reduction of land fertility due to deterioration of its physical properties. Ecological policy of these two countries aims at the development of measures to stop land degradation and improve the land productive potential. Such measures require identification of degradation processes at a local level.
2. The proposed methods for determination of degradation factors of the common types of land cover through differentiation of features characterizing their transformation, distinguish weak, medium and heavy factors of degradation, applying publicly available and not expensive information about physical conditions of land cover of a definite territory. Application of such approach provides information support and determines measures concerning reclamation of land cover depending on the degree of their deterioration by planning of agricultural land use, sustainable forest management, reclamation of anthropogenic landscapes, etc.
3. The results of the research are of practical importance both for Ukrainian and for Latvian institutions of environmental protection and management of land use. Particularly, it will improve the state system of monitoring of land, forests and waters at a local level, supply information for land organizations in terms of development of appropriate documents in the field of land protection and performance of the approved measures, as well as forest management.
4. Further research in the mentioned field will be focused on a more detailed study of classification of degradation features depending on the physical conditions of land and their substantiation on the basis of performed observations of different types of land cover in time.

## References

- [1] Hašič I., Mackie A. Land Cover Change and Conversions: Methodology and Results for OECD and G20 Countries. OECD Green Growth Papers. OECD Publishing, Paris, No. 4, 2018. 60 p.
- [2] Di Gregorio A. Land Cover Classification System: Classification concepts and user manual: Software version (2). Food and Agriculture Organization of the United Nations: Rome, Italy, 2005. [online] [18.02.2019]. Available at: <http://www.fao.org/3/y7220e/y7220e00.htm>
- [3] Loveland T., Belward A. The International Geosphere Biosphere Programme data and information system global land cover data set (DISCover). Acta Astronautica, Vol. 41 (4), 1997, pp. 681-689.
- [4] Friedl M. A., Sulla-Menashe D., Tan B., Schneider A., Ramankutty N., Sibley A., Huang X. MODIS Collection 5 global land cover: Algorithm refinements and characterization of new datasets. Remote Sensing of Environment, 114, 2010, pp. 168-182.
- [5] Herold M., Mayaux P., Woodcock C., Baccini A., Schmullius C. Some challenges in global land cover mapping: An assessment of agreement and accuracy in existing 1 km datasets. Remote Sensing of Environment, 112 (5), 2008, pp. 2538-2556.
- [6] CERES Surface Type Ids. [online] [12.01.2019]. Available at: [https://ceres.larc.nasa.gov/science\\_information.php?page=CeresSurfID#](https://ceres.larc.nasa.gov/science_information.php?page=CeresSurfID#)
- [7] Brown D. G., Polsky C., Bolstad P., Brody S. D., Hulse D., Kroh R., Loveland T. R., Thomson A. Ch. 13: Land Use and Land Cover Change. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 2014, pp. 318-332.
- [8] V.Parsova, A.Jankava, I.Kukule. Determination of Land Degradation for Sustainable Development of Municipality Territories. Proceedings of 2<sup>nd</sup> Baltic Geodetic Congress (BGC Geomatics), Gdansk University of Technology, Gdansk (Poland), 2017, pp. 158-162.
- [9] Platonova D., Parsova V., Jankava A., Berzina M. Expert Judgement of Mutual Influence among Land Degradation Determination Criteria. Proceedings of the 16<sup>th</sup> International Scientific Conference "Engineering for Rural Development", 2017, Jelgava, pp. 1100-1103.
- [10] Land degradation neutrality. A business perspective. [online] [27.12.2018]. Available at: [https://docs.wbcsd.org/2015/10/WBCSD\\_LDN\\_BizPerspective.pdf](https://docs.wbcsd.org/2015/10/WBCSD_LDN_BizPerspective.pdf)
- [11] Jankava A., Paršova V., Berzina M., Didrihsone D., Platonova D., Palabinska A. Assessment of Land Degradation for Sustainable Development of Municipality Territories. Proceedings of the International Scientific Conference „Economic Science for Rural Development”, No 44, Jelgava, 2017, pp. 69-75.
- [12] Про схвалення Концепції боротьби з деградацією земель та опустелюванням: Розпорядження Кабінету Міністрів України від 22 жовтня 2014 р. № 1024-р. [online] [17.01.2019]. Available at: <https://zakon.rada.gov.ua/laws/show/1024-2014-%D1%80> (In Ukrainian).