

Conceptual framework for ensuring resource and environmental safety in the region

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A problem of providing the resource-ecological safety, increase of efficiency of the naturally-economic potential use of territory is one of priority for every region of Ukraine. At the same time, formation of an efficient market economy in the regions requires solution of the problems between the goals of the social and economic system development and negative effects of its impact on the environment with considering the influence of destabilizing factors. In this aspect, forming new comprehensive approaches to ensuring resource and environmental safety in the region and creating strategies for improving primary and secondary resources management based on economic models and mechanisms are becoming a priority in regional development.

Therefore in the article there are worked out and scientifically justified the methodological principles of estimation of resource-ecological safety in the region. They consist in the calculation of three-component index that takes into account ecological safety of regional economy, level of ecological risk on the basis of a priori choice of model of relations "man-environment", and level of resources proceeding in the region. These approaches are based on developing an innovative methodology for regional social and economic system development, that ensures prevention of ecosystems and human health deterioration while improving social and economic conditions of a given system through a mechanism of more efficient use of natural and economic potential of the area.

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. Methodological-theoretical basis of organizing resource-ecological safety of the region is based on integration of ecologic, economic, technological and social imperatives. Economic-mathematic model of resource-ecological safety management and approaches of optimal management strategies determination and their implementation mechanisms are proposed. The results of research allowed to form conceptual principles of providing the resource-ecological safety 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. The methodical base of risks diagnostics of regional resource-ecological safety management system and evaluation of its efficiency are worked out. Practical importance of work consists in optimization of strategy of providing the resource-ecological safety in a region, realization of that will allow: to improve competitiveness of region; to get an additional profit from secondary resources; to save primary resources and improve their quality; to turn contaminated lands in economic turnover of region; to decrease a risk to the health of population from negative influence of wastes; to ensure the preservation and resumption of the natural environment of the region.

Keywords: resource-ecological safety, region, secondary resources, solid wastes.

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Концептуальные основы обеспечения ресурсно-экологической безопасности в регионе

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Проблема обеспечения ресурсно-экологической безопасности, повышения эффективности использования естественно-экономического потенциала территории является одной из приоритетных для каждого региона Украины. В этом аспекте формирование региональных подходов к обеспечению ресурсной и экологической безопасности

в регионе и разработка стратегий совершенствования управления первичными и вторичными ресурсами на основе экономических моделей и механизмов становятся приоритетными в региональном развитии.

Поэтому в статье разработан и научно обоснован теоретико-методологический подход к оценке уровня ресурсно-экологической безопасности регионов в системе устойчивого развития, который заключается в расчёте трёхкомпонентного показателя и учитывает уровень экологической безопасности экономики региона, уровень экологического риска здоровью населения на основе априорного выбора модели, которая отображает разные взаимозависимости в системе отношений «человек-среда», уровень ресурсосбережения и ресурсозамещение в регионе. Разработаны теоретико-методологические подходы к формированию ресурсно-экологической безопасности региона на принципах сочетания экологических, экономических, технологических и социальных императивов. Разработана математическая модель управления ресурсно-экологической безопасностью и подходы к определению оптимальных управленческих стратегий и механизмов их реализации на региональном уровне. Методологической основой исследования стали результаты фундаментальных и прикладных исследований в отрасли физической и экологической экономики, положение концепции устойчивого развития. Полученные результаты исследования позволили сформировать концептуальные принципы обеспечения ресурсно-экологической безопасности регионов Украины, ориентированных на повышение эффективности использования естественно-экономического потенциала территории, ресурсосбережения и ресурсозамещения на основе капитализации твёрдых отходов и минимизации их негативного влияния. Полученные результаты исследования позволили сформировать концептуальные принципы обеспечения ресурсно-экологической безопасности регионов Украины, ориентированных на ресурсосбережение и повышение эффективности использования естественно-экономического потенциала территории. Практическая значимость работы заключается в оптимизации стратегии обеспечения ресурсно-экологической безопасности в регионе, реализация которой позволит улучшить конкурентоспособность региона; получить дополнительный доход от вторичных ресурсов; сохранить первичные ресурсы и улучшить их качество; уменьшить риск здоровью населения от негативного влияния отходов; обеспечить сохранение и возобновление окружающей естественной среды региона, естественного состояния экосистем.

Ключевые слова: ресурсно-экологическая безопасность, регион, вторичные ресурсы, твёрдые отходы.

Modern society is characterized by contradiction of two interrelated processes – economic growth and limited assimilation properties of biosphere. The previous conceptual basis of the economy and development of society has been exhausted, and the use of traditional methods to achieve the objectives is unacceptable for solving new problems of environmental protection. Changing the social development paradigm to an eco-oriented one should promote the harmonious and environmentally sound socio-economic development of society, preservation of the environment 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.

The problem of ensuring resource and environmental safety and more efficient use of natural and economic potential of the area is a priority for each region of Ukraine. According to the natural resource intensity index, which is an integrated indicator of energy and water consumption and airborne emissions hazard, etc. (for Ukraine it makes 8.7), Ukraine is ahead of such countries as Russia, Moldova, Poland and EU-members (this index is equal to 1.0 worldwide) [1].

The formation of an effective market economy in the regions of Ukraine requires a comprehensive solution of problems between the

goals of the social and economic system development and negative effects of its impact on the environment, taking into account the influence of destabilizing factors.

In this aspect, forming new comprehensive approaches to ensuring resource and environmental safety in the region and creating strategies for improving primary and secondary resources management based on economic models and mechanisms are becoming a priority in regional development.

Many researchers have made a great contribution to the development of theoretical and methodological framework of a balanced development of the regions [2–9]. The works of V. Vernadskyi, A. Klymenko, L. Melnyk, J. Odum, S. Podolinskyi, N. Reimers, M. Rudenko, J. Forester and other scientists are dedicated to fundamental studies of interaction between a society and nature.

The issues for further scientific research still involve a problem of forming comprehensive approaches to ensure resource and environmental safety of the regions. These approaches are based on developing an innovative methodology for regional social and economic system development, that ensures prevention of ecosystems and human health deterioration while improving social and economic conditions of a given system through a mechanism of more efficient use of natural and economic potential of the area.

The aim of our research was to develop and to scientifically substantiate theoretical

and methodological approach in relation to the estimation of resource-ecological safety in the regions, on the basis of that to form conceptual principles of providing the resource-ecological safety in the regions of Ukraine, oriented to the increase of efficiency of the territory naturally-economic potential use on the basis of solid wastes capitalization and minimization of their negative influence.

Problem definition: to develop and to scientifically substantiate a conceptual framework for ensuring resource and environmental safety of the Poltava region, that includes theoretical-methodological approach to strategy optimization for ensuring resource and environmental safety and scientific-methodological principles for choosing measures for ensuring resource and environmental safety in the Poltava region.

Description of the main materials of research

Resource and environmental safety of the region is a state of a regional natural and social and economic system that ensures prevention of ecosystems and human health deterioration while improving social and economic conditions of a given system (minimum entropy) considering the influence of destabilizing resource and environmental hazards of external and internal environments through a mechanism of more efficient use of natural and economic potential of the area, which is focused on resource preservation and substitution.

According to the theory of ecosystems safety and taking into account the influence of social and economic factors thereon [10], a theoretical and methodological approach to assessing the level of the resource and environmental safety of the regions has been developed. This approach is to calculate a three-component index taking into account a level of environmental safety of the region's economy (P), a level of environmental risk to the health of population (M) and a level of resource preservation and resource restoration in the region (W):

$$K = f(P, M, W) \quad (1)$$

$$P, M, W \rightarrow 1, \text{ if } P, S, W \geq P_{\text{suff}}, S_{\text{suff}}, W_{\text{suff}}$$

$$P, M, W \rightarrow 0, \text{ if } P, S, W < P_{\text{suff}}, S_{\text{suff}}, W_{\text{suff}}$$

where $P_{\text{suff}}, M_{\text{suff}}, W_{\text{suff}}$ – sufficient value of indexes P, M, W .

Constituents of three-component index in relation to resource-ecological strength of region security it is suggested to determine so:

Calculation of the index of the regional economy environmental safety as a total economic loss for contamination of environment from the technogenic loading in a region on authorial methodology [11], the results of calculation of that allowed to define near-term strategy to direction of improvement of the system ecologically safe development in Poltava region.

The estimation of risk to the health of population that may be carried out by means of authorial model that represents various interdependencies in the system of relations “man-environment:

$$\begin{aligned} Z &= 5,42 + 12,8G - 0,112D + 0,144E \\ E &= 42,4 + 8,2F + 17,5H - 1,4C \\ C &= 21,45 + 1,45M. \end{aligned} \quad (2)$$

In these equations the index of morbidity of population (Z), as a basic indicator of ecological risk, is examined as a function from social-ecological-economic factors that have direct influence on a health of population: influence of contamination of the ground cover (G) as sources of food products, degree of satisfaction of requirements in services of health protection (D) and level of ecological danger of regional economy (E). The level of ecological danger of regional economy (E) is conditioned by social-ecological factors, namely by side effects from the production of contamination of atmosphere (F) and hydrosphere (H), by the level of “social trouble” in the region (C), determining from one side potential possibilities on the improvement of environment, and from other side it is observed to circulating connection: level of morbidity (Z) in much why determines the level of “social trouble” in a region, so as higher morbidity provokes the greater amount of the lost working days and worsening of material terms. On the basis of economic-mathematical model (2) the estimation of ecological risk in the Poltava region (Fig. 1) is conducted (Fig. 1).

The indicator of resource saving in the region includes the following components: energy intensity of solid waste management in the region [11]; economic efficiency of the use of secondary resources in a region [12]; economic efficiency of the use of bioenergetic potential in a region [13]; an estimation of risk of health of population from the existent system of solid wastes handling [14].

Eight values of three-component index of estimation of resource-ecological regional security are possible in theory, that corresponds to 4 zones presented on Figure 2.

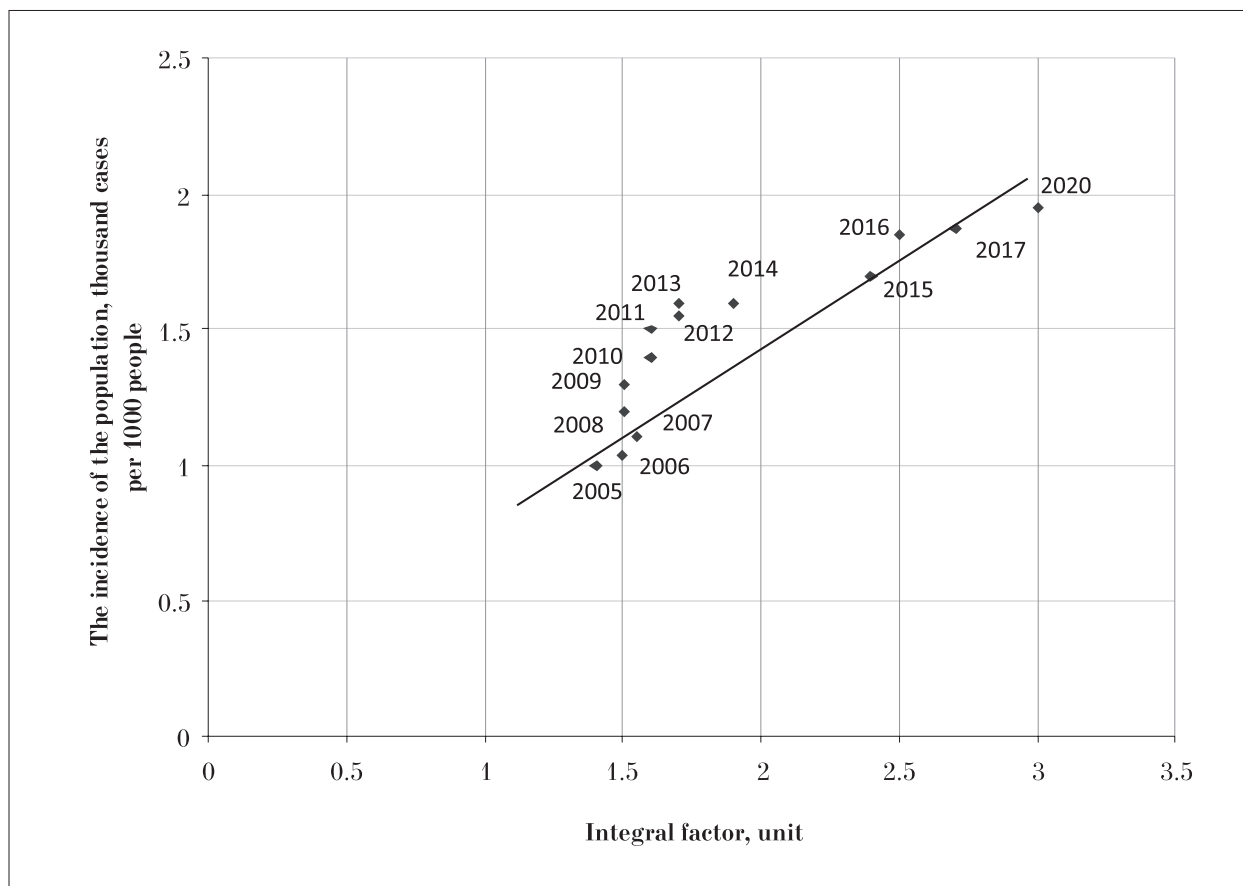


Fig. 1. Estimation (2005–2017) and forecast of ecological risk (until 2020) for the Poltava region

Level of maintenance and proceeding in resources		Level of ecological danger of economy of region			
		sufficient		insufficient	
		Risk to the health of population			
		sufficient	insufficient	sufficient	insufficient
sufficient	(1; 1; 1)	(1; 1; 0)	(1; 0; 1)	(1; 0; 0)	
insufficient	(0; 1; 1)	(0; 1; 0)	(0; 0; 1)	(0; 0; 0)	

Zone of absolute resource-ecological safety of region

Zone of acceptable resource-ecological safety of region

Zone of shaky resource-ecological safety to the region

Zone of impermissible resource-ecological safety of region

Fig. 2. Zones of resource-ecological safety of region

Based on the author’s methodology for identifying danger and for defining resource-environmental safety zones, an integrated approach has been developed to ensure the resource-environmental security of the region.

This approach should include the following components: identification of danger and definition of resource-environmental security zones; scientific and methodological principles for the selection of measures to ensure a sufficient level of

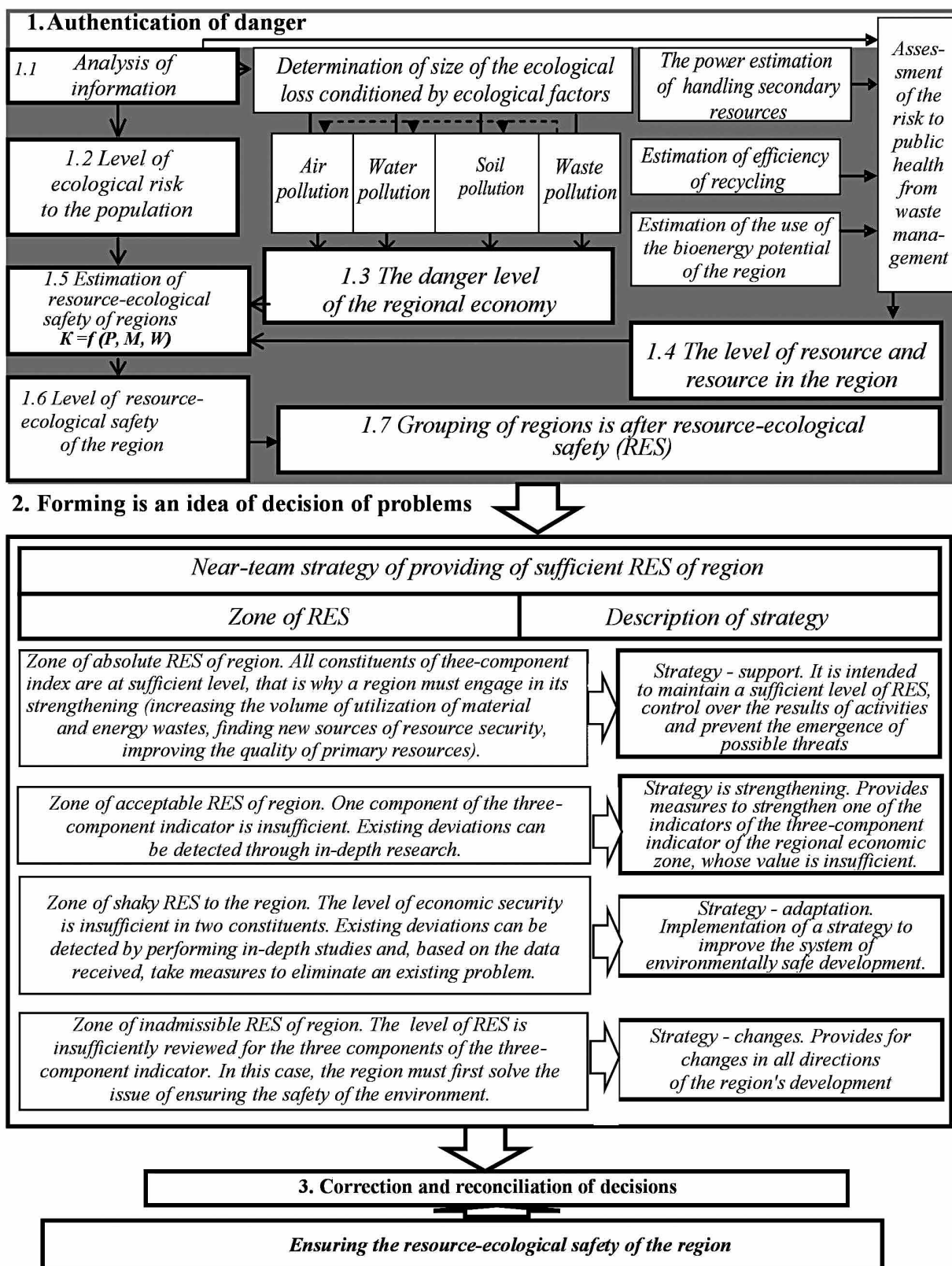


Fig. 3. Methodological principles of providing of resource-ecological safety (RES) in the region

economic security, based on the optimization of economic models; adjustment and concordance of decisions on the basis of an integral model of development of the economical-ecological systems of the use of naturally-economic potential of region (Fig. 3).

In general, implementation of this ideology of rational solutions making in developing a strategy of the environmentally safe and economically effective development of the regions assumes the use of a set of specific scientific and methodological approaches, among which one should primarily distinguish: a scenario approach when developing possible strategy options for the environmentally safe development of the region; studying of business plans of the most effective projects of production development and use of resources, the implementation of which is substantiated by both the perspective of estimating an expected economical efficiency and by ensuring the RES of the region.

Conclusion

The article developed a theoretical and methodological approach to assessing the level of resource-ecological security of regions in the system of sustainable development. This approach is based on calculating a three-component indicator that takes into account the level of ecological security of the regional economy, the level of environmental risk to public health based on an a priori choice of model reflecting various interdependencies in the system relations “man-environment” and the level of resource saving and restoration in the region.

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