SYSTEM ASSESSMENT OF ENVIRONMENTAL STATUS OF AGRICULTURAL LANDSCAPES IN UKRAINE

(case study of Ternopil region)

T. Cherlinka, V. Chaika, N. Bilyera,

National University of Life and Environmental Sciences of Ukraine

It has been studying that MSA index (Mean Species Abandance). could be taking into account for agrolandscapes environmental status assessment and modeling the methods of improvement. It was found, melioration activities based on aforestation and meadowing of low-productive and degradated lands allows achieving slight (2 %) improvement of environmental status. This is the evidence of the fact, that significant improvements are possible only by decreasing the rate of arable lands.

Key words: Biodiversity, anthropogenic influence, antropogenous load, ecological stability

INTRODUCTION

Ukraine as a country with a fairly diverse biota (over 70 thousand of species), the cost of which is estimated at 7,6 trillion US dollars is a net recovery of biodiversity reserves in Europe, because biodiversity as part of the natural capital of Ukraine is one of the most important factors of GNP growth (Sozinov 2005) According to the data of Ukrainian Center for Land Management and Tauride National University named after V. Vernadskyi the total area of natural territories in Crimea is approximately 1,5 times larger than was considered earlier (Prydatko et al. 2008) Ukraine occupying less than 6 % of the Europe has not less than 35 % of its biodiversity. Atlas Flora Europaeae (1999) indicates that Ukraine is situated in that part of Europe, where the density of genetic biodiversity varies between 23 and 430 standard units, and riches 430 standard units in the Carpathian and Crimean mountains (Environment for Europe 2004).

Europe's richest land in Ukraine, combined with favorable climatic conditions should ensure a high level of agricultural production. However,

productivity of agroecosystems in Ukraine is 2-3 times less than in European Union, furthermore, this trend has been observed for many years in spite of the progress of the socio-economic structure, the structure of land use, development of research for the agricultural sector, etc (Lisovyi&Chaika 2009).

Relevance of research is to prevent greater environmental crisis by measures led in optimize the structure of agricultural landscapes to improve their environmental sustainability in terms of environmental protection.

Purpose of this study is system assessment of the ecological condition of agricultural landscapes in Ukraine (case study Ternopil region) and modeling activities with the aim to improve it by biogeocenotic and meliorative methods.

Materials and methods. Ternopil region is situated in western Ukraine (between lon.24°44' and 26°44' S, between lat.48°30' and 50°16'N). Region occupies western part of Podilska Upland. The relief is flat. The surface area has a slope from north to south, confirming directions of riverbeds. Absolute surface height ranging from 443 m (at v. Mechyschiv Berezhansky area) to 116 m (at the river Zbruch). Ternopil region consists of 17 administrative districts. The structure of agrolandscapes includes the rate of arable land (A), environmental-stabilizing lands (ESL) – pastures, forests, perennial crops which are given in table 1.

Table 1

Assessment of the ecological condition of agricultural landscapes of Ternopil region **(**by the ratio proportion of land of administrative district)

№	Districts	Rates of lands, % of the total area (A+ESL)		Environmental condition of agrolandscapes (Tretyak et al., 2001)	Grade	Territory ecotypes
		A	ESL			
1	Berezhansky	39,71	60,28	Critical	3	II
2	Borschiv	68,33	31,66	Crisis	4	III
3	Buchatskiy	67,06	32,93	Crisis	4	III
4	Husyatyn	72,06	27,93	Catastrophic	5	IV
5	Zalishchyky	68,23	31,76	Crisis	4	III
6	Zbarazkiy	76,90	23,09	Catastrophic	5	IV
7	Zborowski	64,31	35,68	Crisis	4	III
8	Kozova	77,5	22,49	Catastrophic	5	IV
9	Kremenetskiy	60,76	39,23	Crisis	4	III
10	Lanivtsi	76,02	23,97	Catastrophic	5	IV
11	Monastyryska	48,70	51,29	Critical	3	II

12	Pidvolochysk	81,8	18,17	Catastrophic	5	IV
13	Podgaeckij	63,02	36,97	Crisis	4	III
14	Terebovlyansky	78,15	21,84	Catastrophic	5	IV
15	Ternopil	73,08	26,91	Catastrophic	5	IV
16	Chertkovsky	74,83	25,16	Catastrophic	5	IV
17	Shumsky	51,30	48,69	Critical	3	II
Total in Ternopil region		68,00	31,99	Crisis	4	III

To make a ranging of the districts by ecotypes the scale of Furdychko (2005) method has been used.

Table 2

Grading of anthropogenic loading on lands

Land utilization type	Grade
Industrial, transport and built-up lands	5
Fallows and perennual crops	4
Natural grasslands, meadows	3
Forest belts, scrubs, forests, swamps, water bodies	2
Microreserves	1

System assessment of the environmental condition was carried out according to the proofed national methods by calculating the coefficient of ecological stability (Kes) and anthropogenic load factor (Kahn) (Tretyak et al.2001).

Assessment of the impact of the lands structure on the ecological stability of the territory depends on the development of agricultural land, rate of arable land, intensity of utilization, land reclamation, construction work, and is characterized by CES, which is different for different agro-ecosystems. At the same time, Kahn characterizes the influence of human activity on the environment, including lands (Tretyak et al.2001).

MSA (mean species abundant) index was calculated according to the methodology described in (Alkemade et al. 2009). The relationship between different criteria of environmental conditions was established by the method of correlation analysis.

Results and discussions

The results of MSA index, Kes and Kahn calculations, as well as correlation analysis data of the studied areas are shown in tabl. 3.

Table 3

Relationship of MSA index values with other indicators of agrolandscapes environmental conditions in Ternopil region of Ukraine

District	*MSA*	*Kahn*	*Kes*
Berezhansky	29	3,2	0,55
Borschiv	20	3,6	0,27
Buchatskiy	19	3,6	0,39
Husyatyn	20	3,7	0,26
Zalishchyky	21	3,6	0,38
Zbarazkiy	18	3,7	0,31
Zborowski	17	3,7	0,26
Kozova	19	3,7	0,38
Kremenetskiy	21	3,5	0,39
Lanivtsi	12	3,8	0,24
Monastyryska	21	3,3	0,48
Pidvolochysk	16	3,9	0,24
Podgaeckij	21	3,5	0,38
Terebovlyansky	18	3,8	0,27
Ternopil	16	3,7	0,29
Chertkovsky	21	3,7	0,32
Shumsky	26	3,3	0,45
Ternopil region	23	3,6	0,33
Correlation		*-0,83*	*0,798*
$p \leq 0.01$		*2,73*	*2,73*
t		*18,6*	*22,3*

The high value of the correlation between MSA, Kahn and Ks was found. This situation is due to the fact that in the calculation of these indicators type of land use is the basic criterion.

Taking into account quantity and quality indexes of environmental condition of agrolandscapes (Prydatko et al. 2008) we were studied quality criteria according to MSA data. The results of our study are shown in table 4.

Table 4

Criteria for qualitative assessment of environmental status Ukrainian territories in terms of index MSA

MSA, %	Environmental status of agrolandscapes
90 – 100	Reference (etalon)
80 – 89	Optimal

70 – 79	Normal
60 – 69	Good
40 – 59	Satisfactory
30 – 39	Moderate
12 - 29	Crisis

According to the criteria of environmental quality assessment all the agricultural landscapes in Ternopil region of Ukraine are in crisis. Accordingly, MSA value for other Ukrainian Region is the follow (Prydatko et al. 2008). Ukrainian Carpathians – 63 %, good; Crimean mountains – 35 % , moderate; Ivano-Frankivsk region. – 55 %, satisfactory; Chernivtsi and Rivne region. – 45 %, satisfactory; Lviv, Volyn and Zhytomyr Region – 42 %, satisfactory; Kiev and Chernigiv Region – 38 %, moderate; Cherkasy and Khmelnytsky Region. 35 %, moderate; Sumy Region – 32 %, moderate; Ternopil Region – 23 %, crisis, Vinnitsa Region – 28 %, crisis, Poltava Region – 27 %, crisis; Kirovograd Region – 24 %, crisis, Odessa and Kharkov Region – 23 %, crisis, Mykolaiv, Kherson and Luhansk Region – 22 %, crisis, Zaporizhya – 21 %, crisis, Donetsk and Dnipropetrovsk Region – 19 %, crisis.

Crisis environmental conditions of theses regions are the main reason of systematic economic crisis totally in Ukraine. Modeling of the main factors of the current environmental condition of the agrosphere of Ukraine on the basis of the concept of ecological functions of agricultural biodiversity proves the link between depleted biodiversity and ecological and socio-economic problems of agricultural production. Social problems of rural territories are due to the current rate of arable lands as a factor of extensive production growth (Lisovyi&Chaika 2009). The deterioration of the environmental situation in Ukraine in general, and in Ternopil region in particular, requires reclamation of agricultural landscapes (Sayko 2000).

The most appropriate economic measures to improve the ecological condition of agricultural land is increasing the share of eco-stabilizing land due to degraded and low-lands. With MSA calculation we have performed simulations of ecological efficiency of biogeocenotic reclamation of agricultural landscapes (tabl. 5)

Table 5

The environmental effectiveness of reclamation activities on degraded lands and low productive agricultural landscapes (case study Ternopil region)

Districts.	Lands to be reclamated, hectares		Actual MSA, %	Expected MSA, %	
	Degradated	Low productive		Afforestation, % (1)	Afforestation and meadowing,% (2)
Berezhansky	707	32	29,2	29,5	29,3
Borschiv	-	756	20,2	20,4	20,4
Buchatskiy	23	2516	19,7	20,3	20,3
Husyatyn	951	-	20,4	20,6	20,5
Zalishchyky	-	1132	21,0	21,1	21,1
Zbarazkiy	863	129	18,1	18,4	18,3
Zborowski	26	838	17,6	17,8	17,8
Kozova	-	762	19,0	19,2	19,2
Kremenetskiy	-	2420	21,3	21,9	21,9
Lanivtsi	165	1616	12,1	12,5	12,3
Monastyryska	256	652	21,2	21,5	21,5
Pidvolochysk	-	851	16,0	16,1	16,1
Podgaeckij	-	629	20,5	20,8	20,8
Terebovlyansky	-	3899	17,8	18,5	18,5
Ternopil	14	649	16,2	16,4	16,4
Chertkovsky	-	1987	20,5	21,0	21,0
Shumsky	21	2690	25,8	26,3	26,3

Under transferring of degraded and low lands from intensive cultivation to afforestation, biodiversity growth rate exceeds 23 %. If degraded and low lands will be allocated for reforestation, meadow, the MSA index in Ternopil region predicted to increase by 22,9 %.

Expected changes in MSA index were evaluated in two options of biogeocenosis reclamation: (1) the total area of afforestation of degraded and low-lands; 2) low-lands afforestation and meadowing of degraded lands.

It was established that predictive environmental efficiency of used reclamation options is negligible. For example, reclamation through afforestation (1) increases the minimum value of the MSA index (Lanivtsi district) from 12,1 to 12,5 % and the maximum (Berezhansky district) - from 29,2 to 29,5 %. Similar results are expected after the second option of reclamation: Lanivtsi district - from 12,1 to 12,3 %, Berezhansky region - from 29,2 to 29,3 %. Thus, the "soft"

reclamation activities without making drastic alterations of agricultural landscapes, will not improve the environment.

Conclusions

1. MSA index has a strong correlation with such indexes Kes, Kahn. This allows us to use MSA values for environmental analysis of local territories, as well as for modeling of improvement measures.

2. Agrolandscapes reclamation in Ternopil Region which is based on afforestation and meadowing of low- and degraded lands allows achieving some improvement (2 %) in ecological condition of agricultural lands. It is indicated that visible improving of environmental condition is possible to have only after decreasing he share of arable lands.

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СИСТЕМНА ОЦІНКА ЕКОЛОГІЧНОГО СТАНУ АГРОЛАНДШАФТІВ УКРАЇНИ В ТЕРНОПІЛЬСЬКІЙ ОБЛАСТІ

Т. П.Черлінка, Н. М.Білєра, Чайка В. М.

З'ясовано, що індекс узагальненого видового різноманіття MSA (MeanSpeciesAbandance), може бути використаний для оцінки екологічного стану агроландшафтів і моделювання заходів щодо його поліпшення. Доведено, що меліорація агроландшафтів Тернопільської області на основі заліснення та залуження низькопродуктивних і деградованих земель дозволяє отримати незначне (2 %) покращення екологічного стану території. Це свідчить, що суттєве покращення екологічного стану довкілля можливе лише за скорочення площ орних земель.

Ключові слова: *біорізноманіття, антропогенний вплив, антропогенне навантаження, екологічна стійкість.*

СИСТЕМНАЯОЦЕНКАЭКОЛОГИЧЕСКОГО СОСТОЯНИЯ АГРОЛАНДШАФТОВ УКРАИНЫ В ТЕРНОПОЛЬСКОЙ ОБЛАСТИ

Т. П.Черлинка, Н. М.Билера, Чайка В. М.

Установлено, чтоиндекс MSA (MeanSpeciesAbandance, обобщенного видового биоразнообразия) может быть использован для оценки экологического состояния агроландшафтов и моделирования мероприятий по его улучшению. Доказано, что мелиорация агроландшафтов Тернопольской областина основе облесения и залужения низкопродуктивных и деградированных земель позволяет получить незначительное (2 %) улучшение экологического состояния территории. Это свидетельствует, что существенное улучшение экологического состояния окружающей среды возможно только при сокращении площадей пахотных земель.

Ключевые слова: *биоразнообразие, антропогенное воздействие, антропогенная нагрузка, экологическая устойчивость.*