

Decomposition of the Process of Developing a Methodology for Managing the Sustainable Development of Natural-Anthropogenic Complexes in Rural Areas

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Abstract—The article presents the results of a study on the decomposition of development of a methodology for managing the sustainable development of natural-anthropogenic complexes in rural areas. The proposed decomposition is based on generalized results of the philosophical and methodological analysis of management ideas evolution at the philosophical, methodological, theoretical and methodological levels. The sustainable development management of natural-anthropogenic complexes of rural territories in this study is considered in the context of classical, non-classical and post-non-classical types of scientific rationality, with the subsequent identification and analysis of the main limitations characteristic of each of these approaches. Factors, conditions and relations that are formed in the process of managing natural-anthropogenic complexes of rural territories are due to the constant complication of management objects, which requires the development and application of adequate response tools. Development of such tools at the present stage is possible only within the framework of post-non-classical type of scientific rationality in the management paradigm “subject – self-developing polysubject environment”. The article substantiates the need for a transition to this management paradigm in relation to natural-anthropogenic complexes that are forming in rural areas.

Keywords—*natural-anthropogenic complex, sustainable development, management, methodology.*

I. INTRODUCTION

Relevance of developing a methodology for managing the sustainable development of natural-anthropogenic complexes (NAC) of rural territories is due to aggravating problems in the field of agriculture and rural areas, which are caused by an increase in the level of industrialization, which, in turn, negatively affects the environment and inevitably exacerbates socio-economic problems in the countryside.

Tendency that has been outlined in recent years towards the transition to resource-saving technologies in agriculture, as well as increasing the level of automation and digitalization of production processes and management processes, along with obvious advantages pose certain threats to the sustainable development of rural territories [1-3]. One of the main threats is a significant release in rural areas on the horizon of the next 10-15 years of low-skilled labor. In addition, modern agricultural technologies exert increasing pressure on the environment, which leads to partial or complete degradation of natural

complexes, where natural-anthropogenic complexes arise with an extremely low level of natural stability [4-7]. In the future, the development of these trends can lead to extremely negative social, economic and environmental consequences.

Of course, today the world scientific community is actively working on the problems of ensuring sustainable development of agriculture and rural areas. One of the key trends in this direction is the colonization of agriculture and the transition to organic farming [8-11].

The purpose of this study is to determine the approach to the development of a methodology for managing the sustainable development of NAC in rural areas taking into account the identified problems. In order to achieve the stated goal, the following tasks were set and solved: a generalized philosophical and methodological analysis of the evolution of ideas about managing sustainable development of NAC in rural areas was made, the necessity of developing a methodology for managing sustainable development of NAC in rural areas in the context of a post-non-classical type of scientific rationality was substantiated.

II. METHODS

The decomposition of process of development of methodology for managing the sustainable development of NAC in rural areas is based on a scheme of philosophical and methodological analysis of management ideas evolution proposed by V.E. Lepsky [12].

At a philosophical level, the management of sustainable development of the NAC in rural areas can be represented in the context of classical, non-classical and post-non-classical types of scientific rationality, each of which is characterized by its own basic philosophical approach.

The classical type of scientific rationality as a basic philosophical approach is based on positivism. The basic paradigm of classical type of scientific rationality at the methodological level is the “subject-object” relationship, and NACs act as complex systems. The basic providing area of knowledge at the theoretical level is cybernetics. Accordingly, the methodological level is represented by the classical control based on analytical models with feedbacks.

The non-classical type of scientific rationality is based on philosophical constructivism. The methodological level of

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management is implemented in the “subject-subject” paradigm, where the NAC acts as an active system. Second-order cybernetics acts as the basic supporting field of knowledge. At the methodological level, reflexive, informational and network management are implemented in simulation mathematical models, role-playing and organizational-activity games G.P. Shchedrovitsky [13].

The post-nonclassical type of scientific rationality as a basic philosophical approach is based on a humanistic interpretation of philosophical constructivism and considers management in the paradigm “subject - metasubject”, in which the NAC is presented in the form of self-developing environments. The methodological level of management in this type of scientific rationality is represented by soft forms of management, control through the environment in “human-sized” (combined) systems.

In this study, the decomposition of process of development of methodology for managing the sustainable development of NAC in rural areas is carried out at philosophical, methodological, theoretical and methodological levels in the context of indicated types of scientific rationality.

III. RESULTS

A. *NAC management in rural areas in the context of classical type of scientific rationality*

The approach to NAC management in rural areas from the standpoint of the classical type of scientific rationality involves the consideration of natural and anthropogenic complexes as complex systems that include three subsystems: socio-economic, technological and environmental relations. In this case, the studied complex system acts as a control object, on which the subject exerts control actions. By acting on individual subsystems, the subject seeks a coordinated and harmonized development of social, industrial and environmental spheres of rural territories. In this case, the feedback mechanism acts as the main control mechanism, in which the effectiveness of each control action is evaluated by the response of a separate subsystem.

The presented approach to NAC management dominated science and practice until the mid-80s. of the 20th century and led to an exacerbation of a whole range of socio-economic and environmental problems in agriculture. Examples that clearly demonstrate the results of applying this approach to the management of NAC in Russia are desertification as a result of the development of virgin lands and catastrophic changes in the Aral Sea basin.

All analytical NAC management models built in the “subject-object” paradigm and based on principles of feedback with cybernetics as the basic control mechanisms objectively have limitations, the influence of which inevitably leads to the degradation of any natural complexes. Such models cannot fully take into account the internal processes occurring in the control objects. In relation to the NAC, these are internal processes that are initiated in all subsystems, regardless of the direct control actions of the subject. NACs in rural areas are not just complex systems – they are the active systems that are capable of self-development beyond the control actions. If this self-development is not taken into account in the development and adoption of managerial decisions, the sustainable development of NAC becomes impossible.

The transition to the NAC management in the context of non-classical type of scientific rationality allows us to solve this problem.

B. *NAC management in the context of non-classical type of scientific rationality*

In the context of non-classical type of scientific rationality, the NAC are presented as management objects in the form of active systems capable of self-development and self-improvement. The problem of managing the sustainable development of NAC in rural areas comes down to harmonizing the development of three basic subsystems: socio-economic, technological and environmental, taking into account the internal processes of transformation and the system of reflective management.

The transfer of NAC management from the subject-object to the subject-subject position at the methodological level, on the one hand, allows a systematic approach to the problem of sustainable development; on the other hand, it significantly complicates the development and justification of management decisions, as it requires an interdisciplinary approach in the development process and implementing such decisions.

Despite the more complex management mechanisms the vast majority of domestic and foreign scientists, to date, are developing and promoting NAC management tools at the methodological level in the context of a non-classical type of scientific rationality. Such tools include simulation and industry models [14-17]. Such models are developed either for NAC as a whole, or for individual subsystems that are developing within NAC [18-21].

In the context of non-classical type of scientific rationality, the basic mechanisms and technologies for managing NAC in rural territories are communication links and reflective processes. Moreover, it is communications that play the main role in management, which is clearly manifested in the scrupulous attention of the scientific community to the informational component of the management process at all its stages from the development of a managerial decision to its implementation.

The presentation of NACs in the form of active systems forces researchers not only to identify and analyze information flows generated by management entities, which is also characteristic for the classical approach to managing complex systems. The information generated by the natural-anthropogenic complexes themselves as a result of the processes occurring in them, which are directly independent of the control actions of the control subjects, also falls into the zone of special attention.

In NAC as active systems, two main sources of the formation of communicative activity can be distinguished, the presence of which transfers the control object under consideration from an object to a subject position: the first is biological objects and systems, the interacting set of which forms natural-anthropogenic complexes, the second is socio-economic systems and relations, which are an integral part of NAC.

Biological objects and systems, being an active part of NAC, generate their own information flows, which should be taken into account when developing and implementing sound management decisions. Self-development, inherent in all biological objects and systems, is carried out regardless of the presence and vector of managerial influences of subjects on

NAC. The global development program embedded in biological objects and systems can only be slightly adjusted by human exposure to a specific time horizon. As soon as a person's active influence on NAC ceases, a return to the previously established development program or a transition to a new program takes place – it depends on the degree of changes that natural complexes underwent as a result of exposure to anthropogenic factors. In addition, the self-development of biological objects and systems included in NAC inevitably leads to unplanned effects from the managerial influences of subjects, for the forecasting of which simulation models are actively used.

The very possibility of constructing simulation models in relation to NAC indicates that these systems act as active entities and their predicted activity significantly affects management decisions that are developed and implemented by management entities.

An integral part of NAC in rural territories is socio-economic systems and relations, the impact of which forms the anthropogenic component. The most noticeable result of this impact is the emergence and exacerbation of environmental problems associated with the transformation of natural objects and systems included in NAC.

Socio-economic systems and relations developing in a certain territory are the basis for the formation of natural-anthropogenic complexes as such. At the same time, classical management in socio-economic systems based on feedback in principle cannot be effective, since such systems are always in a state of self-development. Even in authoritarian systems built on tight management and control, internal processes inevitably arise and develop that are not controlled by external management influences.

Transition from classical NAC management to management in the context of non-classical scientific rationality is inevitable and is due to the complexity of the management object, which acts as an active self-developing system.

Development of NAC management methodology within the framework of non-classical type of scientific rationality today still has significant potential in the development of justified management decisions in relation to specific situations associated with improving the development efficiency and functioning of their individual components. But, if we talk about a systematic approach to managing NAC in rural areas, taking into account the explosive growth of engineering and technology at the present stage of development and increasing attention to the place and role of a person in the analyzed processes, the described approach to management leads to an understanding of the system of restrictions that are in the context of non-classical type scientific rationality is insurmountable.

The nature and typology of these restrictions are due to the fact that at the present stage of NAC development, they are a self-developing complex that includes humans, technical and technological systems that transform natural objects and systems, the ecological system and the cultural environment in which the value system is formed and implemented, including in relation to a person with his environment and the latest technology. Ultimately, all this creates the need to consider NAC not just as an active system, but as a self-developing polysubjective environment, which can be represented as a human-sized self-developing system [22].

Obviously, the effective management of such a system in the framework of non-classical type of scientific rationality becomes impossible.

C. NAC management in rural areas in the context of post-non-classical type of scientific rationality

The post-non-classical type of scientific rationality at the philosophical level is based on humanistic interpretation of philosophical constructivism, in which a person and his needs act as the starting point for the subject to build the interpretation of the world model [12].

The basic paradigm of the post-non-classical type of scientific rationality is the relation “subject – polysubjective self-developing environment” at the methodological level. NAC also acts as such an environment.

Consideration of NAC management issues in the framework of post-non-classical type of scientific rationality allows you to consciously approach the understanding of influence on management efficiency of the following factors:

- Development and implementation of management decisions in relation to NAC in rural territories is determined at the present stage by value and target orientations of the management subject. It is the management subject, acting as the bearer of certain values that is responsible for the sustainable development of NAC. Today, science and technology offer a significant number of methods and tools to minimize the negative impact of the anthropogenic component on natural objects. In this case, the choice of the model of interaction between man and nature in each specific case remains with the subject and this choice always lies in the plane of value-target orientations.
- NAC management becomes a collective action, since the possibility of mass communication in the modern world leads to the formation of a certain collective subjective estimation, consisting of the opinions, texts, files and relationships of many entities interested in the preservation and development of natural-anthropogenic complexes. Today, in relation to any managerial decision, especially in the sphere of interaction between man and nature, public opinion is formed, which can significantly affect its content. The need for certain issues to pass through the system of public discussion and control in many countries already today is a prerequisite for making managerial decisions regarding NAC. It should be noted that the effectiveness of such an instrument largely depends on the level of development of social relations and the value and target orientations of the subjects.
- NAC is considered as the environment of entities living in this territory and forming a collective subjective opinion regarding proposed and adopted management decisions. It is the formation of a comfortable living environment that acts as a key factor in the development and adoption of managerial decisions regarding NAC. At the same time, the level of comfort is determined by a combination of socio-economic, natural and environmental factors. In addition, the level of comfort is also formed depending on the value and target orientations of the subjects.

- Monitoring of the sustainable development of NACs in rural areas, including their individual components, at the present stage of development of public relations and technological capabilities, is most effectively carried out through the network form of organization of reflective processes. Feedback mechanisms in assessing the effectiveness of NAC management in rural areas are inefficient, since they do not take into account the significant number and variety of processes occurring within NAC. Communications and reflexive processes also cannot cover all aspects of NACs development, since the managing subject is forced to contact a multisubjective self-developing environment, which creates multiple communication channels and a significant variety of opinions and points of view on the analyzed problem. As a result, there is a need to develop and apply fundamentally new control and monitoring mechanisms based on network interaction and collective intelligence [23].

Only the consideration of the indicated problem within the framework of post-non-classical type of scientific rationality allows taking into account all of the above factors when developing a methodology for managing NACs in rural areas.

IV. PRACTICAL SIGNIFICANCE

The research presented in this article is fundamental. Practical significance of the obtained results lies in the fact that within the framework of this study an attempt to substantiate the need to consider the NAC management issue in the context of a non-classical type of scientific rationality was made.

The distinguished factors of NAC management, which are forming at the present stage of development of technologies and public relations, sooner or later will require fundamentally new approaches and management tools. Some countries of Western Europe and certain regions of Russia are already faced with the need to transform approaches to NAC management due to low efficiency of traditional tools. This trend will eventually cover new regions and, ultimately, will inevitably lead to a change in the prevailing paradigm in the field of the nature and man relationship. A new management paradigm is already today being formed in Russia in the context of post-non-classical type of scientific rationality, which can provide new effective tools in setting up self-developing polysubjective environments [12,13,22,23].

V. CONCLUSION

We would like to emphasize once again that the transition to NAC management in rural territories within the framework of post-non-classical type of scientific rationality is becoming relevant at the present time and is still not always applicable in practice, regardless of those conditions (legal, political, economic, social), which occurs during NAC formation and development.

At the same time, it is completely obvious that NAC management within the framework of classical type of scientific rationality has completely exhausted itself and inevitably leads to the complete degradation of NACs and the impossibility of their further socio-economic exploitation.

NAC management within the framework of non-classical type of scientific rationality is currently the main approach

that is implemented at all levels of management in most countries of the world. At the same time, the new characteristics of NAC as management objects, the formation of which is becoming more and more distinct in modern conditions, poses new issues about management subjects that can be adequately solved only within the framework of post-non-classical type of scientific rationality.

Further convergence of technologies, networking of social and economic relations, transformation of value-oriented guidelines and human attitudes towards the environment, as well as aggravation of environmental problems, will inevitably lead to the need of developing and implementing new approaches to the management and sustainable development of NAC in rural areas.

Further research in this area will be aimed at developing a methodology for managing NAC in rural territories within the framework of post-non-classical type of scientific rationality as an answer to new challenges arising due to development of the man and nature relationship.

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