Disadvantages of the classical approach to managing sustainable development of natural-anthropogenic complexes of territories at the methodological level

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Abstract. The article presents the results of research in the field of classical management of sustainable development of natural-anthropogenic complexes of rural areas, formed within the framework of grain production. Within the framework of classical management, the natural-anthropogenic complex is presented in the form of a system that is controlled using feedback mechanisms. Based on the emerging feedbacks, managerial influences are formed, which can be combined into an analytical model based on mathematical relationships between both the generated managerial influences and between their results. In this case, the object of modeling - the natural-anthropogenic complex itself - acts for the subject as a "black box", into which certain resources are supplied to the input, and a certain result is formed at the output. On the one hand, such an approach to the management of natural-anthropogenic complexes makes it possible to build basic mathematical models of management, the use of which in the short term has a positive effect on the technological and economic efficiency of resource use. On the other hand, feedback mechanisms do not allow to ensure sustainable long-term development of natural-anthropogenic complexes, since their high complexity makes it difficult to reliably identify all connections and take into account their systemic impact on the controlled subsystem. This problem manifests itself especially clearly in the process of transition from the management of individual subsystems of natural-anthropogenic complexes to the management of the entire system as a whole.

1. Introduction
Methodological aspects of managing sustainable development of natural and anthropogenic complexes of rural areas are an important element of the general theory of management and, ultimately, form a system of tools and methods with the use of which managerial influences are carried out and the effectiveness of their application is assessed. Sustainable development of rural areas today is in the area of special attention of both Russian and foreign authors.

Natural and anthropogenic complexes of rural areas are complex systems that are projected into different planes, closely interconnected with each other and influenced by external factors. In general terms, the natural-anthropogenic complex (NAC) of any rural territory can be represented in the form of four projections reflecting various functional aspects of the interaction of the NAC with the factors and conditions of the external environment: economic projection - reflects the processes of interaction of subjects of economic relations NAC rural areas, technological projection - represents a set of processes of interaction between means of production and technologies that are used in the
transformation of natural resources in the formation of NAC in rural areas, environmental projection - reflects the environmental issues of the emergence and development of NAC in rural areas, social projection - shows the interaction between entities that are directly involved in production processes, and also live on the territory of the NAC [1]. Depending on the type of scientific rationality, within which the natural-anthropogenic complex of rural areas is considered, the relationship between these subsystems is built on a different methodological and theoretical basis, which is projected onto the methodological level in the form of the corresponding basic models, mechanisms and management technologies [2].

Further, within the framework of this study, the management of sustainable development of rural areas NAC will be considered through the prism of the classical type of scientific rationality within the framework of the subject-object paradigm of management. The importance of this study is due to the search for effective tools and mechanisms for managing the sustainable development of the NAC in rural areas, which are formed in the process of grain production, which is constantly carried out by Russian and foreign scientists within the framework of the concept of reducing the environmental impact of man on nature. These studies are carried out both on an integrated basis, taking into account many factors and emerging synergistic effects [3-8], and in relation to certain aspects of sustainable development, including technological (application of new information technologies to manage sustainable development [9-10]), social [11-12], economic [13-14] and ecological and natural resource aspects [15].

2. Materials and methods
This research is based on the philosophical and methodological analysis of the evolution of ideas about management, presented in the works of V.E. Lepsky [16]. At the methodological level, the natural-anthropogenic complex is considered in the system of subject-object relations and is a subject of management in the form of a complex system projected into the economic, social, technological and ecological plane. Each projection of such a system, on the one hand, is a separate control object, for which it is possible to build an analytical model based on its activity. On the other hand, all projections of the natural-anthropogenic complex are closely related to each other by a feedback mechanism, which allows developing complex management models at the methodological level.

Since the NAC of rural areas is quite diverse and can arise in the framework of various types of human activities, in the framework of this study, the issues of sustainable development management will be considered using the example of natural-anthropogenic complexes arising because of grain production in rural areas of the Omsk region.

3. Results
The grain complex of the Omsk region is represented by 2 million hectares of crops. The annual gross harvest of grain crops in the region is more than 3 million tons. Grain production is carried out in rural areas of all thirty-two districts of the Omsk region, the main grain crop is spring soft wheat.

Natural and anthropogenic complexes that form in the rural areas of the Omsk region as a result of the production of grain crops are complex systems, the elements of which are projected into one of four planes.

The first projection is the technological elements of the NAC, including agricultural technologies of production, varieties of local, Russian and foreign selection, a fertilizer system, a crop protection system, machinery and equipment used in the production of grain crops.

The second projection is the social elements of the NAC, which include the human capital of rural areas where grain crops are produced, the culture of production and common values that unite communities of people living in rural areas. This projection is less obvious than the first, but often has a very serious impact on the formation and management of the NAC.

The third projection is the economic elements of the NAC, which include the main indicators of the economic efficiency of the grain complex of rural areas and directly affect the standard of living of the rural population.
The fourth projection is the environmental elements of the NAC, which inevitably arise due to the transformation of resources within the framework of the organization of grain production.

Obviously, the issues of managing the sustainable development of NAC in rural areas formed because of grain production should cover all of the above projections.

At the methodological level, the classical approach to sustainable development management of the NAC of rural areas formed because of grain production is based on a feedback mechanism. Accordingly, the need for and the level of management influences is determined based on the signals received by the subject of management from the controlled system. Each NAC projection generates its own responses to management influences through a feedback mechanism, which allows you to quickly develop and make management decisions. The peculiarity of the classical management of sustainable development of the NAC in rural areas formed because of grain production is that the feedback mechanism is influenced by the following factors.

The first one is a certain production cycle, on average equal to a calendar year (from winter tillage to harvesting), which allows, within one cycle, to identify a situation requiring managerial influence, develop and implement managerial influence, and evaluate the results obtained. The second is the formation of feedback mechanisms both inside and outside of production processes. The third is the close relationship between the elements of the NAC system, and, therefore, the ambiguity of the identification of subsystems that generate a feedback to management influences.

4. Discussion

Let us consider in more detail the features of the classical management of sustainable development of the NAC of rural areas that are formed because of grain production.

The first feature is associated with a well-defined production cycle, which is equal to the calendar year. On the one hand, this makes it possible to accurately determine the effects of the development and implementation of managerial influences aimed, for example, at transforming the technological or socio-economic component of the NAC. Because of the data obtained, sufficiently accurate analytical models can be built to optimize the cultivated areas, both on the scale of individual agricultural enterprises and on the scale of rural areas, including municipal districts or the region as a whole. On the other hand, in the subsystems of the NAC of rural areas, many processes take place that go beyond the framework of one calendar year both in identifying problems and in measures to solve them. For example, in the technological subsystem, it takes three to five years to implement modern technologies for monitoring grain crops using unmanned aerial vehicles and remote sensing materials. It is not possible to correctly assess the effects of the introduction of this technology within one year. Issues related to the introduction of new varieties also require a longer observation and calculation cycle. The use of foreign varieties in the Omsk region allows in the first year to obtain an excess of yield over local varieties of up to 40%. If we rely only on these data, the introduction of varieties of foreign selection is an effective tool for increasing the technological and economic efficiency of the grain sub-complex. Further observations show that in the next 2-3 years, varieties of foreign breeding lose their advantages in yield, while requiring a very high background for mineral fertilizers and plant protection products. Modern varieties of local selection are drought tolerant and show high resistance to diseases and pests [17]. Accordingly, they are more efficient from a technological point of view for NAC in rural areas of the Omsk region.

The second feature of the sustainable development management of the NAC in rural areas, which are formed because of grain production, is associated with the fact that, first, the subjects of management pay their attention to feedbacks formed within the framework of production and technological processes. This is quite logical, since it is here that the most obvious points of application of managerial influences lie, which make it possible to manage NAC in rural areas. Can the culture of production and the attitude of local communities of people living in rural areas to the production process have a significant impact on the sustainable development of rural areas? Directly - it cannot, but the formation of common values and industrial culture can have serious strategic consequences for the sustainable development of NAC. For example, a shift to organic agriculture in
the short term may reduce the economic efficiency of grain production, as it will take time to introduce varieties for organic farming and restructure the existing farming model in the area. In the Omsk Region, there are varieties of grain crops of local selection, the use of which minimizes the use of mineral fertilizers and plant protection products from diseases and pests (the reduction in comparison with traditional varieties is from 60% to 100%). At the same time, the gross harvest of cereals remains at the same level as compared to traditional varieties. The reduction in the level of environmental impact is obvious here, but the implementation of such a model requires a high culture of production, since organic farming does not forgive violations of production technology. Accordingly, additional investments are required in personnel training and technological equipment. Given that there is no system for the distribution of organic products in the region, agricultural producers who decide to follow this path run the risk of not getting the required economic efficiency of grain production. If, when developing and justifying management decisions, rely only on the feedback mechanism formed within the framework of production processes and do not take into account the long-term requests of rural communities for greening production and obtaining organic agricultural products, the sustainability of the NAC of rural areas formed as a result of grain production in the long term period decreases.

The third feature of the classical management of sustainable development of NAC in rural areas is manifested in the fact that feedbacks are formed not only within individual subsystems of natural-anthropogenic complexes, but also between subsystems. This requires the application of an interdisciplinary approach to management, which is characteristic of the non-classical type of scientific rationality. For example, a significant deterioration of the ecological state of rural areas where grain crops are produced due to the need to use high doses of mineral fertilizers and plant protection products requires the development and adoption of appropriate management decisions. Which NAC subsystem should these decisions be directed to? The first obvious answer is to the technological one in the form of the introduction of new resistant varieties, effective fertilizers and animal protection products that reduce the environmental load. A less obvious answer is to the economic subsystem in the form of adjusting key indicators of economic efficiency in favor of reducing the intensity of land use. For example, the withdrawal of part of the land from economic circulation for a long period for self-recovery. Another tool for solving the problem that has arisen can be a gradual transformation of the existing technical and economic model of the NAC from a production model to a service delivery model, for example, the development of agritourism. However, this requires a certain request from the population living in rural areas, since such a transformation requires the readiness of the population for the alternative development of their territories [18-20].

5. Conclusion
The management of the sustainable development of the NAC of rural areas formed as a result of the production of grain crops, within the framework of the classical type of scientific rationality at the methodological level, makes it possible to form a system of analytical models that can be used to develop operational and tactical management decisions.

A significant drawback of such models is that individual subsystems and the entire HSS are presented as a closed system, from which the necessary information is taken at the input and output. At the same time, the feedback formation mechanism and issues of its improvement go beyond the framework of classical management. This situation is objective within the framework of managing complex systems in the paradigm of subject-object relationships and clearly demonstrates the need to consider issues of managing NAC in rural areas from the perspective of subject-subject relations within the framework of a non-classical type of scientific rationality.

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References

[1] Nardin D S and Nardina S A 2020 Sustainable development management of natural-anthropogenic complexes of rural territories. *Journal of Advanced Research in Dynamical and Control Systems* **12**(3) 1447–1452

[2] Stepin V 2009 Self-developing systems and philosophy of synergetics. *Economic strategies* **7** 24-35

[3] Ovchinnikova N 2020 Analysis of sustainable development of rural areas in Russia: Results challenges and solutions. *E3S Web of Conferences* **210** 14002

[4] Diuldin M, Bykova N, Zhuchenko A, Cheremisin A and Switala F 2020 Sustainable development of rural areas Russian issues. *IOP Conference Series: Earth and Environmental Science* **578**(1) 012005

[5] Diaz-Sarachaga J M 2020 Combining participatory processes and sustainable development goals to revitalize a rural area in Cantabria (Spain). *Land* **9**(11) 412 1-29

[6] Voronkova O Y and Kovaleva I V 2020 The Sustainable Socio-Economic Development of Rural Areas in Terms of Development of Organic Farming. *IOP Conference Series: Materials Science and Engineering* **753**(8) 082016

[7] Stovba E, Lukyanova M, Stovba A and Kolonskiih N 2020 Foreign Experience in the Development of Strategic Planning Theory and Practice of Sustainable Development in Rural Areas on the Foresight Technologies Basis. *IOP Conference Series: Materials Science and Engineering* **753**(8) 072007

[8] Semin A, Bukhtiyarova T and Stovba E 2020 The Use of Cluster and Foresight Technologies in the Design of Strategies for Sustainable Development of Rural Areas of the Region. *IOP Conference Series: Materials Science and Engineering* **753**(8) 082007

[9] Zhang X and Zhang Z 2020 How do smart villages become a way to achieve sustainable development in rural areas? Smart village planning and practices in China. *Sustainability (Switzerland)* **12**(24) 105101-20

[10] Adamowicz M and Zwolinska-Ligaj M 2020 The "smart village" as away to achieve sustainable development in Rural Areas of Poland. *Sustainability (Switzerland)* **12**(16) 6503

[11] Allanina L M, Smirnova E A, Kalafatov E A, Shadskaja I G and Shirokovskikh S A 2020 Sustainable development of rural areas: Increasing employment in the context of digital technologies development. *Journal of Advanced Research in Dynamical and Control Systems* **12**(4) 1069-1076

[12] Ristic L, Vujicic M and Radevic B 2019 Poverty reduction as a factor of sustainable development of rural areas in the Republic of Serbia. *Fresenius Environmental Bulletin* **28**(9) 6998-7005

[13] Ternovykh E V and Durova L V 2019 Establishment of the differentiated economic mechanism of company bankruptcy prevention as a basic element of sustainable development of rural areas. *IOP Conference Series: Earth and Environmental Science* **341**(1) 012218

[14] Battino S and Lampreu S 2019 The role of the sharing economy for a sustainable and innovative development of rural areas: A case study in Sardinia (Italy). *Sustainability (Switzerland)* **11**(11) 3004

[15] Stovba E V and Kolonskikh N E 2019 Natural and resource capacity as a basis for sustainable development of rural areas in the Non-humus zone in the Republic of Bashkortostan. *IOP Conference Series: Earth and Environmental Science* **274**(1) 012136

[16] Lepsky B E 2012 Reflexive aspects in the evolution of ideas about management International scientific-practical interdisciplinary journal. *Reflexive processes and management* **1-2**(12) 26-55

[17] Nardin D S, Krasnova Y S, Nardina S A, Mozzherina T G and Aleshchenko V V 2016 Prospects of import substitution of seminal wheat in the russian federation by breeds of local selection. *International Journal of Economic Research* **13**(6) 2453–2463

[18] Epuran G, Tescasu I B, Tecau A-S, Ivasciu I-S and Candrea A-N 2021 Permaculture and
downshifting-sources of sustainable tourism development in rural areas. *Sustainability (Switzerland)* **13**(1)230 1-19

[19] Ayu Saraswati Bhakti B and Iskandar K 2020 Cultural and tourism attraction in workaway projects as a sustainable agriculture development attempt in rural area: A case study of a Workaway Project in Yufuin. *E3S Web of Conferences* **211** 01030

[20] Shi L-Z, Li X-D, Cao R-F, Lei M-M and Zhang X-L 2020 Research on Sports Tourism Promoting Sustainable Development of Coastal Rural Areas Based on Fuzzy Fault Tree. *IOP Conference Series: Earth and Environmental Science* **546**(3) 032002