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STRATEGIC MANAGEMENT DIRECTIONS OF SOLID DOMESTIC WASTE SPHERE IN THE POLTAVA REGION

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A problem of providing of municipal solid waste management sphere, increase of efficiency of the naturally-economic potential use of territory is one of priority for every region of Ukraine. Optimization of development model in municipal solid waste management sphere in the region aimed at balancing economic and environmental criteria has been developed.

Have also been determined development directions for handling municipal solid waste in the context of realization of socio-economic and environmental strategies and recommendations regarding improvement in financial and economic support. The methodological basis of the study were the results of basic and applied research in the field of physical economy, ecological economics, of the concept of sustainable development.

The development strategy of municipal solid waste sphere allows to the formation of an effective integrated waste management system that will enable achieving the following results: creating legal, scientific and technical basis for rational and safe waste management, developing economic instruments aimed at forming and developing waste market as secondary resources; improving of organizational infrastructure for sustainable waste management; introduction a single system of accounting, control and management of municipal solid waste streams and establishing a system for monitoring ecological condition for the disposal places of solid waste; providing environmentally safe disposal of solid waste and creating trends for reducing "end wastes", which are transported to the landfill; reducing unauthorized removal of solid waste and economic loss for the solid waste pollution; minimization of municipal solid waste formation; increasing waste utilization coefficient and investments in this given sphere, introducing separate collection system of solid waste; construction of waste sorting station for development of second resources market; providing population with services for collecting waste and with technical means of removal of solid waste; creation of capacities for utilization of organic waste at composting plants.

The results of research allowed to form conceptual principles of providing of municipal solid waste management sphere in the regions of Ukraine, oriented to the increase of efficiency of territory naturally-economic potential use on the basis of solid wastes capitalization and minimization of their negative influence.

Keywords: *municipal solid wastes, sphere of waste management, region, strategy of development, balanced development.*

A problem statement

One of the conditions for sustainable territorial development is a socio-ecological-economic balance in the region, which presents such a state of regional systems that provides economic growth, social stability and ecological safety in the region. Violation of this balance leads to the emergence of losses having different characteristic features: ecological, economic and social. An essential element of socio-ecological-economic balance in the region is effective functioning of municipal solid waste (MSW) management sphere.

The problem of achieving sustainable development in the region expands the sphere of human impact on the environment and intensifies the use of natural resource base, which inevitably brings the problem of rational use of secondary resources to the fore. The region becomes a self-active economic agent, an active subject of competitive relations in national and global economy. In a deeper sense, as V. I. Vernadski noted in his studies, the solution of this problem requires creation of a new international order aimed at ensuring coordinated actions of the entire world community to avert environmental disaster, that is the transition to the noosphere development as intelligently managed co-development of a human being, society and nature, in which the satisfaction of vital needs of the population is made without prejudice for nature and future generations [1].

Today MSW management sphere in the region does not have systemic features, most likely it is a set of related but non-effective elements. Exactly under these conditions the task of transformation of

"a set of elements" into a system becomes important through the development of MSW management system, covering all aspects of solid waste management: social, economic, technological, environmental and legal and their optimization. In this regard the region can and should become the backbone "vehicle" of the state policy in this area and provide a purposeful wide range decision of the problems related to waste handling.

The analysis of recent publications

It is to be noted that effective waste management problem has been solved to some extent in developed countries, in the first place in Europe. Though for example, "garbage crisis" of 2007-2008 in Naples showed that Western experts having great experience and scientific knowledge in the field of solid waste management cannot assert that the problem is completely solved [2]. As for Ukraine, primarily the sphere of waste management is in a state that has been inherited from the planned economy of the former Soviet Union. In recent years a large number of works devoted to this problem has appeared in Ukraine, including the works by A. I. Bondar [3], V. Ye. Baranovsky, V. L. Pilyushenko [4], O. V. Moroz, A. O. Sventyh [5], V. S. Mishchenko, G. P. Vygovsky [6] and others. However, despite the significant scientific principles established by these and other scholars, their attention is focused mainly on the technical and technological aspects of the problem. At the same time there is lack of scientifically based methods and mechanisms of effective management in this field. Poorly substantiated here is also economic leverage. Besides the issues focused on getting the desired effect from the use of the potential waste management sphere, as a part of the total potential of the region's economy and as a result of cumulative actions of the participants of the wastes management sphere, have not yet received proper consideration up till now. That is, there is a need for comprehensive theoretical elaboration and practical improvement of MSW managing based on the parameters and the criteria of the region sustainable development in terms of spreading globalization.

Purpose, task and methods of research

It is necessary to work out the optimization model of waste solid management aimed at balancing of the two mutually contradictory criteria: economic damage for environmental pollution and total expenses for the functioning of MSW handling sphere. The model will create the basis for determination of strategic development directions in the given sphere within realization of socio-economic and ecological strategy of regional development. The aim of our research was to develop and to scientifically substantiate theoretical and methodological approach in relation to the determine development directions for handling municipal solid waste in the context of realization of socio-economic and environmental strategies and recommendations regarding improvement in financial and economic support.

Modern society characterized by contradiction of two interrelated processes – economic growth and limited assimilation properties biosphere. It can be noted that the previous conceptual basis of the economy and development of society exhausted, and the use of traditional methods to achieve the objectives unacceptable in solving new problems environmental protection, which requires a paradigm shift in social development in eco-oriented, resulting in has become harmonious, environmentally sound socio-economic development and conservation of environmental quality and natural resources. In this context methodological research on resource and environmental safety should be multidisciplinary and include elements of the theory that define the purpose of applied research: systemic, synergistic, strategic, targeted, value and functional approaches; dialectical and metaphysical methods of learning, the cyclical nature of nature and society.

Results and discussion

In the Poltava region the growth trend of MSW formation since 2000 has been observed, its composition, physical and chemical characteristics being diversified.

The annual MSW formation per capita has also increased (from 0,25 ton per a person a year in 1998 to 0,42 ton per a person a year in 2017). This is a common trend in Ukraine. Thus, the volume of the formed MSW in 2000 was 0,99 million m³, in 2011 it was 1.1 million m³, in 2017 it became 1.6 million m³ (1.6 times more than in 2000). A considerable part of MSW (34,11%) is formed in Poltava and Kremenchug. Coverage of the Poltava region population by collecting and removing waste services is 60% on the average, for urban population it being 90% and for rural – 25% [7].

Comparing with 1998 the content of polymer waste, glass, paper and cardboard waste in MSW has considerably increased. The reason for this is, in the

first place, the increase of packing material and its diversity. At the same time the volume of utilization of MSW valuable fractions does not exceed 3% on the average. So, in 2017 the amount of collected waste paper was 9697,97 m³, of polymers – 8829,03 m³, of glass – 2734,15 m³. In fact, the collection of resource valuable fractions in the area of MSW collection is currently done in Myrgorod, the system is implemented in Kremenchug, Horol, Lubny. Therefore, most of the resource valuable materials that make MSW are transported to the landfills and dumps and are sorted partially into separate groups. The amount of resource valuable components is not controlled. Sorting out waste is not centralized and is done by hand with the assistance of other physical persons – enterpreneurs on a contractual basis. An important problem in this sphere is the off-gauge waste that cause the formation of unauthorized dumps [8].

Handling the collected MSW in the Poltava region includes mainly liquidation method now. According to the State Administration of Environmental Protection of the 1.01.2017 in the Poltava region there were 377 authorized landfills and MSW dumps with a total area of 460,2 hectars, of which 90 have been certified and calculated. Today about 60% of landfills do not meet the standards of environmental safety and more than 18.5% are overloaded. The area of illegal dumps has also increased significantly. In 2008 the dumps were found with the total area of 18 hectars, in 2009 – 298 landfills with the area of 13,7 hectars, in 2017 – 411 dumps with the area of 60,2 hectars.

The carried out research in MSW handling sphere allows to distinguish the major problems in the field of waste handling in the Poltava region. They are: particular constant increase in waste formation in the region, low utilization level of MSW landfills and lack of correspondence of the majority of them to environmental health and safety standards, situations regarding waste handling in disorganized storage space is far from being satisfactory. On the whole the situation in the Poltava region in waste handling sphere is complex, it results in the loss of great amount of secondary materials and the shortfall of revenue from their utilization, the need for a permanent allocation of considerable amount of financial resources for building new waste grounds. The maintenance of the existing landfills and dumps in most cases create ecologically hazardous conditions in the areas of landfill.

The studies of current trends and the problems of solid waste handling in the Poltava region testify to the necessity of working out the strategy of waste handling development sphere accounting the interests of all stakeholders of this process [9]. According by the optimization model of waste solid handling development has been offered, it is aimed at balancing the two opposite criteria: economic damage from environmental pollution (D) and the total operation cost of the sphere (V):

$$V = \sum_{t=1}^{T} \left[\frac{1}{(1+i)^t} \cdot (A_t \cdot X_t + B_t \cdot Y_t + C_t \cdot Z_t + E_t + F_t) \right],$$

$$D = \sum_{t=1}^{T} (((\gamma \sum_{m=1}^{M} ER_m^A \cdot H_{factor_m}{}^A) + (\alpha \sum_{n=1}^{N} ER_n^W \cdot H_{factor_n}{}^W)) \cdot X_t + ((\gamma \sum_{m=1}^{M} EL_m^A \cdot H_{factor_m}{}^A) + (\alpha \sum_{n=1}^{N} EL_n^W \cdot H_{factor_n}{}^W)) \cdot Y_t), \quad (1)$$

where i – the discount rate;

t – functioning periods of MSW handling sphere per year;

A – processing costs, excluding profit from the sale of resource fractions (hryvnias/ton);

B – the cost of collecting and transportation of MSW (hryvnias/ton);

C –the disposal cost of MSW burial (hryvnias/ton);

X –MSW mass that goes to recycling (ton);

Y – MSW mass that is transported to the landfill (ton);

Z – total MSW amount that is removed, and the residue from recycling (ton);

E, F – the cost of putting the processing plant (station), waste ground into operation (hryvnias);

ER^A, ER^w –emission of pollutant substances into water or the atmosphere in compliance with "recycling" technology (ton);

EL^A, EL^w – emission of pollutant substances into water or the atmosphere in compliance with "burrying" technology (ton);

$H_{factor}{}^A$, $H_{factor}{}^W$ – coefficients of pollutants relative harmfulness that enter the atmosphere and water;

γ, α – constant values that are determined considering inflation rate (hryvnias/ton);

m, n – the amount of pollutants entering the atmosphere and water.

On the basis of the proposed model the optimal ratio of ecological and economic criteria for the development of waste management in the Poltava region (Fig. 1) has been determined. The development of MSW management sphere should be aimed at resolving the priority issues of: providing environmentally safe MSW management at maximizing recycling and market development of recyclable materials, minimizing waste forming. Solving these problems in the region should be performed in accordance with the main directions that are proposed to be carry out in three phases (Figure 1).

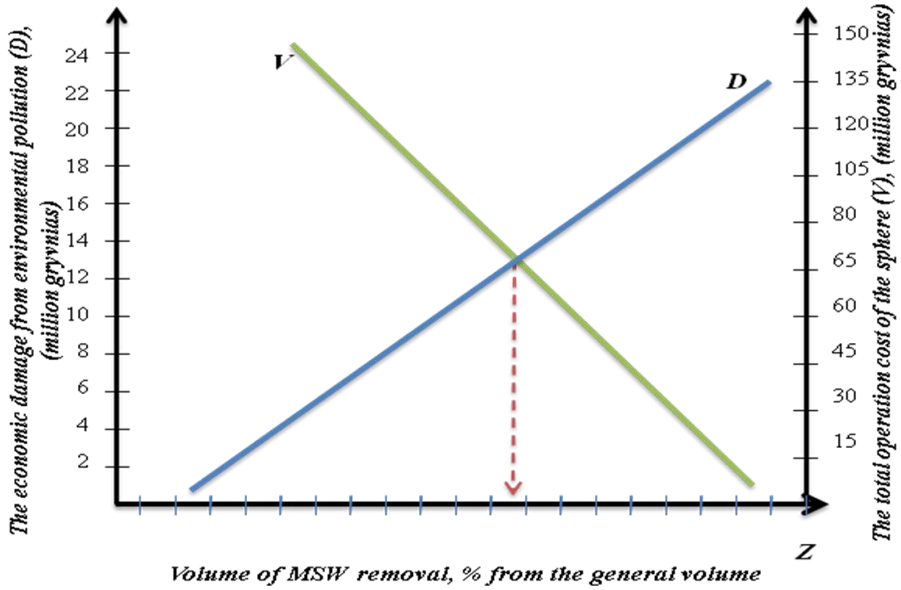

Figure 1. **Optimal ratio of development criteria in MSW sphere in the Poltava region**

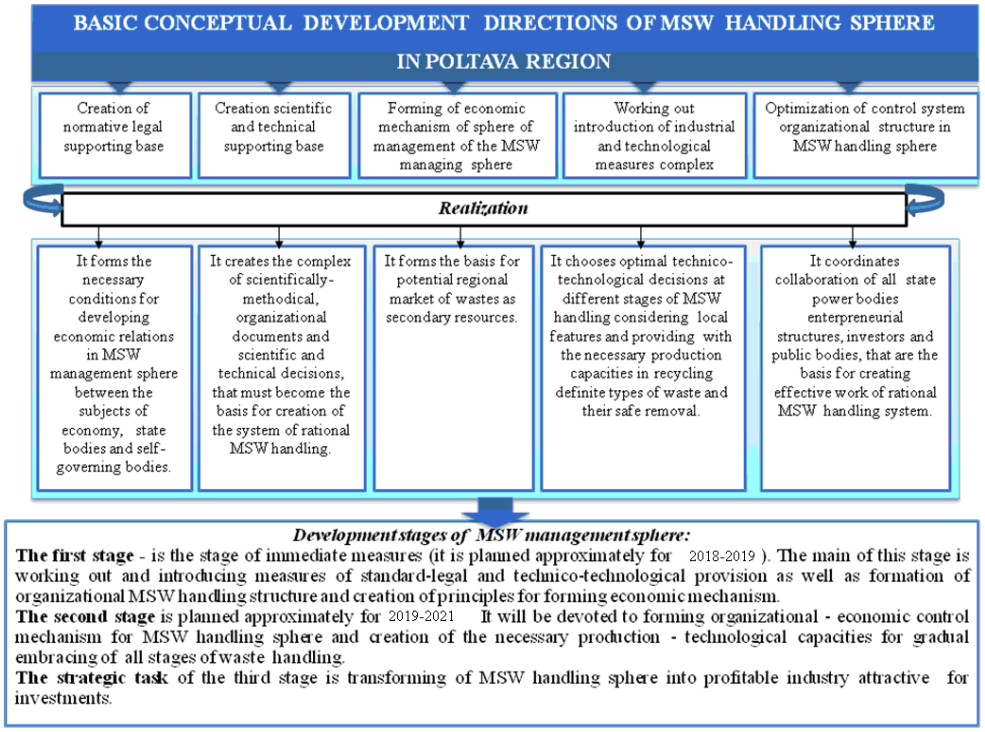

Figure 2. **The main strategic development directions of MSW handling sphere in the Poltava region**

According to the defined development directions of MSW handling sphere the urgent problem remains this: a wide application of financial and economic provision measures. But the vector of using these measures should have innovational character for creating powerful production potential from secondary raw materials; ecological safety and social growth must be promoted. Otherwise the financial resources coming into the sphere of waste management will compensate losses from irrational management in this sphere and will support uncompetitive model of production organisation. Considering the demands to local development policy of MSW handling sphere, introducing the system of priority measures of financial and economic supply of optimal functioning and development of the sphere as well as the Resolution of EU Council "The Strategy of the European Union in Waste Management" it is necessary to strive for realization of tactic goals: minimization of MSW formation and their highest possible utilization and there safe removal (Fig. 3).

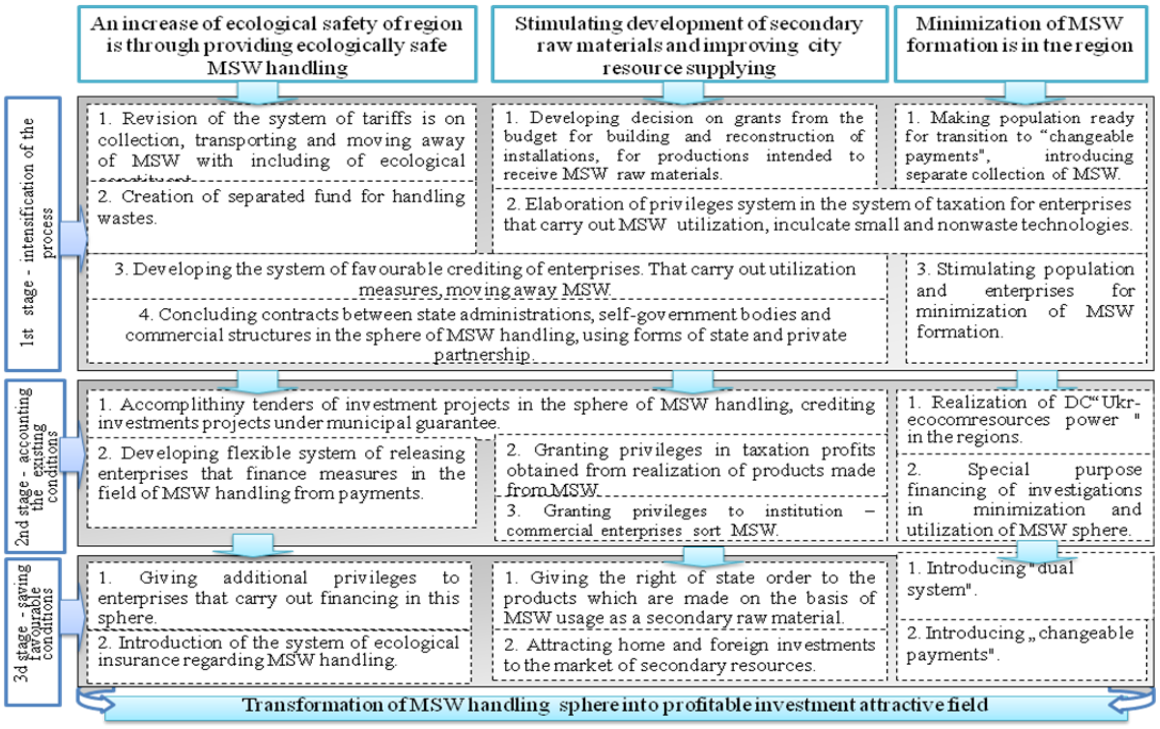

Figure 3. **Differential approach to the selection of financial and economic measures providing development of MSW sphere**

The mentioned measures will have to be realized in 3 stages: stage I – immediate measures aimed at intensifying the process, the II stage – medium measures aimed at taking into account the existing conditions, the III stage – long-term measures aimed at preserving the favorable conditions in certain target areas.

Conclusion and prospects of further research

The development strategy of MSW sphere allows to the formation of an effective integrated waste management system that will enable achieving the following results: creating legal, scientific and technical basis for rational and safe waste management, developing economic instruments aimed at forming and developing waste market as secondary resources; improving of organizational infrastructure for sustainable waste management; introduction a single system of accounting, control and management of MSW streams and establishing a system for monitoring ecological condition for the disposal places of solid waste; providing environmentally safe disposal of solid waste and creating trends for reducing "end wastes", which are transported to the landfill; reducing unauthorized removal of solid waste and economic loss for the solid waste pollution; minimization of MSW formation; increasing waste utilization coefficient and investments in this given sphere, introducing separate collection system of solid waste; construction of waste sorting station for development of second resources market; providing

population with services for collecting waste and with technical means of removal of solid waste; creation of capacities for utilization of organic waste at composting plants.

Subsequent researches

The expected results of implementing optimization strategies are a comprehensive solution to the economic, social and environmental challenges of the region, ensuring economical using of primary raw materials, and fuel-energy resources of the regions of Ukraine. Based on model management area of recourse with solid domestic waste formed algorithm definition of optimal management strategies and mechanisms for their implementation, which allows solving the problems of optimize development area of handling with solid waste with a given set variables and parameters of system state for a particular type life cycle this area. Subsequent researches include the practical application of this model on the example of the Poltava region on the basis of optimization of three target functions: the ecological risk to the health of the population from the area of handling with solid waste; maximizing profits with minimal investment in this area; energy intensity of the waste management system.

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СТРАТЕГІЧНІ НАПРЯМИ УПРАВЛІННЯ СФЕРОЮ ПОВОДЖЕННЯ З ТВЕРДИМИ ПОБУТОВИМИ ВІДХОДАМИ ПОЛТАВСЬКОГО РЕГІОНУ

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Проблема поводження з твердими відходами, підвищення ефективності використання природно-економічного потенціалу території є однією з пріоритетних для кожного регіону України. У статті розроблено методологічні засади управління сферою поводження з твердими побутовими відходами регіону на засадах поєднання екологічних, економічних, технологічних та соціальних імперативів, зокрема сформовано оптимізаційну модель розвитку сфери

поводження з твердими побутовими відходами регіону, яка спрямована на збалансування економічних та екологічних критеріїв.

Отримані результати дослідження дозволили сформувати стратегічні напрями розвитку сфери поводження з твердими побутовими відходами в контексті реалізації соціально-економічної та екологічної стратегії та надані рекомендації щодо удосконалення її фінансово-економічного забезпечення. Методологічною основою дослідження стали результати фундаментальних і прикладних досліджень в галузі фізичної економіки, екологічної економіки, концепції сталого розвитку.

Практична значимість роботи полягає у оптимізації стратегії поводження з твердими побутовими відходами у регіоні, реалізація якої дозволить досягнути наступних результатів: створення нормативно-правової і науково-технічної бази раціонального й безпечного поводження з твердими побутовими відходами; розробку системи економічних важелів, направлених на формування та розвиток ринку відходів як вторинних ресурсів; удосконалення організаційної інфраструктури для раціонального поводження з твердими побутовими відходами; впровадження єдиної системи обліку, контролю та управління потоками відходів та налагодження системи моніторингу за екологічним станом місць видалення твердих побутових відходів; забезпечення екологічно безпечного видалення твердих побутових відходів та створення тенденцій щодо зменшення обсягів "кінцевих відходів", які вивозяться на звалище; зменшення несанкціонованого видалення твердих побутових відходів та еколого-економічного збитку за забруднення довкілля відходами; мінімізацію утворення твердих побутових відходів; збільшення коефіцієнту утилізації відходів та збільшення інвестицій у дану сферу, впровадження системи роздільного збору твердих побутових відходів; будівництво сміттєсортувальної станції та розвиток ринку вторресурсів; забезпечення населення послугами щодо збиранням твердих побутових відходів та технічними засобами їх вивезення; створення потужностей для утилізації органічних відходів на компостних підприємствах.

Ключові слова: *тверді побутові відходи, управління сферою поводження з відходами, регіон, стратегія розвитку, збалансований розвиток.*

СТРАТЕГИЧЕСКИЕ НАПРАВЛЕНИЯ УПРАВЛЕНИЯ СФЕРОЙ ОБРАЩЕНИЯ С ТВЕРДЫМИ БЫТОВЫМИ ОТХОДАМИ ПОЛТАВСКОГО РЕГИОНА

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Проблема обращения с твердыми отходами, повышение эффективности использования природно-экономического потенциала территории является одной из приоритетных для каждого региона Украины. В статье разработаны методологические основы управления сферой обращения с твердыми бытовыми отходами региона на основе сочетания экологических, экономических, технологических и социальных императивов, в частности сформирована оптимизационная модель развития сферы обращения с твердыми бытовыми отходами региона, которая направлена на сбалансирование экономических и экологических критериев.

Полученные результаты исследования позволили сформировать стратегические направления развития сферы обращения с твердыми бытовыми отходами в контексте реализации социально-экономической и экологической стратегии и даны рекомендации по совершенствованию её финансово-экономического обеспечения. Методологической основой исследования стали результаты фундаментальных и прикладных исследований в области физической экономики, экологической экономики, концепции устойчивого развития.

Практическая значимость работы заключается в оптимизации стратегии обращения с твердыми бытовыми отходами в регионе, реализация которой позволит достичь следующих результатов: создание нормативно-правовой и научно-технической базы рационального и безопасного обращения с твердыми бытовыми отходами; разработку системы экономических рычагов, направленных на формирование и развитие рынка отходов как вторичных ресурсов; совершенствование организационной инфраструктуры для рационального обращения с твердыми

бытовыми отходами; внедрение единой системы учета, контроля и управления потоками отходов, системы мониторинга за экологическим состоянием мест удаления твердых бытовых отходов; обеспечение экологически безопасного удаления твердых бытовых отходов и создание тенденций по уменьшению объемов "конечных отходов", которые вывозятся на свалку; уменьшение несанкционированного удаления твердых бытовых отходов и эколого-экономического ущерба за загрязнение окружающей среды отходами; минимизацию образования твердых бытовых отходов; увеличение коэффициента утилизации отходов и увеличение инвестиций в данную сферу, внедрение системы раздельного сбора твердых бытовых отходов; строительство мусоросортировочной станции и развитие рынка вторресурсов; обеспечение населения услугами по сбору твердых бытовых отходов и техническими средствами их вывоза; создание мощностей для утилизации органических отходов на компостных предприятиях.

Ключевые слова: *твердые бытовые отходы, управления сферой обращения с отходами, регион, стратегия развития, сбалансированное развитие.*