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THE PART TO RATIONAL LAND USE – INDICATION OF THE ENVIRONMENTAL CONDITION OF AGRICULTURAL LAND

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Indication research of ecological condition of agrarian land use in Ukraine was made on the basis of the author's method. Research period includes data of 1985-2013 years. Based on the results it was concluded that the agricultural land use in Ukraine corresponds the requirements of sustainable development. Indices are the main components of indication model of sustainable agricultural land use development in Ukraine.

Keywords: indication, model, land use, sustainable development, ecological conditions, method.

1. Introduction.

In current conditions the solution of the problems existing in agricultural area is not possible without transferring to sustainable development model. In accordance with the principles of the Rio de Janeiro conference – the science-based system of sustainable development and land use should be developed.

Development of any scientific system requires, among other things, determination of the scientific principles, building of system and indicators by which one can determine the level of its operation.

About 3 thousand ecological indicators have been developed and used in practice today, and more than 2/3 of them are partial ecological indicators. Such a big number of ecological parameters require their respective classification for more focused and effective use of indicators in identifying and addressing certain ecological problems.

An important contribution to the scientific bases of integrated assessment of sustainable land use development was made by

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leading national scholars: A. Tikhonov (2003), O. Tsarenko (2003), N. Hrebeniuk (2003), O. Tykhonenko (2010), V. Fedenko (2010), O. Popov (2012) and others. They suggested the system of stability indicators of agricultural land use. The system has more than 30 sets of indicators in three blocks – economic, ecological and social. In our opinion, this system can be used as a baseline list of indicators (the use of a baseline list of indicators is a prerequisite for the initial phase of the creation of sustainable development indicators system), but it needs improvement: first, at the choice of the system features classification (number of blocks and their names, systematization of indicators by type); secondly, on the choice of indicators.

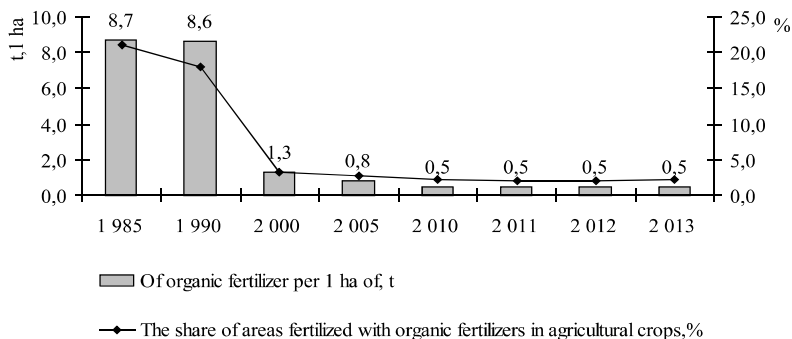
Recent research of indication of agricultural land use sustainability on different methodological approaches are dated 2005 and 2009 years. Data need updating and unified approach to model construction: the ability to monitor the development of land use, determine level of its stability and an indication of the process in time and dynamics.

We set the goal to research the indication of ecological condition (the first block of indication model) of agricultural land use in Ukraine based on the methodological approaches specified by us before [1]. The specified system of indicators [2] is suggested to assess the sustainable development of agricultural land use at the meso level and divided by type (status, dynamics, balance and result) and for blocks (social, ecological, economic, ecological-economic, social-economic and ecological-social-economic).

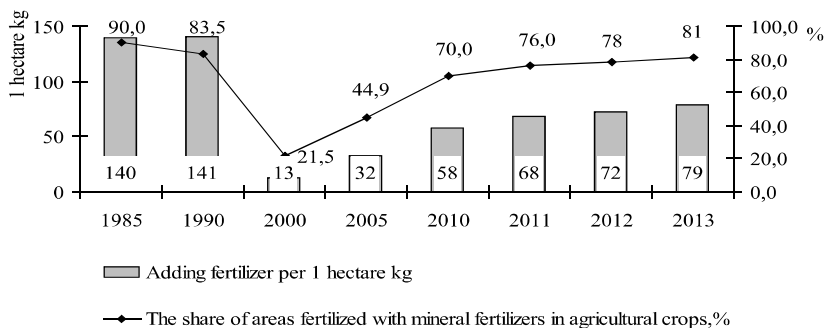
2. The main material.

We note that the current status of the majority of the land resources of Ukraine is characterized as intense, and sometimes – crisis, with a tendency of deterioration, which significantly complicates the socio-economic development of the country and adversely affect the landscape and biodiversity, health and living conditions of the population. Thus, according to surveys of soil humus content in the soil of Ukraine in 1991 compared to 1881 decreased by 31.3%. However, only for 30 years (between 1961 and 1991) humus content in arable soils decreased by 0.4 points or 11.4%.

Among other things not this situation affected permanent reduction of organic fertilizers. If in 1985 to 1 hectare made 8.7 tons of organic fertilizer and limed area was 21.1%, in 2013 the share of areas fertilized with organic fertilizers for agricultural crops accounted for only 2.2% and 0.5 t and 1 ha (picture 1). The opposite tendency is observed on fertilization, since 2005, there has been a steady increase of chemical fertilizers per 1 ha, and the proportion of fertilized crop acreage in 2013 was already 81%, which is only 9 pct less than 1985 level (picture 2).



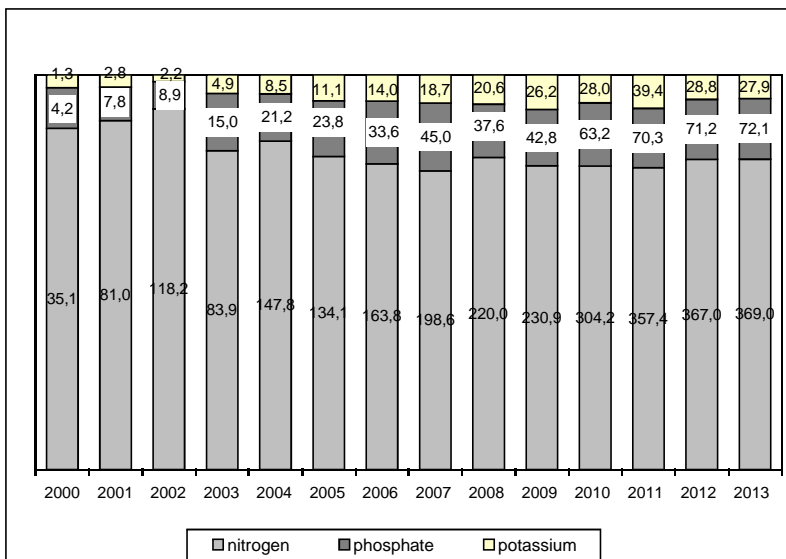
Pic. 1. Dynamics of organic fertilizers for agricultural crops in Ukraine



Pic. 2. Dynamics of mineral fertilizers for agricultural crops in Ukraine

Source: based on the author's data [3]

The intensity of land use by improving crop yields as a result of organic and mineral fertilizers is one of the most important ways to improve the economic efficiency of farms, but not always a positive influence on the quality of the soil.



Pic. 3. Distribution of mineral fertilizers in terms of 100% nutrients sown of agricultural crops agricultural enterprises (except small) by types

Deterioration of soil processes continue in Ukraine. In 1996, the total area of arable land eroded reached 10598,6 thousand hectares to 7991,4 thousand hectares in 1961, namely increased by 2607,2 thousand hectares, which is 76,7 thousand hectares of the year. In 1996, from the total area of eroded land 7879,7 thousand hectares or 74.4% were slightly eroded land, 2241,4 thousand hectares or 21.1% – medium eroded and 477,5 thousand hectares or 4.5% – much eroded. Comparatively with 1961, in 1996 eroded area of arable land increased by 32.6%, of which slightly eroded by 28.9%, medium eroded by 41.8% and much eroded by 61.0%. There is not only the growth of eroded areas of arable land, but especially high

growth rate of much eroded areas of arable land. According to various estimates annual erosion lost from 11 to 24 million tons of humus, over 0.5-1 million tons of nitrogen 0,4-0,7 million tons of phosphorus, 0.7 million tons of potassium losses are compensated fertilizer only 20-25%. Loss of agricultural products from erosion exceed 9.12 million tons of grain units annually.

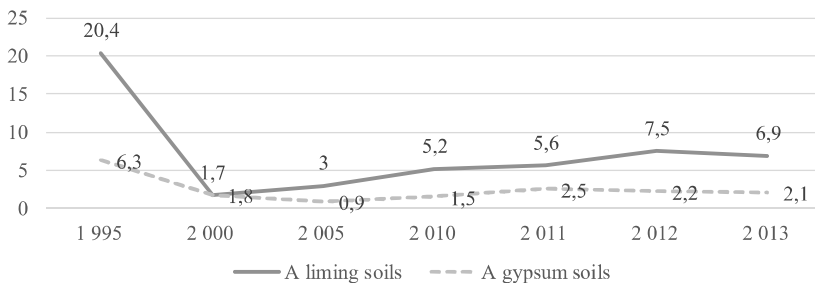
Along with their flatness erosion is rapidly developing processes of linear erosion and gullies creation. Gullies area is 140 800 ha, and their number is over 500 thousand. Some ravine-beam system with erosion intensity exceed the average 10-20 times.

Wind erosion systematically influences more than 6 million hectares of land, and in the years of dust storms – 20 million hectares. Ukrainian land fund inclined to deterioration and also on other quality parameters (salinity, saline, over moisture etc.).

Intensive agricultural land use leads to a decrease in soil fertility through their consolidation (especially black soil), loss lumpy, granular structure, water penetration and aeration capacity of all ecological impacts. The most exposed soil compaction regions of western Ukraine, the least – North (North Polesie and forest-steppe). Thus, the structure of the land fund of Ukraine occupy large areas of soils that are characterized by poor properties (washed, deflation saline, saline, wetlands, etc.) – Is degraded and marginal soils. According to the calculations, soil area of arable land exceeds 6.5 million hectares (20% of arable land) and direct annual losses (ie the difference between the value of gross domestic product and cost to receive it) reaches an average of 66.5 UAH/hectare or in general in Ukraine – about 400 million UAH. Monitoring of agricultural land by indicators that affect soil fertility show that in 1995 compared with 1990 square saline soils decreased by 61.2 thousand hectares of acid – to 1078.5 thousand hectares of wetlands – the 318,3 thousand hectares of wetlands – on 197.0 hectares deflationary dangerous – to 395.7 thousand hectares.

At the same time during this period area of saline and alkaline soils complexes increased on 45.3 thousand hectares, rocky ones – on 108.3 thousand hectares and eroded – on 454.8 thousand hectares.

This dramatically reduced the amount of work on carrying lime and gypsum soils. In 1990 liming and gypsum soils were performed according to 1407.9 and 285.4 thousand hectares, the size of the area in 2013 decreased by 93.1 and 97.9% (Pic. 4).

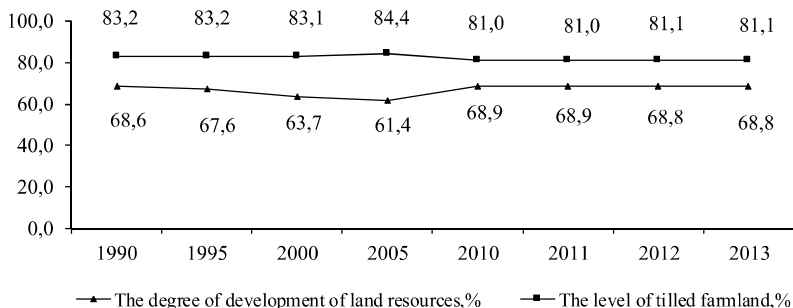


Pic. 4. Dynamics of lime and gypsum soils in Ukraine, 1990 = 100%

Source: based on the author's data [4]

The defining parameters that characterize the impact of agriculture on the environment is the extent of cultivated land and the degree of development of agricultural land. Since the vast majority of land resources is in intensive agricultural circulation, the area of land with available scientific and technological level of agriculture determines their quality status and social significance. It should be noted that with the economical and efficient use of agricultural land plans for economic and social revival of the village, the possibility of rapid economic stabilization, improvement of environmental conditions are associated. The negative result of intensive land use, especially agricultural development is the vulnerability of large land area towards water and wind erosion (deflation hazardous area). Over the past twenty-four years the level of development of land resources (arable area) and the level of tilled farmland in Ukraine hardly changed. Comparatively with 1990, in 2013 plowed area has increased – from 68.6% to 68.8%,

and agricultural land decreased, but not so much – from 83.2% to 81.1% (Pic. 5).

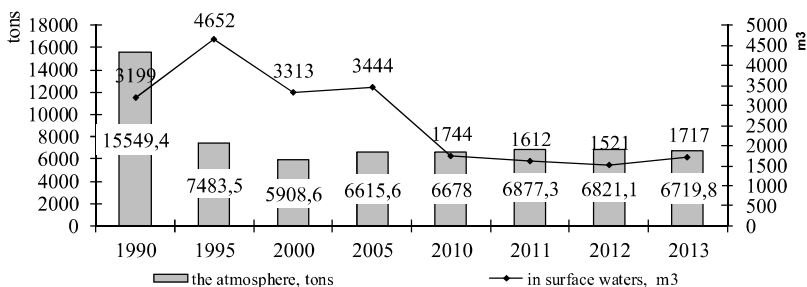


Pic. 5. Tendency in the development of land resources and arable farmland in Ukraine

Source: based on the author's data [5]

Recently the processes of soil cover degradation, which are caused by man-made pollution, increased a lot. The greatest danger for the environment is soil contamination with radionuclides, heavy metals and pathogens. The main sources of pollution are agriculture, heavy industry and chemical industry, transport.

From 1990 to 2013 revenues of air pollutants decreased 2.3 times: in 1990, 15.5494 million tons got into the atmosphere, in 2013 – 6.7198 million tons. Pollutants into surface waters decreased almost twice – from 3199 to 3891 tons (Pic. 6).



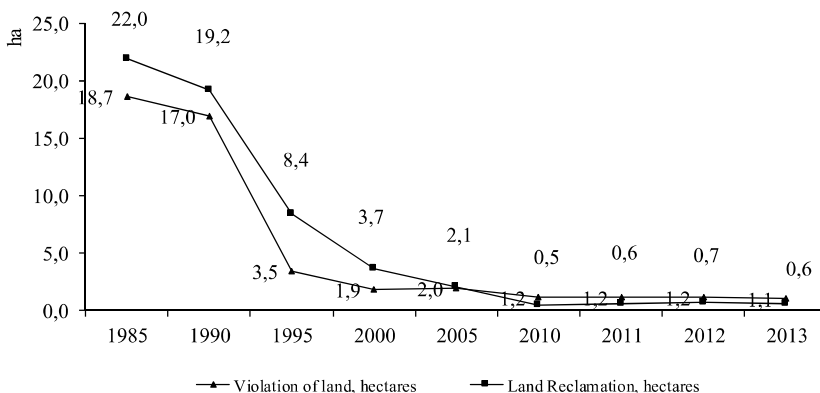
Pic. 6. Dynamics of pollutants into the environment in Ukraine

Source: based on the author's data [4]

Wastewater without cleaning has been reduced in Ukraine. In 1990 it was 470 million m³, in 2013 – 266 million. m³, almost doubled. You should also note the positive tendency of decline in existing industrial toxic waste per square kilometer – from 43.5 tons in 2000 to 20.9 tons in 2013. In Ukraine, a positive tendency of expanding reserves and national parks has been detected. If in 1985 their area was 368,700 hectares, in 2013 it increased to 1.5761 million hectares, which is more than four times. Thus, the average area of protected areas are growing annually by 63.1 thousand hectares.

Indicators of forest cover remain virtually unchanged – 17.6%, while in 2000 the forest cover was 18.0%. Thus, the average area of protected areas are growing annually by 63.1 thousand hectares. Increasing of this indicator value is especially important for Ukraine, because the forest area in the country is negligible.

The positive tendency in decreasing of land has been detected. If 1985 was a 18,7 thousand hectares were destroyed, in 2013 only 1.7 thousand hectares, or 11 times less. However, land reclamation has deteriorated. While in 1985 it amounted to 22.0 thousand hectares, in 2006 only 1.4 thousand hectares, or 15.7 times less (Pic. 7).



Pic. 7. Dynamics of violations and land reclamation in Ukraine

Source: based on the author's data [4]

However, in general, the situation cannot be considered as satisfactory, since at the end of 2006 the disturbed land area was 157,6 thousand hectares, 48,8 thousand hectares of executed.

Farming practices greatly affect the quality status of land resources, carried out in order to improve and restore soil cover, prevent potential negative consequences of land disturbance. In 2013 compared to 1995 all indicators except Shore were decreased: length of shafts, trenches – at 135.2 km walls, terraces – 5.4 km; shaft-road – at 16.0 km; erosion rates – at 176.5 km degraded and meadow area contaminated with harmful substances arable land decreased by 12433.5 hectares (table).

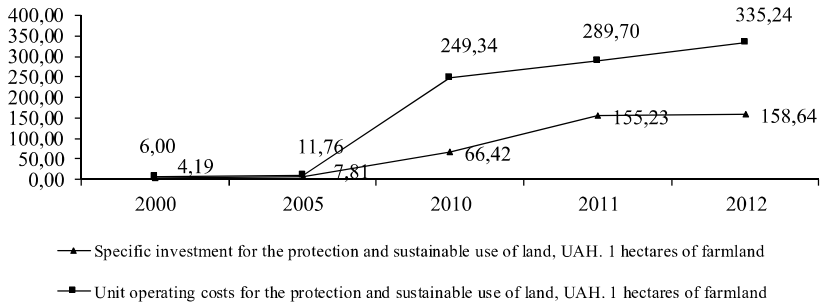
Table

**The dynamics of the implementation
of measures to protect land in Ukraine**

| Performance | 1995 | 2000 | 2005 | 2010 | 2013 | 2013 relative to 1995 | |
|---|---------|------|--------|--------|-------|-----------------------|-------|
| | | | | | | +,- | % |
| Meadow arable land, hectares | 12785,0 | 9,3 | 6341,5 | 1015,2 | 351,5 | -12433,5 | 2,8 |
| Construction erosion of hydraulic structures: | | | | | | | |
| shafts, shaft-ditch, km | 135,2 | 10,9 | 3,6 | 4,1 | 0,0 | -135,2 | x |
| rain-terraces, km | 5,4 | 2,2 | 6,6 | 0,0 | 0,0 | -5,4 | x |
| wali-road, km | 16,0 | 24,0 | 1,1 | 0,1 | 0,0 | -16,0 | x |
| against erosion, ha | 177,0 | 18 | 7,0 | 6,6 | 0,5 | -176,5 | 0,3 |
| discharge structure, items | 51,0 | 4,7 | 2,0 | 12,0 | 3,0 | -48,0 | 5,6 |
| shore, km | 1,0 | 9,3 | 3,9 | 4,3 | 1,3 | +0,3 | 130,0 |

Source: based on the author's data [4]

Ukraine is undergoing the significant environmental pollution. The situation is complicated by pollution area especially after the Chernobyl accident. Over 4.6 million. Hectares of land in 74 districts of 11 provinces got contaminated with radionuclides, including 3.1 million contaminated hectares of arable land and 119 thousand hectares of agricultural land, including 65.0 thousand hectares of arable land – removed from use. Despite the deep economic crisis Ukraine investments on measures for the protection and management of land resources are 145 UAH on 1 hectare of farmland and 345 UAH on running costs (Pic. 8).



Pic. 8. Specific investments and operating costs for the protection and rational use of land in Ukraine, UAH on 1 hectar of farmland

Source: based on the author's data [4]

3 Conclusions and suggestions.

Our research allowed to establish the following:

- 1) the issue with conservation and improvement of soil fertility due to a sharp decline in organic fertilizers, which in turn will reduce crop yields, is being solved on a very poor level;
- 2) sanitary-chemical state of the soil is practically not improving, as evidenced by their high contamination of various chemicals, nature neutralizes them very slowly;
- 3) necessary measures to protect the soil against erosion have not been made, as evidenced by their growing areas, especially of much eroded soil;
- 4) reclamation of disturbed lands is performing poorly, which does not allow its productive use;
- 5) saline land area increases, indicating a lack of gypsum;
- 6) plowed farmland is not reduced, indicating that the intensive use of arable land, thus deteriorating ecology of the lands, and therefore – reduced efficiency of land use;
- 7) reducing of pollutants in the atmosphere and surface waters is a positive fact. However, this is primarily explained by the crisis in industrial production, rather than the introduction of technologies of ecologically;
- 8) in recent years, positive steps to expand the area of nature reserves, national parks have been made, it will positively impact on the environment, conservation of flora and fauna;

9) environmental condition of land use in Ukraine over the years, especially after 1990, when the reform in the agricultural sector began, shows that it does not meet the requirements of sustainable development of land use. Land – the main means of production – from year to year deteriorates, which can contribute to raising the efficiency of agricultural production both now and in the future;

10) indication of the ecological state of land in Ukraine shows that it does not meet the requirements of sustainable development.

In the future, it is advisable to examine indicators of sustainability of economic and social unit with the aim to build indication model of sustainable development of agricultural land in Ukraine.

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О. Котикова, О. Христенко. **Частина раціонального використання земель – індикація стану навколишнього середовища сільськогосподарських земель.**

Індикація дослідження екологічного стану використання сільськогосподарських земель в Україні було зроблено на основі методу автора. Період досліджень включає в себе дані про 1985-2013 роки. На підставі результатів було зроблено висновок, що сільськогосподарське використання землі в Україні відповідає вимогам сталого розвитку. Індекси є основними компонентами індикації моделі сталого розвитку сільськогосподарського землекористування в Україні.

А. Котикова, О. Христенко. **Часть рационального использования земель – индикация состояния окружающей среды сельскохозяйственных земель.**

Индикация исследования экологического состояния использования сельскохозяйственных земель в Украине была сделана на основе метода автора. Период исследований включает в себя данные по 1985-2013 годам. На основании результатов был сделан вывод, что сельскохозяйственное использование земли в Украине соответствует требованиям устойчивого развития. Индексы являются основными компонентами индикации модели устойчивого развития сельскохозяйственного землепользования в Украине.