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**ECOLOGICAL SUSTAINABILITY PRESERVATION
OF NATIONAL ECONOMY BY WASTE
MANAGEMENT METHODS**

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Introduction. With the development of the economy, the amount of waste increases per capita, the number of packaging materials and the total of goods, the life cycle of which ends in the transformation into waste. Due to the slow development of waste recycling in Ukraine, the problem of their accumulation is aggravated with the increasing impact of waste landfills, which are increasing and becoming an area of increased risk, which leads to a decrease in the welfare of the population and a reduction in labor productivity.

Aim and tasks. The goal of this work is to analyze the problem of waste accumulation and find ways to reduce environmental pollution as an effective way to improve the well-being of the population and increase the economic and environmental potential of Ukraine.

Results. The article analyzes ways to solve the problem, taking into account the realities and positive experience of developed countries, where waste recycling has become a lucrative business and is based on the secondary use of waste and its return to the life cycle as a commodity. Identified corruption links between business and government, inefficient use of budget funds, slows down the transition to complete waste recycling, and leads to a distortion of the free market system on a competitive basis and the impossibility of foreign investors interested in running a transparent and environmentally friendly business in the field of waste recycling. The structure of the main components of household waste and the distribution of the time of their decomposition are revealed, and a diagram of the negative impact of landfills on the environment and waste management is given. The article discusses the principles of state regulation, which can improve the situation in the field of waste utilization and environmental welfare of the population.

Conclusions. An analysis of modern approaches in the field of waste utilization, both liquid and solid, has shown that the main method of waste utilization is recycling as the basis of the general concept of Zerowaste for the countries with a high level of development. In Ukraine, the formation of regulators and tools to overcome the garbage crisis is slow and does not lead to significant changes. It has been substantiated that, on the basis of internalizing external effects and assisting the population in minimizing negative impacts, it is possible to achieve a reduction in overproduction of goods and services with negative external effects. Significant progress in the utilization process is possible only in the case of investment attractiveness of waste recycling business, institutional changes in tax and customs tariff legislation, macroeconomic and financial stabilization in the country.

Key words: waste, welfare economy, recycling, ecology.

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ЗБЕРЕЖЕННЯ ЕКОЛОГІЧНОЇ СТІЙКОСТІ НАЦІОНАЛЬНОЇ ЕКОНОМІКИ МЕТОДАМИ УПРАВЛІННЯ ВІДХОДАМИ

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Вступ. З розвитком економіки зростає і кількість відходів на душу населення, збільшується кількість пакувальних матеріалів та загалом товарів, цикл життя яких закінчується перетворенням у відходи. У зв'язку з повільним розвитком сфери переробки відходів в Україні, проблема їх накопичення загострюється разом зі збільшенням впливу полігонів відходів, кількість яких зростає та стає територією підвищеного ризику, що призводить до зменшення добробуту населення та зменшення продуктивності праці.

Мета і завдання. Метою даної роботи є аналіз проблеми накопичення відходів та пошук методів зменшення забруднення навколишнього середовища, як ефективного способу покращення добробуту населення та підвищення економічного і екологічного потенціалу України.

Результати. В статті проаналізовані шляхи вирішення проблеми, враховуючи реалії та позитивний досвід розвинутих країн, де переробка відходів стала прибутковим бізнесом та основана на вторинному використанні відходів. Виявлені корупційні зв'язки між сферами бізнесу та влади, нераціональне використання бюджетних коштів, що стримує процес переходу до повної переробки відходів, та призводить до спотворення вільної ринкової системи на конкурентних засадах і не зацікавленості іноземних інвесторів у веденні бізнесу у сфері переробки відходів. Розкрита структура основних складових побутових відходів та розподіл часу їх розкладання, а також наведено схему негативного впливу полігонів на навколишнє природне середовище та поводження з відходами. В статті розглядаються принципи державного регулювання, що можуть покращити ситуацію, яка склалась у сфері утилізації відходів та екологічного добробуту населення.

Висновки. Аналіз сучасних підходів у сфері утилізації відходів, як рідких так і твердих, показав, що для країн з високим рівнем розвитку основним методом утилізації відходів є рециклінг як основа загальної концепції Zerowaste. В Україні формування регуляторів та інструментів подолання смітцевої кризи відбувається повільно та не веде до суттєвих зрушень. Обґрунтовано, що на основі інтерналізації зовнішніх ефектів та сприяння населення у мінімізації негативних впливів можливо досягти скорочення перевиробництва товарів і послуг з негативними зовнішніми ефектами. Суттєвий прогрес у процесі утилізації можливий тільки у разі інвестиційної привабливості бізнесу з переробки відходів, інституційних змін у податковому та митно-тарифному законодавстві, макроекономічної і фінансової стабілізації у країні.

Ключові слова: відходи, економіка добробуту, рециклінг, екологія.

Introduction. Population growth in the world and changes in the level and quality of life are among the significant factors contributing to the emergence of many kinds of environmental stress. The role of the growing population is most evident in the fact that it is a major factor in determining the need to increase food production. And with the expansion of production increases significantly the amount of waste that accumulates gradually. Most of all, this problem arises in front of developing countries, where the environmental legislation is not fully developed, the slow turnover of investments in the environmental protection sector and in the implementation of the latest environmental technologies.

In the current economic situation, business structures are not interested in investing in the processing and utilization of waste, and the state is not able to solve this problem on its own.

The formation of regulators and tools to overcome the garbage crisis is slow and does not lead to significant shifts. One of the priority directions of scientific and technological and innovative development at the present stage is the creation of systems of resource conservation on the basis of the formation of the industry of recycling and waste management. The experience of the developed countries of the world testifies to the possibility of achieving a significant economic, ecological and social effect through the formation of the waste utilization industry and its transformation into an integral part of the socio-economic infrastructure of the economy of the regions.

Aim and tasks. The purpose of this article is to analyze the current state of waste management in Ukraine, to identify the main trends with regard to their quantity, structure and accumulation rate, and the choice of methods for reducing environmental pollution for Ukraine.

Analysis of literature. The research on the impact of waste on the ecosystem has been actualized in recent years due to an increase in the manifestations of environmental hazard at the level of activity of households and enterprises with the formation on the basis of their activities of hazardous waste, since waste is one of the most intense sources of environmental pollution.

This is due, on the one hand, to the diversity of chemical substances, including toxic substances in waste, their high concentration, on the other hand - with the mismatch of most landfills-drives with regulatory requirements regarding their location, arrangement and operating conditions. Weak economic growth, on the one hand, reduces the rate of growth of waste generation, on the other hand – constrains the development of waste utilization [1-2].

The work of Lupinos, A., Nurzhii, N. [3] considers the problems of the formation and development of the system of recycling and utilization of domestic waste, the search of effective environmental mechanisms for improving the system of treatment with domestic waste.

The works of Ghisellini P., Cialani C., Ulgiati S. [3], Hamad, K., Kaseem, M., Deri, F. [4] are devoted to the study of waste management from polymeric materials, as well as the use of recycling and the possibility of obtaining secondary raw materials.

Theoretical and methodological bases for the development of infrastructure in the area of handling, processing and utilization of solid household wastes and the economic evaluation of the used methods of waste management from polymeric materials are studied in the works by Foolmaun, R.K., Ramjeeawon, T. [5], Bernardo, C.A., Simões, C.L. & Pinto, L.M.C. [6].

Results. Waste landfills are sources of negative impacts on ecosystems and economic systems as a result of rising losses for all actors in society (state, enterprises and population) with increasing waste volumes.

Pico's social welfare theory is the basis for an approach to rational nature management. In developed countries, the state and society are trying to minimize the balance. The basis was laid the principle of organizing production, which means the use of raw materials and energy in a closed loop. A closed loop means the chain of primary raw materials - production - consumption - secondary raw materials [7]. The concept of "Zero waste" [8] should be the basis for the development of society in all areas where profits would be calculated taking into account the costs of returning the environment to the original state.

Economist Gofman, K. G. [9] also made a significant contribution to the development of the theory and practice of economic assessments of natural resources and environmental conditions. He believed that it was necessary to take comprehensive account of the environmental burden in all sectors of society, which would be reflected in taxes and enshrined at the legislative level. This would help to reduce the negative impact on the environment and controlled by the state, whose leadership should be interested in increasing the state

budget and improving the lives of the population [9].

The development of such areas of waste processing using modern environmentally friendly technologies such as recycling, which is an effective way to solve the problem of waste management, requires changing the attitude of households in the process of primary waste sorting and, accordingly, organizing a logistics system for collecting such waste by public utilities or specialized enterprises in the field of recycling with household waste.

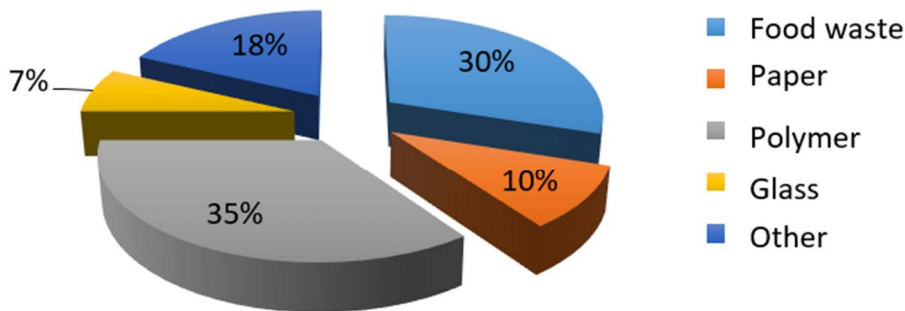


Fig. 1. Structure of the main components of household waste

Source: Constructed and supplemented by the author on the basis of [7].

From Fig. 1, we can see that polymers that have a long decomposition period currently occupy the main share in the structure of garbage. The average weighted decomposition

time of the main components of solid household waste is over 100 years (5 main components), but completely unpackaged garbage decomposes more than 150 years (Fig. 2).

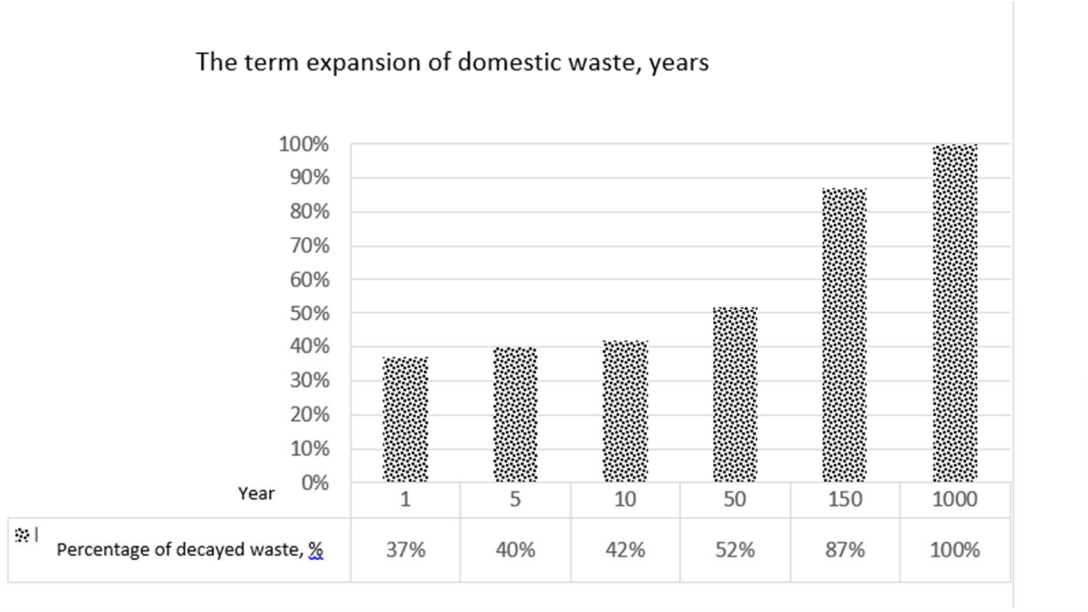


Fig. 2 Time distribution of household waste decomposition

Source: Developed by the author.

If analyze 8 main components (paper, food waste, wood, glass, textiles, metals, polymers, other substances), shown in Fig. 2, it can be noted that in the first year, only components such as paper, food waste and wood under satisfactory conditions are almost completely decomposed, while other components dominant in the structure have a longer decomposition term. Particularly the tendency to increase the weighted average decomposition time has been observed in the last 20 years due to the increase in the number of polymeric materials [10].

Therefore, it is not advisable to use the method of disposal - burial, while the secondary recycling of polymers returns them to the state of the product and is more environmentally sound. In the overall structure of industrial and domestic waste, the balances from extraction and processing of natural resources, packaging materials and construction waste are the main components in the structure of rubbish.

In addition, it has become increasingly difficult to detect and control the main sources of contamination due to the constant increase in their numbers. At present, there is an increase in the number of unauthorized illegal landfills, which are not reflected in the waste management reports.

The main factor in the increase in the number of illegal landfills is not the interest of specialized companies in the field of domestic waste management in the creation of specialized

units and sites for the processing and utilization of industrial and domestic waste. Particularly acute is the problem of utilization of industrial waste due to large amounts of residues and inappropriate use of them. Introduction of new environmentally friendly technologies is capital-intensive, and entrepreneurs optimize their profits due to environmental degradation. Under such dangerous conditions, the solution should be to improve environmental legislation, which increases the tax burden on enterprises that are harmful to the environment.

Weak economic growth, on the one hand, reduces the rate of growth of waste generation, on the other hand - constrains the development of waste utilization [1].

The solution of the problem of garbage in public places and the management of unauthorized landfills of municipal waste involves the organization of a centralized collection of garbage in all settlements. Therefore, it is necessary to create appropriate conditions for attracting investors in order to build waste processing plants with the planning of appropriate logistics in waste management.

Numerous studies in the world show the extremely negative impact of landfill toxins on human health. Further analysis showed that living near landfills increases the likelihood of development of nervous system disorders by 29%, bone and muscular system by 16%, skin by 32% (Table 1).

Table 1. Impact of landfill toxins on human health

Disease	Increase in probability, %
Birth of a sick child	63%
Disorders of the nervous system	29%
Violation of the bone and muscular system	16%
Disease of the skin	32%
Spina bifida in children	33%

Source: Compiled by the author on the basis of [13].

The state is losing due to the reduction of labor productivity due to illnesses that arise due to the deterioration of the environmental situation and the contamination of hazardous substances. In addition, the financing of social security expenditures is increasing due to the deterioration of the environment and the need for state aid to such groups of the population. Negative consequences of receiving high profits

of enterprises that deteriorate the state of the environment, are paid at the expense of the whole society, and especially due to population of areas close to landfills. Cities near landfills should be considered areas of high environmental hazard and the population of these areas should receive additional income due to uneven distribution of environmental load.

Based on the conclusions of the scientists of Yale University [11], we suggest the following formula for assessing the index of health damage at the regional level:

$$S_p = (\sum_{i=1}^m p_i \times S_i) \sum_{j=1}^n N_j \quad (1)$$

Where S_p – is the indicator of regional damage in monetary terms, p_i – is the increase in probability and disease due to the functioning of the landfill, S_i – are averaged losses from and the disease, m – is the number of diseases caused by the location of the landfill, N_i – is the amount of population near the landfill, n – is regional amount of landfills.

In addition to the environmentally hazardous impact of such a method of waste

utilization like waste disposal at landfills, significant energy and material resources are lost, which can be reused.

Dumps affect significantly the entire ecosystem (Fig. 3), which is located at a distance of up to 1 km (from the border of cities according to sanitary and epidemiological standards and state building norms of Ukraine.

According to the state construction norms of Ukraine solid waste landfills should be located at a distance of at least 3 km from the boundary of recreation, open water reservoirs of economic purpose, objects that are used with cultural and recreational purpose, places of leisure, reserves, resting places for migratory birds, marine coast.

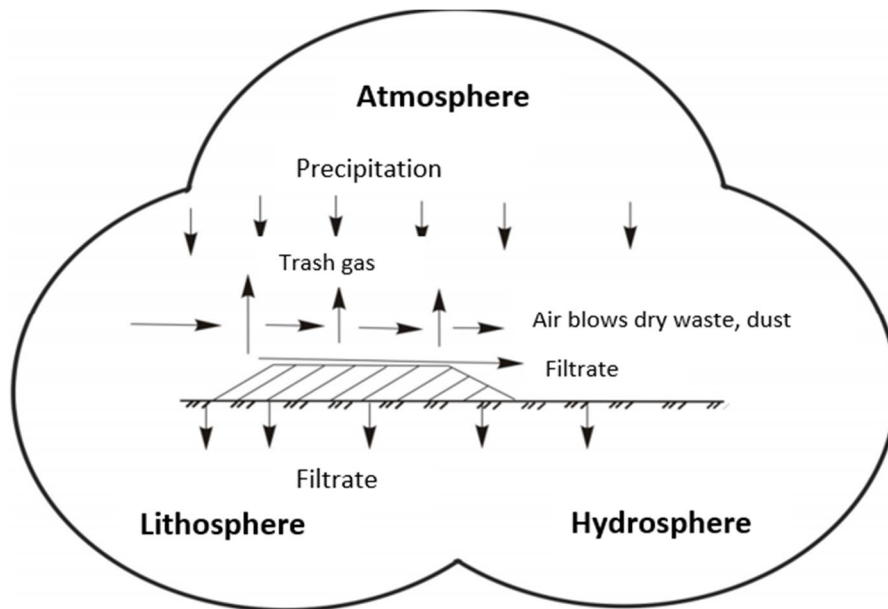


Fig. 3 Scheme of the negative impact of the garbage on the natural environment

Source: Compiled by the author on the basis of [12].

The ecological danger of landfills is, first of all, that they generate not only decomposition products that pollute water sources, but also emit methane and other garbage gases into the atmosphere. Therefore, measures to increase the environmental performance of industrial enterprises should be strengthened. However, the actions of the government and the local authorities regarding appropriate measures and target expenditures remain fragmented and not effective. Low tariffs for garbage disposal are not able to cover the costs of introducing new "green" technologies, which causes not only the need to send significant amounts of funds from

state and local budgets for these purposes, but also blocks the creation of its own waste recycling infrastructure [13].

This approach does not correspond to modern concepts of state regulation, based on the views of eminent economists Hicks D. R. [13], Pigou, A. [14], Samuelson P. E., Nordhaus V. D. [15]. Increasing tariffs is not necessary for increasing budgets, but in order to ensure that environmentally hazardous enterprises do not receive competitive advantages over an ecologically and socially responsible business.

The total amount of waste accumulated in Ukraine in 2018 is more than 13 billion tons [17]. Their predominant share (more than 75%) is industrial waste (sludge), mineral products, metallurgical slag from industrial and energy companies, and forming high risk areas in industrial cities. Almost 85% of the total volume of industrial waste is the waste of the primary mining and enrichment cycle, which was accumulated in the form of waste heaps and sludge, where the highest concentrations are observed in the mining basins. However, another component of rapidly growing waste is domestic waste, since consumption has been a much stronger determinant of waste generation than all initiatives and measures to prevent it.

Taking into account the tendency to decrease the volume of wastes of 1-3 classes, there are more and more landfills, new landfills and spontaneous landfills appear, large areas are clogged up with randomly located garbage, often polymers. Forests and protected areas are gradually turning into anthropogenic littered landscapes.

The problem also lies in the fact that illegal landfills are increasing, which complicates the situation in the field of waste utilization, since the reduced figures do not reflect the real situation and restrain the changes that have to take place both at the state level and at the level of enterprises and households.

According to Hicks's public utility function, there is a principle of compensation, according to which an increase in public utility is achieved when it is possible to cover the losses of one subject to another. Compensation in the form of environmental taxation (tax Pigou (Eng. Pigouvian tax)) is aimed at stimulating environmental protection by paying taxes on economic activities, generates negative side effects due to environmental pollution. In this case, an enterprise that produces environmental pollution costs recovery. Possible increase of monitoring of individual enterprises and pollutants is possible with coordinated activity of local communities as a controlling body of regional importance.

According to this theory, environmental pollution is considered as externalities. The essence of this term is that the market mechanism does not transform external costs,

which the whole society bears from pollution to internal production costs, is not reflected in the prices of products of enterprises – the issuers of pollutants. The existence of externalities leads to a discrepancy between private and public costs (public costs equal to the sum of private and external, that is, those that are not polluters, but third parties), private expenses are less than public. Due to internalization of external effects and assistance of the population in minimizing negative impacts, it is possible to achieve reduction of overproduction of goods and services with negative external effects. Therefore, corrective Pigouvian taxes contribute not only reduce the negative external effects due to sanctions to the subjects of their production, namely the achievement of market equilibrium production and consumption of the benefits of society.

The existence of externalities leads to a distinction between private and public expenditure (public expenditure is equal to the sum of private and external, that is, those who are not polluters but third parties), private spending is less than public expenditure. Due to the internalization of external influences and the promotion of the population to minimize negative impacts, it is possible to reduce the overproduction of goods and services with negative externalities. Therefore, Pigouvian corrective taxes contribute not only to the reduction of negative externalities due to sanctions on the subjects of their production, namely the achievement of market equilibrium production and consumption of public goods.

Only in the context of environmental costs, the entrepreneur must calculate the profit. Unfortunately, in Ukraine, if using this model, most enterprises would have negative profit, because the burden on the environment, the use of resources, is not taken into account. According to this theory, social welfare will not increase due to the environmental burden and deterioration of the health of population.

Responsibility for the environmental condition should be borne not only by the state as the main investor in the construction of the waste recycling industry.

Firstly, the state is not an effective business entity besides; Ukraine has one of the highest levels of corruption in Europe.

Secondly, in the conditions of the budget deficit of recent years, with a low level of investment and lack of economic growth, funds for this sector should not be expected.

Thirdly, the environmental situation of a particular region is primarily concerned with local residents, and therefore should be decided by local authorities, corresponds to the vector of decentralization in which our country begins to move. The effectiveness of the final results of utilization largely depends on the implementation of the principles of a systematic approach that takes into account the interests of society, business and state. We use the three-element approach for solving the problem of waste utilization: society, business and

generalized government (Fig. 4). The first two elements affect the state of the environment, by contamination of domestic and industrial waste. The society has the greatest impact on the state of the environment, at the same time, when business and government are to some degree in a privileged position (for example, it is hard to imagine that a member of any Ukrainian government or owner of a company has its own house near the landfill). However, any political force that seeks to win the election takes into account the social mood that is concerned about the state of the environment. In this way, environmental legislation is adopted, which should reduce the degree of industrial pollution by introducing environmental taxes.

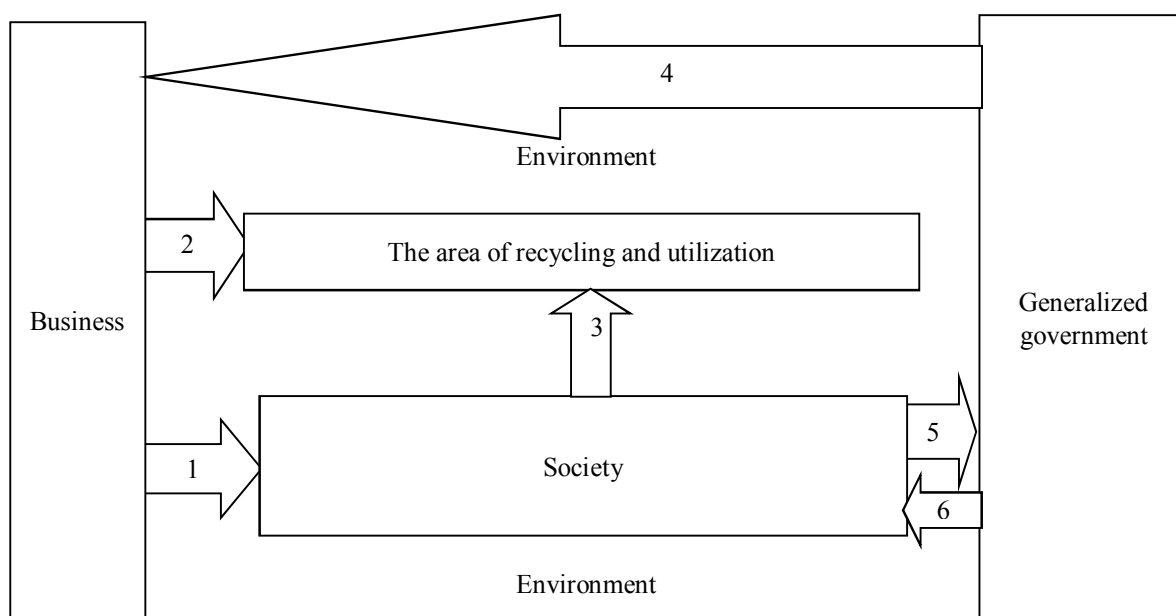


Fig. 4 Structural scheme of waste management

Source: Compiled by the author.

Where:

- 1 –Goods for consumption
- 2 –Industrial waste,
- 3 –Household waste,
- 4 –Environmental legislation,
- 5 –Public consciousness regarding the state of the environment,
- 6 –Household Waste Management Rules.

It is possible that with a decrease in the level of public corruption, environmental legislation will have a greater impact on the state of the environment. However, for effective utilization of household waste, you must have your own national concept and community

support. The example of the concept used in the developed countries is considered in fig. 4.

This waste management scheme will work only with the support of the state, society and enterprises as a whole, improve and enforce legislation [20-21].

Recycling is practically not used in Ukraine, although some schemes have been saved since the planned economy, such as the reuse of glass bottles and waste paper. However, during the planned economy, only a small percentage of domestic and extremely hazardous industrial waste generated by the country's powerful military-industrial complex was recycled. Due to the low income of the majority of the population, the rate of waste generation in Ukraine is significantly lower than

in developed countries of the world. Waste is accepted to be divided into hazard classes. There are 4 classes of waste: the first class of waste is extremely dangerous, the second class is highly dangerous, the third one is moderately dangerous and the fourth class is a little dangerous. The hazard class of waste is established depending on the content of highly toxic substances in them by the calculation method or according to the list of waste listed in the State Classifier of Waste [18].

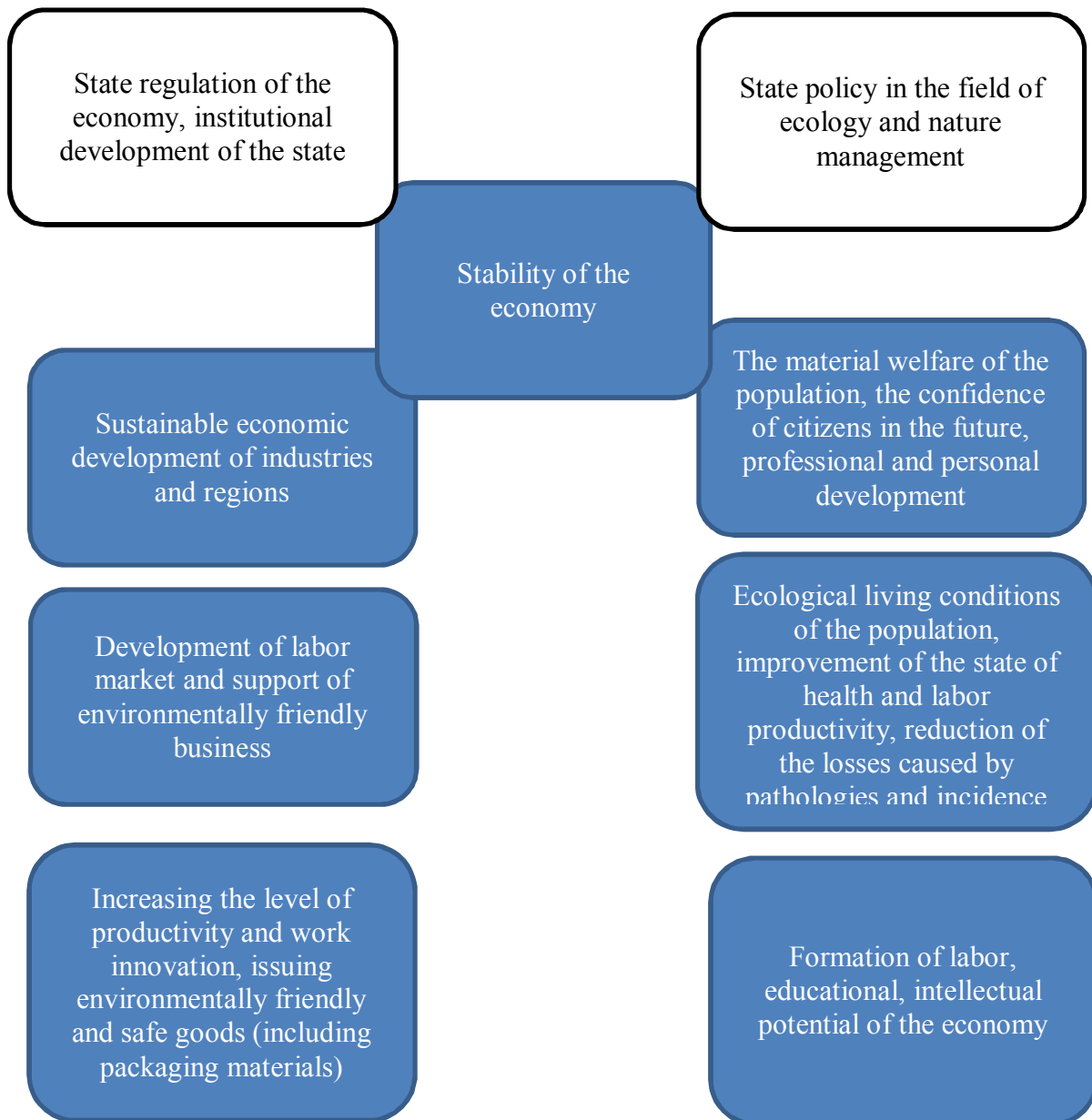


Fig. 5 System of state management of the quality of life of population

Source: Compiled by the author.

The state cannot become an effective subject of entrepreneurship in the field of waste utilization and recycling, in the conditions of the budget deficit of recent years, with a low level of investment and lack of economic growth, funds in this field should not be expected.

The issue of the ecological state of a particular region concerns, first and foremost, local residents, and therefore the local authorities must solve them, which corresponds to the vector of decentralization in which our country is beginning to move (Fig. 5).

Untreated waste has an impact on the environment and is becoming a serious danger to the environment. Therefore, in order to prevent further predatory pollution of the environment in Ukraine, the following directions to solve this problem are needed:

- to create the infrastructure of the system of separate collection, sorting and transportation of garbage;

- to develop and correct legislative documents on the safe solution of the problem of garbage accumulation in Ukraine and establish a system for monitoring compliance with these provisions;

- to establish the work of local communities and control the solution of this problem at the regional level;

- to monitor more carefully financial flows for waste management and spend money on implementing recycling;

- to restrain the formation of illegal landfills;

- to pass to environmentally friendly technologies of processing and neutralization of industrial and household garbage;

- to install the necessary equipment at the places of waste collection, re-equip the machines for the transportation of waste and build modern waste recycling complexes [19];

- in addition, it is necessary to introduce the latest technologies based on the use of satellite data and the use of GIS systems for analyzing and monitoring the current state of waste landfills and monitoring the number of illegal landfills.

Conclusions An analysis of modern approaches in the field of waste utilization, both liquid and solid, has shown that for countries with a high level of development, the main method of waste utilization is recycling as the basis of Zero waste general concept. By means of an econometric model it has been proved that with an increase in the level of a country's economic development, the share of household waste that is recycled increases. Ukraine is a zone of increased environmental load through the creation of illegal landfills and the activities of landfills, which accumulate mostly solid domestic waste.

The formation of regulators and tools for overcoming the rubbish crisis is slow and does not lead to significant changes. The choice of specific disposal methods depends on the existing system of relations, the cost of credit resources, environmental and tax legislation and other factors, however, for Ukraine the main stimulus to overcome the problem of waste accumulation would be the desire of all sectors of the population, government and business to implement recycling. Significant progress in the utilization process is possible only in the case of investment attractiveness of waste recycling business, institutional changes in tax and customs tariff legislation, macroeconomic and financial stabilization in the country.

In connection with the processes of European integration of Ukraine, it is proposed to improve legislation, in particular, to increase fines for unsorted garbage, and introduce monitoring and control systems for the environment and waste management at the local level.

At the same time, control over financial flows to prevent corruption and inefficient use of funds is proposed. To increase the percentage of waste recycling, it is proposed to install containers for separate waste collection, re-equip machines for transporting them to recycling centers and monitor the implementation of the waste management system of all parts of the society and government.

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