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ECOLOGICAL SITUATION AND ITS DYNAMICS IN THE REGIONS OF UKRAINE

Sytuacja ekologiczna i jej dynamika w regionach Ukrainy

Streszczenie
Różne antropogeniczne zakłócenia i degradacja zasobów naturalnych nie poprawiają stanu środowiska na Ukrainie. Emisja zanieczyszczeń powietrza jest nadal wysoka, mimo że znacznie spadła w porównaniu z rokiem 1990. W pracy dokonano analizy dynamiki spożycia wody z naturalnych zbiorników wodnych i dynamiki powstawania ścieków, a także wytwarzania i utylizacji odpadów. Dla tych wskaźników jakości środowiska uzyskano linie/ę trendu, co pozwoliło na przewidywanie wielkości do 2015 roku.
Słowa kluczowe: emisja zanieczyszczeń, pobór wody, zrzuty ścieków, wytwarzanie odpadów, utylizacja odpadów, Ukraina

Abstract
In accordance with the various anthropogenic disturbances and degradation of natural resources is created the appropriate environmental situation. In Ukraine, the environmental situation is remains rather tense. Emissions of air pollutants remain high, although it declined significantly as compared with the 1990. In our study was analyzed the dynamics of the water withdrawal from natural water bodies and discharges contaminated wastewater into surface water, and also generation of wastes and utilization of wastes. For these indicators of environmental quality were derived trend's lines, which allowed to predict their amount to 2015.
Keywords: emissions of pollutants, water withdrawal, wastewater discharges, wastes generation, utilization of wastes, Ukraine.

Introduction

Depletion and pollution of natural resources are the main types of anthropogenic disturbance and degradation of natural resources and components. As a result of these changes are formed the corresponding ecological situation. In other words, the intensity of resources use, pollution of natural components and ecological situation of territory are interrelated and interdependent. In this connection, having examined one phenomenon (eg, the intensity of anthropogenic impact), we can get an idea about the other (on the ecological situation) and vice versa.

Considering the limited scope of this article, we will discuss only the first of these two aspects, which concerns the emission of pollutants into the main components of landscape environment of Ukrainian regions and the

typology of regions on this indicator. We in one of the articles have described theoretical and methodological bases of the study the dynamics of the environmental component of regional development[1].

The aim of the article is to highlight of the ecological situation and its reasons in regions of Ukraine, its dynamics and forecasting. Also in the purposes of the study was to examine the dynamics of the environmental situation during the 1991-2012, that has evolved from a combination of atmospheric pollution, surface water and groundwater pollution, as well as the accumulation of wastes.

To evaluate the level of air pollution used three indicators: the total amount of pollutant emissions, the emissions of pollutants to the atmospheric air from stationary pollution sources and mobile transport means by regions. To assess the quality of groundwater and surface water have been studied the water withdrawal from natural water bodies and contaminated wastewater discharges into surface water. Ecological status of soils and geological environment was taken into account by the analysis the generation of wastes of the I-III grades of hazard and utilization of wastes by regions.

The dynamics of the ecological situation was evaluated by constructing spatial and temporal series. To forecasting the environmental situation were used the trend extrapolation models. Their use is associated with the inertia of ecological situation in the region, and that opens the possibility of implementing the methods of extrapolation. For this reliable time series were formed, the methods for estimating the parameters and equation were selected, which describes the dynamics of the phenomenon, and then we carried out the forecast and the estimate accuracy of this forecast.

Many scientific studies of transition economies, like Ukrainian, have been established correlation between the increase or decrease of GDP and growth or decline the amount of pollutant emissions into the environment. This correlation can be considered as proved.

Nowadays, considerable attention is paid to ecological situation issues in scientific researches. Such Ukrainian scientists as V.I. Andrienko, V.S. Krysachenko, V.A. Bokov, A.B. Kachynskiy, A.V. Lushchyk, E.P. Buravlov, E.V., Khlobystov, T.V. Hordaschuk, V.P. Voytenko, N.M. Koshel, A. V. Pysarchuk, V.A. Zerkalov, O.G. Stegniy and others made important contribution in revealing the nature of environmental situation, main reasons that caused dangerous environmental conditions, classification of environmental disasters, anthropogenic ecological crises, modern crisis ecological situation. Among foreign researchers the names D. Deudney, A.

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[1] Kornus A. *Theoretical and methodological foundations of transformation geoecological component investigation of the regional socialgeosystems*, Visnyk of Karazin National Kharkiv University, No 1070, 2013, P. 42-47.

Ehrlich, M. Fishbein, N. Myers, D. Gray, A. Irwin and others should be indicated [2-8].

Despite of actual research of the problem and ways of its solution, the ways of socio-economic impacts of the ecological situations and balanced relationship between society and nature, transition to sustainable development continue to be urgent and need immediate solution [9].

In Ukraine, the most complete information about the intensity of nature use can be obtained from statistical reporting [2]. Typically, in the most complete and comparable form it is given by administrative areas. Therefore, as research unit was taken the administrative region and the consequences of nature use were evaluated by communication "anthropogenic stress – ecological conditions". The analysis of the absolute and integrated indicators of anthropogenic impact on the environment is suggests that the ecological situation in the natural environment, as a vital habitat for human existence, is rather difficult.

Atmospheric air pollution

It is known that among the components of landscape environment special role belongs to atmospheric air [3]. In Ukraine annually into the atmosphere is gets about 7 million tonnes of pollutants from stationary and mobile sources (Figure 1). In the total amount of pollutants emissions of methane and nitrous oxide, which are greenhouse gases, were respectively about 900 and 14-15 thousand tonnes. In addition to these substances into the atmosphere from stationary and mobile sources is emitted annually 200-250 thousand tonnes of carbon dioxide, which also contributes to climate change.

Looking at Figure 1 gets the impression of widespread dominance of emissions from stationary sources as compared with mobile means. In fact, in most regions of Ukraine the most of emissions come from mobile sources (mostly vehicles). The overall picture in Ukraine achieved through huge emissions of pollutants from stationary sources in Donetsk and Dnipropetrovsk regions (1.32 and 0.74 million tonnes respectively), and some other areas. It should be noted that this situation throughout the period of observation was fixed forever. Despite the fact that in some years, such as in 2007-2010, the number of regions where the main part of emissions came

[2] See, e.g. *Environment of Ukraine*: Statistical yearbook, http://ukrstat.org/en/druk/ publicat/kat_e/publ4_e.htm, 19.01.14

[3] Kornus O., Kornus A., Shyschuk V. *The role of medical-environmental research in geoecological analysis of the region*, Journal CNU Yuriy Fedkovych. Geography, Vol. 614-615, 2012, P.66-69.

from mobile sources was reaching 20 (almost 75% of the regions), the proportion of pollutants from stationary sources of industrial enterprises in the country has always been greater than mobile means. During the period of Ukraine's independence, it ranged from 76% (1995) to 61% (2009). Interestingly, that is about the same it was in Soviet times – 60.7% (1990).
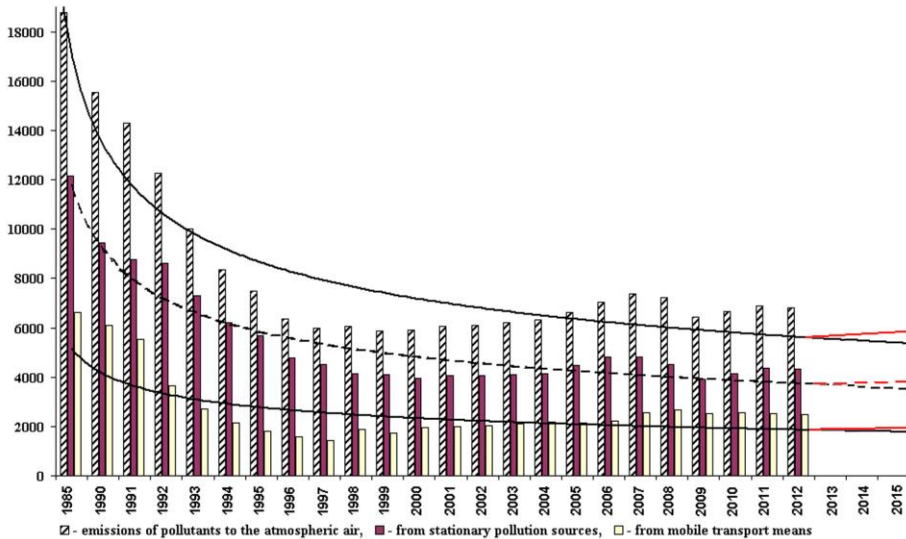

Figure 1. Emissions of pollutants to the atmospheric air from stationary pollution sources and mobile transport means by regions (thousand tonnes)

If the ratio of emissions from stationary and mobile sources has approached to be existed before the independence of Ukraine, then this cannot be said about their volumes. So, gross emissions in 2012 have been amounted only 43.9% from 1990 levels, also do not reach 50% the emissions from stationary and mobile sources separately.

Today in Ukraine remains consistently high air pollution level in large cities and industrial centers. As a result, almost two-thirds of the population lives in areas where the state of the atmosphere does not meet hygienic standards. This is especially true of the population of 14 cities where into atmosphere is emission more than 100 tonnes of pollutants annually: Burshtyn, Debaltseve, Dnipropetrovsk, Dniprodzerzhynsk, Zaporizhzhya, Zelenodolsk, Enerhodar, Komsomolske, Krivoy Rog, Kurakhovo, Lugansk, Mariupol, Novy Svit, Khartsyzk. Moreover, in 11 of these cities the volumes of emissions are not reduced, but increased.

For trend modeling and forecasting of atmospheric emissions, we used a power trendline by using the following equation to calculate the least squares fit through points: $y = cx^b$, where c and b are constants. By means of which was projected volume of emissions towards 2015. When saving the

existing trends of pollutants emission into the atmosphere and immutability other factors affecting[4], emissions to the atmosphere in Ukraine in 2013 will amount to 6,800 thousand tonnes with a possible deviation of 428.4 thousand tonnes. It is assumed reducing of emissions in future.

A result of modeling the equations were derived, reflecting the pace of reducing total emissions into the atmosphere $y = 17091x^{-0,35}$, as well as emissions from stationary sources $y = 11779x^{-0,361}$ and mobile sources $y = 5168,5x^{-0,321}$, respectively. The World Bank is gave a forecast for Ukraine's GDP at 2% in 2014 and 1% in 2015[5]. If this forecast is justified, we expect a slight increase in emissions of pollutants to 2015 (red lines on Figure1), which can be described by power and exponential trendline $y = ce^{bx}$, where c and b are constants, and e is the base of the natural logarithm: $y = 5587,2e^{0,02x}$ (for total emission of pollutants), power trendline $y = 1489,4x^{0,1859}$ (for emissions of pollutants from mobile transport means) and linear trendline $y = 50,665x + 3988,7$ (for emissions of pollutants into the air from stationary pollution sources).

Water resources use and pollution

Quality of ground water in many regions of Ukraine (Crimea, Donbas, Prydniprovya) does not meet the regulatory requirements for water sources, due primarily by anthropogenic pollution. Only a few artesian water pipelines have the equipment for purification of water. The ecological situation in the Black and Azov seas in general remains tense. The main ecological problems of seas are eutrophication of shelf waters and marine pollution by toxic substances. Other alarming trends include: deterioration of seawater in the areas of recreation, intensive building development of coastal areas, accompanied by the loss of natural and recreational potential, the growing the threats associated with the development of oil and gas industry and the volume of dangerous goods transportation.

For the ecological assessment of water resources, we will focus on two of its main characteristics – water withdrawal from natural sources and the contaminated wastewater discharges into surface water (Figure 2).

As can be seen from Figure 2, already 3-4 years water intake from natural objects remains at level 14.5-15.5 billion m³. In this more noticeable decline in the proportion of water intake from underground sources from

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[4] In accordance with the World Bank the GDP growth in Ukraine was amounted to -1.1% in 2013.

[5] *GDP and Current Account Balance growth forecasts by country, region, and income level*, www.worldbank.org/en/publication/global-economic-prospects/data?variable=NYGDPMKTPKDZ&region=ECA, 19.01.14

16.7% in 1995 to 13.4% in 2011 In general, as compared with the 1990, water withdrawals today decreased on 20.964 billion m^3, including from underground sources on 3,239 billion m^3. The main consumers of water are electric power (32.4%), agriculture (29.5%) and housing and communal services (17.8%). Basic volume of wastewater is discharged into surface water bodies in the Dnipropetrovsk (29.3%), Donetsk (34.4%) and Odessa (7.3%) regions. The purest water is in the Volyn and Vinnitsa region.
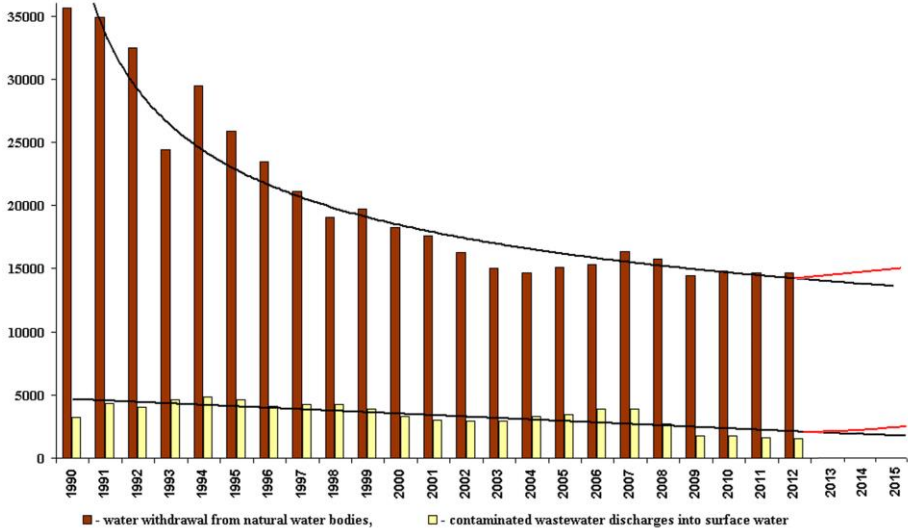

Figure 2. Water withdrawal from natural water bodies and contaminated wastewater discharges into surface water (million cubic meters)

Similarly, was decreased the volumes and wastewater discharge. In 1995, into surface water of Ukraine were dropped 4,625 billion m^3 of contaminated wastewater discharges, in 2012 their volume decreased to 1.521 billion m^3. However, for the period of investigation a capacity of treatment facilities is also decreased by 0.732 billion m^3. The main part of the polluted wastewater comes from municipal utilities (35.4%), metallurgy (33.2%) and coal industries (14.4%). More than half (50.4%) of contaminated water discharged into the Dnipro basin, including 38.9% – into the Dnipro river directly.

Water withdrawal from natural objects and polluted wastewater are better described by power and linear trand models. In result of modeling are obtained equations, reflecting the pace of reducing water withdrawal – $y = 42872x^{-0,352}$ and a reduction in wastewater – $y = -116,41x + 4798,6$. In the case of an optimistic forecast economic growth of Ukraine, we forecast an increase of water withdrawal from the current 16.4 billion m^3 to 14.7 billion

m^3 in 2015 and discharge of wastewater to 2.7 billion m^3 to in accordance with 1.5 billion m^3 in 2012 (red lines on Figure 2).

Wastes production, handling the wastes

The problem of wastes is one of the most intractable. Despite on the declared efforts and actual recession in the formation of new wastes, the latter are more formed than the volume of their utilization (Figure 3).
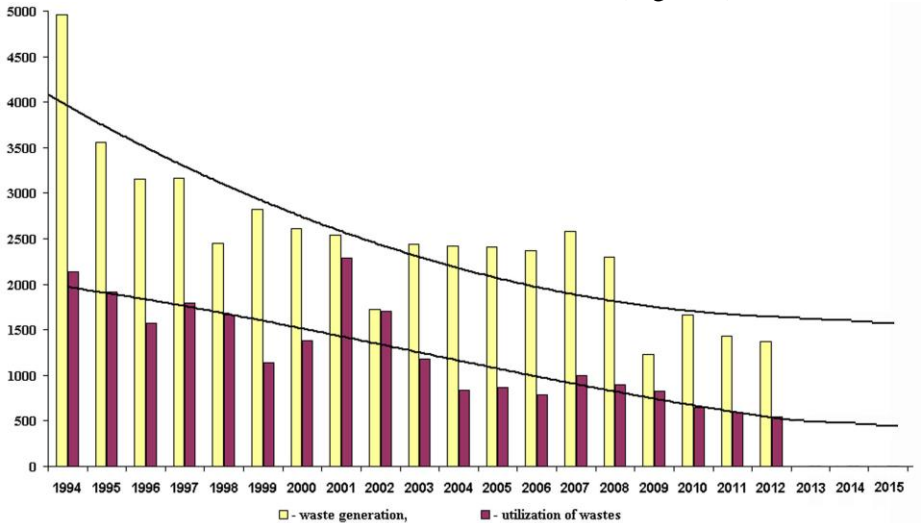

Figure 3. Generation of wastes of the I-III grades of hazard and utilization of wastes by regions (thousand tonnes)

This leads to the accumulation of wastes on the territory of Ukraine. As of January 1, 2013 in designated areas and territories of enterprises in the country, was accumulated 14.91 million tonnes of wastes, of which 28.6 tonnes refer to hazard grade I, 2.2 million toness – II grade, 12.0 million tonnes – III grade, and 14.89 million tonnes – hazard grade IV. In the three regions are kept 93% country's wastes of hazard grade IV which accumulated – in Dnipropetrovsk (9.5 million tonnes), Donetsk (2.9 million tonnes) and Lugansk (1.5 million tonnes) areas. At the same time, more than 80% of the wastes I-III hazard grades are placed in the other three regions: Zaporizhzhya (7.7 million tonnes), Sumy (2.0 million tonnes) regions and in the Autonomous Republic of Crimea (1.9 million tonnes).

For a long time in Ukraine does is not solution the problem of disposal and recycling toxic wastes stored in landfills and special landfills, as well as the construction of new sites for their disposal. At the same time, environmental pollution by toxic industrial wastes has reached to level that affects the health of the population.

Almost 90% of the total volume of wastes was created in Dnipropetrovsk (277.1 million tonnes, or 62.6%), Donetsk (61.2 million tonnes, or 13.8%), Kirovohrad (36.4 million tonnes, or 8.2%), Luhansk (18.1 million tons, or 4.1%) regions. The smallest volume of wastes was created in Chernivtsi (0.04% of total volume in the country) and Transcarpathia (0.03%) regions.

In the future, we expect a gradual decrease as the amount of wastes and recycling volumes. For their calculation are obtained equations of logarithmic trendline by using the following equation to calculate the least squares fit through points: $y = c\ln x + b$, where c and b are constants, and ln is the natural logarithm function $y = -973,7ln(x) + 4500,8$ (for wastes generation) and exponential trendlines $y = 2321,7e^{-0,071x}$ (for utilization of wastes).

Conclusions

Air pollution is one of the factors reducing the quality of the human environment and affects human health. According to our calculations the level of pollutants emissions to the atmospheric air in 2015 will be 6.1 million tons according to the scenario of economic development of the World Bank (including 4.1 million tons from stationary pollution sources and 2.0 million tonnes from mobile transport means) and 5.6 million tons – at the present negative trends of economic development (including 4.0 million tons from stationary sources and 1.6 million tonnes from mobile transport means).

Almost all surface water sources of Ukraine over the past decade were intensive polluted. Because water treatment is bad, receipt of contaminated wastewater into surface waters is not reduced significantly. The vast majority of industrial enterprises and municipals have discards of pollutants with significant excess of the established maximum permissible levels of discharges. According to our calculations, the level of water withdrawal from natural water bodies in 2015 will be to 14.6 billion cubic meters according the optimistic scenario of the World Bank and 14.0 billion cubic meters under the pessimistic scenario of national economic development. Level of wastewater discharge into surface water respectively will be amount of 2.3 billion cubic meters and 1.9 billion cubic meters.

Generation of wastes of the I-III grades of hazard and utilization of wastes will be reduced in volume regardless of macroeconomic trends. By 2015, the expected decrease in the volume of waste up to 1,560 thousand tonnes and a reduction of volume their utilization to 540 thousand tonnes. On the one hand this is due to greater complexity of raw materials, the introduction of low-waste technologies, and on the other hand with a decrease in attention to waste management, their small use as sources of raw materials.

Environmental activities need improvement of funding. According to our estimates the share of environmental protection expenses in the gross regional product (GDP) in 2014 will 2.1% versus 3.34% in 1996. To ensure sustainable development in legislation it is necessary to establish a share of GDP for solving of the environmental problems not less than 2.5-3%.

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