

# **State Organization «Institute of Market and Economic&Ecological Researches of the National Academy of Sciences of Ukraine»**

## **Summary of scientific novelty for the research**

### **3.1.8.62/Б «Methodology for the Formation of a Management System for the Greening of Economic Sectors»**

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The scientific novelty of the most significant research results is as follows:

#### **Within scientific&methodological aspects:**

- The paradigm of nonlinear development of economic-ecological systems has been theoretically substantiated. This paradigm is based on the nonlinear representation of their dynamics, characterized by specific behaviors such as high sensitivity to internal synergistic and external energy impacts, instability, uncertainty, the emergence of unpredictable effects, and multiple options for management decisions aimed at shifting these systems toward a targeted eco-oriented trajectory.

- A hypothesis has been formulated, based on analytical assessments of the activity and efficiency of sectoral greening processes, suggesting a shift in methodological approaches and management tools to activate the vector of accelerated ecological modernization of the national economy and establish institutional dominants of environmental governance.

- The theoretical foundations have been developed for the systemic-parametric generalization of modern axioms of linear and nonlinear management of complex systems concerning the tasks of managing the greening of economic development. A foundational system of invariant concepts of the theory of economic-ecological nonlinearity has been established, including the nonlinear economic-ecological (EE) system, nonlinear EE phenomena and processes, nonlinear development, nonlinear models, and nonlinear management.

- A system of principles for implementing nonlinearity into the greening of the economy has been formulated, as key components of the nonlinear approach methodology for managing greening processes. These principles have been categorized into groups based on fundamentality (e.g., duality, integrity, nonlinear coevolution of ecology and society), specific nonlinear features (e.g., accounting for changes in structure and relationships within systems, introducing instability elements), and interaction effects (e.g., synergies, emergence, institutional traps, and anthropogenic chain connections).

- Forms, types, stages, and processes have been substantiated as axiomatic elements for implementing the nonlinear approach in managing eco-oriented sectoral

development. These elements define the functional and structural complexity of management as a process of eco-oriented goal setting and subsequent managerial activities.

- The development vector for managing sectoral greening, combining the self-organization processes of economic-ecological systems with management aimed at achieving sustainable planned results, has been substantiated. This approach contrasts with the classical linear model, emphasizing attractors to achieve stability rather than increasing control impact for proportional returns.

- The methodology of understanding the time factor in managing nonlinear economic-ecological systems has been substantiated, defining the subject area and the fundamentals of time theory. A systemic-parametric model of the classifier of time theory concepts has been presented, based on the ternary (three-dimensional) description of complex systems, allowing time to be considered as a fundamental property of economic-ecological processes.

- A conceptual model for strategic management of the greening process of the economy has been proposed, focused on sustainable development goals, sectoral strategies, and the analysis of typologies of natural resource management systems (resource-oriented, economic, ecological approaches, and "recipient-oriented" approach). The specificity of sectoral greening depending on its proximity to nature has been considered, which ensures managerial impacts directed toward achieving real goals, behavioral models of enterprises in cases of ecological conflicts, application of the synergetic approach, and the implementation of information systems to support the management process.

- The theoretical and conceptual justification for the differences in the behavior of economic-ecological systems with linear and nonlinear dynamics has been developed, distinguishing them by the degree of relative stability, the possibility of unexpected changes in economic and ecological processes, distant consequences, the number of equilibrium and instability states, and the methodology and tools for management.

- Basic principles for the development of economic-ecological systems have been developed (principle of superposition, principle of system development, principle of necessity and randomness in system behavior, principle of uncertainty, principle of predictability), considered as objects of axiomatic analysis, culminating in a generalized comparative assessment of the features of linear and nonlinear systems as management objects.

- The theoretical definition of the architectonics of the sectoral economy greening process within the existing vertical structure of environmental management (state, regional, municipal, local, public) has been developed. It has been investigated from the perspective of institutional support and organizational structure,

fundamentally transformed under decentralization conditions.

- A theoretical justification for the conceptual scheme of information support for eco-oriented management decisions has been developed, based on the principles of a systemic approach to the formation of statistical information (collection, processing, accumulation, and use) and representing a project of a multifunctional, automated resource.

- Scientific justification for the characteristic features, algorithms of behavior of nonlinear economic-ecological systems, factors complicating their ecological diagnostics (multifactoriality and cost measurement of system parameters, high dynamics, external challenges, weak feedback), which collectively reduce management efficiency and determine the way to obtain reliable diagnostic conclusions through task decomposition. This approach makes it possible to adjust managerial impacts based on data obtained from simplified diagnostics procedures.

- A theoretical justification for the need to change the goal-setting of sectoral strategies toward greening by implementing nonlinearity principles in sectoral development management as an alternative to supporting linear economic growth trends has been developed.

- Scientific understanding of the functioning of the eco-economic system model has been advanced, serving as the basis for studying problems of managing the greening of social development. Unlike the existing systemic understanding as a set of interacting elements, it is supplemented by an understanding of the synergetic development of economic and natural systems, allowing a new perspective for researching the functioning of complex systems of various origins. This includes their coevolution, ambiguous transformation trajectories, internal and external interconnections, principles of nonlinear synthesis, and forms a new theoretical concept of strategic management in general and sectoral greening in particular.

- Scientific understanding of the functioning of economic sectors as complex economic-ecological systems has been advanced, considering the synergetic concept of openness, imbalance, and nonlinearity, where changes in system structure occur under stochastic influences, with properties of self-organization and alternative development directions.

- A theoretical justification for the directions of applied management of sectoral greening processes has been developed. These directions form the dependence of management efficiency on determining the vector of self-organization processes in economic-ecological systems, applying soft or rigid (in critical development conditions) control within the formed management organizational structure, and defining conditions under which the system gains stability through impacts on the self-organization mechanism according to the desired scenario.

**Within scientific&practical aspects:**

- A modern approach to managing greening processes in the economy has been improved, integrating external and internal factors into the methodological foundation for building integrated corporate governance for greening development as a set of interconnected goals, approaches, criteria, methods, and means for achieving them.

- A methodological approach to evaluating the effectiveness of state programs and projects of sectoral economic-ecological development has been improved, applying a binary analysis of programmatic and project activity impacts on ecological, social, economic, and institutional environments. This aims to enhance the ecological management system, increase transparency in the "cost-result" system, and strengthen the accountability of implementers.

- A conceptual vision of the decision-making algorithm in the model of adaptive (soft) management that restores ecological equilibrium has been improved. This is based on the principles of precedence and transcendence, enhancing the effectiveness of managerial decisions under high uncertainty and dynamism in economic-ecological systems.

- A methodological approach to the systematization of institutional support directions for economic greening has been improved based on application level (state or sectoral), tools used, and their classification by impact on business entities (regulatory, motivational, fiscal, control), and the state of non-productive spheres promoting sectoral greening (education, information). Together, they form a qualitatively new type of socio-ecological-economic relationships, behavioral models, and consumption patterns.

- A digitized algorithm for collecting and processing information in environmental taxation and the use of funds from the State Environmental Protection Fund has been improved, differing in its method of data submission, a list of mandatory data, a feedback system, creating a proper statistical base for permitting systems, forecasting environmental tax revenues, and monitoring the use of funds for environmental needs.

- The process of organizing the collection and provision of statistical information between managers and users (governance entities) has been improved. Unlike the existing system, it streamlines the circulation of information (receipt, accumulation, and transmission) between the primary collection level and potential users capable of making effective management decisions based on real-time environmental measurements and ecological consequences of enterprise activities.

- A conceptual approach to environmental diagnostics as a multi-level analysis of cause-effect relationships in managing complex economic-ecological systems has been developed. Unlike the traditional approach (identifying a cause and eliminating it), the analysis focuses on disaggregating ecological problems, identifying resolution points, and determining a new trajectory for management changes.

- Trends in the nonlinear dynamics of economic-ecological systems have been identified through formalization, systematization, and typologization of processes occurring at the sectoral level, highlighting the inadequacy of traditional management in conditions of uncertainty regarding system behavior.

- An information-analytical support mechanism for objective, justified, and prompt managerial decisions has been improved by enhancing the methodology for forming reliable information-analytical support for eco-oriented management systems, including a digitized algorithm for collecting, processing, storing, and using statistical environmental information.

- Practical application of the synergetic approach to sectoral greening management has been substantiated, enabling the concentration of step-by-step actions in the management algorithm for complex economic-ecological systems. Elements include identifying the controlled system, factors capable of changing and activating its state, evaluating the existing management vertical, and areas for growth. This allows assessing shortcomings and consequences of traditional management in the real economy sector, particularly in agriculture, fisheries, energy, agricultural land use, and marine spatial planning as a tool for greening the marine economy.

- Methodology for quasi-dynamic modeling has been applied, including the analysis of dynamic states and the effectiveness of intermediary institutions, assessment of decision-making methods and mechanisms, completeness of initial condition consideration, institutional strategies, and phenomena. This has allowed evaluation of the institutional space for reforms related to sectoral greening.

- Methodological foundations for organizing statistical environmental research within the state monitoring system have been advanced, particularly in systematizing, processing, and grouping primary statistical data. This forms the informational basis for managerial decisions and actions in sectoral greening, streamlines the interaction system between data managers and users, and eliminates constant management delays in responding to new information.

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