Sustainable Development of Rural Settlement in Modern Russia: the Systematic Approach and the Theory of Centers

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Abstract: Based on an analysis of developments on the issues about sustainable development of rural settlement system, the author uncovers two significant oversights within the research discourse: firstly, the disregard for the internal organization of rural settlements, often lacking a real centre (quasi-centre); and secondly, the underestimation of individual or local initial subsystems potential within rural settlement system, operating in relative isolation from other components. By addressing these lacunae, we could not only enrich the scientific comprehension of rural settlements, but it also facilitates the formulation of recommendations for territorial planning. An important role is played by the conscious organization of trajectories and communications of residents inside and outside the settlement, since the settlement system is not a mechanical aggregate. elements, but exists due to active connections between them. Such activities serve to mitigate the risk of rural area desertification, thereby averting disruptions within the settlement system. Importantly, the insights gleaned from the Russian experience hold relevance for numerous countries grappling with accelerated urbanization trends and trying to sustainable development of the entire territory in contemporary times.

1 INTRODUCTION

Despite numerous management measures, the rural settlement system of the Russian Federation persists in a unsustainable condition. A significant downturn was particularly evident in the 1960s, attributed to shifting demographic behavior (Cárdenas 2017) characterized by increased life expectancy and dwindling birth rates. During the reform period of the 1990–2000s. the smallest and largest rural settlements turned out to be more stable (+5.3% and -1.0%, respectively). True, the positive indicators of the network of settlements that had over 1000 inhabitants (the number and number of residents changed by 1% and 10.3%, respectively) is due to the fact that in approximately 70% of cases this happened due to the transformation of urban settlements into rural ones. The total number of medium-sized settlements decreased by 2 thousand, or 15.5%. “If we take into account that populated areas of average size are the basis of rural settlement, then the widespread decrease in their number on the territory of European Russia leads to a disruption of the framework of rural settlement,” experts warn (Chugunova 2023). Strengthening sustainability necessitates the exploration of novel methodologies or, as in our context, a more deeply working with existing research methodologies.

The balance of the settlement system is the most important condition for its sustainability. Experts have observed that the agricultural sector's economic upturn, witnessed from the onset of the 1990s to the early 2000s, yielded minimal impact on alleviating the social challenges pervading rural locales, thereby perpetuating rural-urban migration dynamics (Ioffe 2006). Consequently, endeavors aimed at ameliorating the prevailing predicament demand meticulous deliberation and strategic clarity.

The foregoing determines the purpose of the article: to show possible ways to strengthen the sustainability of the rural settlement system of

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modern Russia using system-genetic and system-structural analysis.

2 METHODOLOGY

The definition of a settlement system as a scientific concept is controversial; many positions are given in (Yurkova 2021). We dwell on the fact that this is "a group of territorially close and *functionally connected* settlements" and communications between them. Without taking them into account it is impossible to talk about any "continuum" (A.I. Treivish) or the development synchronicity of settlement and transport networks. The nearest to our position version underlines an interaction as a force for system: this term "suggests that the interactions between places, on the one hand, and, on the other, between the individuals who live in them and their environments constitute a driving force in the evolution of these systems, and notably in the transformations of the related spatial patterns" (Sanders 2021, Chapter 2). But such interpretation is not very widespread, since it requires additional research efforts to take into account the dynamics of systems.

The methodology for studying settlement systems, including rural ones, is currently being developed by A.I. Alekseev, E.A. Antipova, R. V. Keating, A.V. Levchenkov, M.G. Rumyantseva, A. Zavodnik. Since the topic is closely related to the climatic, geographical and economic realities of each individual region and country (Bogglia 2014), we rely mainly on sources from Russian authors. Large-scale scientific reviews are especially useful for studying specific issues, such as in the book by A.I. Alekseev (Alekseev 1990). They make it possible to compare data with modern period and to fit more specific issues into a broad historical and socio-economic context, to isolate the main and secondary issues in local settlement systems.

The literature on settlement systems, depending on the original specialty of a particular author, includes different approaches that we identified earlier (Bystrova 2022): geographical (D.N. Lukhmanov, N.V. Chugunova, Qin Y), historical (R. Drennan, M.J. Haller, L. Sanders with co-authors), mathematical (Yu.R. Arkhipov, F. Bogglia at all.), urban planning (G.V. Mazaev, A.G. Mazaev), economic (E.I. Animitsa, A.I. Treivish), economic-managerial (R. Akchamov), sociological (T.I. Zaslavskaya), demographic (V.V. Patziorkovsky). It seems that specialists from other countries and regions also have a similar specialization, with a general movement towards interdisciplinary methods of study. The connection between the sustainability of the rural settlement system and actions that take into account traditional forms of territory development as much as possible is well shown in (Mouraz 2023), (Nguen 2019), others.

At the same time, one cannot but agree that insufficient attention has been paid to the comprehensive study of rural areas in Russian science: individual aspects have been worked out in depth, and attempts to study rural areas as an integral object are sporadic. The same thing is observed in other countries (Ambrosio-Albalá 2010), (Dwijendra 2021). While studying socio-economic aspects in detail, scientists and practitioners in vain unjustifiably ignore the natural component of the rural settlement system as an important factor in planning and lifestyle. So far, the connection between the rural settlement system and natural conditions has been studied in more detail in the Kaliningrad (A.V. Levchenkov) and Orenburg (I.V. Osipova) regions, as well as Udmurtia (A.L. Lekomtsev).

It is impossible to imagine the processes of rural settlement in the fullness of their connections with the processes of urbanization analyzed in the works of V.L. Glazychev, L.N. Mazur, T. Kümmel, etc. Attempts to connect at the theoretical level the study of the Russian settlement system in the context of issues of strengthening sustainability. Here we name the works of M. Ambrosio-Albala, Yu.A. Arkhipov, E.V. Gorbenkova, P.N. Davidenko, E. Pisani, V.I. Tikhoy and others.

In accordance with the stated approach, we understand the settlement system not only as a "group" of connected settlements, we take into account the essence, intensity and scale of connections and communications between them, both in synchronic and in diachronic aspects. The research program includes references to the theory of centers (Ch. Alexander, N. Salingaros) and central places (W. Kristaller), which allows one to explain the current state of a particular rural area (development or degradation) by the presence or absence of centers and connections between elements (communications). The potential of both approaches is not fully realized today, since the concept of "system" is often used in documents purely nominatively, without taking into account its conceptual depth, and the word "center" is associated only with a position in space. Because of this, "blind spots" arise in the study of processes in rural areas, since: a) not all levels of the settlement hierarchy have been studied and taken into account in management actions; b) external and internal structural

connections of elements of rural settlement are considered in isolation from each other, preventing a holistic view.

The peculiarity of the system methodology is to focus on the integrity of the object and the factors that determine it. It allows to identify all the diversity and complexity of connections inherent in an object and present them in real unity. The systems approach does not exist in the form of a strict methodological concept: it performs its heuristic functions, remaining not very strictly bound by a set of cognitive principles, the main meaning of which is the appropriate orientation of specific studies. Finally, the systems approach initially involves not only research, but also the development of a design strategy, which can be carried out at the next stage of work taking into account the developments already made (Shcherbina 2018).

If we use the methodological capabilities of these approaches to the fullest, two interrelated parts of the article naturally arise: analysis of systems (or, more precisely, subsystems) of rural settlement, weakly or minimally connected with other levels of the hierarchy, but having their own logic of organization with which you can work for their conservation or even development; analysis of the internal structure of rural settlements, ensuring their real inclusion in the life processes of larger-scale systems. The problem posed is interdisciplinary, therefore, on the one hand, in the course of the study it is necessary to rely on data from different branches of science, on the other hand, to follow professional town planning and urbanistic discourses, taking into account the specifics of the landscape and the presence of humans in it (Aydin Turk 2017), (Korandei 2021).

To address the topic, the multi-scale study of the subject at different levels of the hierarchy (macro-, meso-, micro-level of rural territory; respectively, federal, regional, municipal, level of individual settlements) and in different aspects (urban planning, economic-geographical, climatic-geographical, socio-cultural) is essential. Along with taking into account the current administrative boundaries of cities, regions, and other territories, we try to take into account historical versions of settlement. The geography of a place and the associated dominant (or determining) socio-economic structure give rise to no less common features in rural settlement systems of different regions than universal socio-political attitudes or socio-economic measures. Knowledge of the processes in their entirety enriches the scientific model of settlement.

3 DISCUSSION

3.1 The uniqueness of rural settlement systems

Unlike the urban settlement system, rural settlement in modern Russian regions is not homogeneous, but consists of a large number of separate local and often unrelated structures, mainly of a linear type.

We initiate from the thesis about the impossibility, or at least ineffectiveness, of studying rural settlement systems by analogy with urban settlement or exclusively in inextricable unity with it. Despite the fact that urbanization changes a lot in the boundaries between city and countryside, it is on the scale of settlement systems that the difference is quite significant (Bystrova 2022). The two types of settlement did not arise simultaneously; initially, a system of rural settlement emerged. Being earlier, it is closely connected with the landscape. The unit of rural settlements was and often remains a “house” or, more often, a “yard” with a whole set of outbuildings; The communal nature of rural life almost does not extend to the structure of the settlement.

The urban settlement system, which gradually evolved within the rural framework, stemmed from its essence and facilitated its own expansion and structural development, thereby broadening the array of potential technological infrastructures within it. It transitioned into complex hierarchical systems, wherein a hierarchy of settlement system elements materialized, giving rise to cores of varying levels, including predominant cores accommodating up to 50% or more of the population. These cores catalyzed the formation of agglomerations, delineating the framework of a settlement system that spanned the entirety of Russia's National Settlement System. Presently, different segments of the urban settlement system are in various stages of development, yet interconnected as a cohesive unit, exhibiting distinct trajectories for future growth, which can be scrutinized and considered by specialists in forecasting and modelling.

Conversely, the rural settlement system, owing to its initial strong ties with natural elements and inclination towards stability, saw minimal development and remained at a rudimentary organizational level. The limited stratification levels preclude the formulation of a unified system model. Despite its expansive geographical coverage, such as within the Russian Federation, it exists as numerous discrete territorial entities, lacking a cohesive structure not only at the national level but also within individual regions.

The classical Russian village is connected with the landscape and natural rhythms; therefore, it has a free layout, far from regularity, the patterns of which are largely determined by the terrain, and perimeter development “around lakes, ponds, ... sources” (E.N. Bubnov). It is difficult to study, and therefore to manage its processes. The situation is aggravated by the classification as rural settlements, which in fact are not rural, but are only located outside the cities and have a small size and number of inhabitants. The settlements of logging workers or railway workers (serving, for example, a semi-abandoned narrow-gauge railway), roadside settlements stretching in a narrow strip along the highway, or settlements of summer residents do not produce agricultural products as the main one. Their choice of place of residence and its logic are not dictated by rural factors themselves, often being based on an external administrative imperative or developing spontaneously. Accordingly, the universal laws of the rural settlement system do not apply to them.

For example, the rural settlements of the Urals have tended towards instability since the 17th century: among the Bashkir population this is caused by the desire to follow cattle; among miners of metal or stone – by searching for new sources of raw materials, etc. Settlements determined by external determinants, by definition, do not have sufficient resources for development and are doomed, unless in the process of existence, especially in new historical conditions, in the settlement itself there will be an initiator or reason - a new craft (ceramics, leather, metal processing, etc.), occupation (growing berry crops, breeding, animal husbandry).

Not any conglomerate of settlements can be considered a system, but only one that is distinguished by integrity, self-organization, the presence of a hierarchical structure, uniform distribution of elements, and irreducibility to the sum of the properties of the elements that make up the system (Enin 2016, 194). The existence of a system cannot be stated: it must be proven by turning these characteristics into criteria for assessing a particular settlement structure.

The reason for repeated unsuccessful definitions and classifications is due to the fact that rural settlement does not form an integrated system as a whole, similar to urban settlement. This is a special type of settlement, consisting of many local formations and “subsystems”, mostly of a linear type, not connected even at close distances, and does not have its own designated centers and, especially, the predominant center of the entire system. The framework of all elements of the system is “external”, developing in addition to the elements of rural settlement. It is represented mainly by municipal and regional roads. This diffuse and discrete settlement has a certain degree of connectivity, but does not form higher organized levels of hierarchy. The stability of such a loosely coupled entity is always in question (Boggia 2014).

Accordingly, management decisions to “enlarge” separate rural settlements and subsystems simplify (rather than complicate) the structure, reducing its already low sustainability.

3.2 Local subsystems of rural settlement: potential for self-organization

In this section, the discussion revolves around the thesis that, due to their initial logic, verified by many generations, local subsystems of rural settlement are capable of developing from within themselves, if their structure is not deformed by actions that are not inherent in them initially. For as overcoming disintegration (Ioffe 2006) as proposals for the sustainable development of rural settlement systems of different scales, it is necessary to follow their own intentions.

3.2.1 Underestimation of the initial organization “rightness” of a rural settlement

Undetected by experts, we label overlooked segments of rural settlements as "blind spots," a phenomenon influenced by various institutional factors.

In a real village, external and internal processes flow into each other, whereas in planning actions or management decisions they are often isolated from each other. This is most clearly noticeable in relation to individual small subsystems, tightly connected within themselves and even among themselves, but without access to other parts in a higher level of scale. The same applies to the officially called administrative and planning centers of settlements, which do not perform the functions of a center in the architectural and urban planning sense of the word, that is, they do not contribute to development and are not the intersection point of many communications and trajectories. According to experts, centers are not just physical focal points, but are deeply intertwined with human perception and experience. In particular, N.A. Salingaros argues that well-designed centers evoke a sense of coherence, harmony and connection

within architectural spaces, promoting human activity and social interaction (Salingaros 2006), (A New Pattern... 2020). The opposite is also true: we regard spaces of social interaction as centers. This assessment is not always achieved by simply having a number of required administrative buildings. If they are located among monotonous, homogeneous spaces or form homogeneity, then such an environment contributes to a feeling of desolation and ownerlessness, uncharacteristic of the mentality of rural residents. Oddly enough, for a long time experts did not consider the structure of rural settlements and settlement systems to be factors in strengthening sustainability (Boggia 2014, 161).

Historically, the village had a nonlinear organization, in particular, circular or cumulus, moreover, with a large number of external and internal (natural, pedestrian, transport and other) connections (Mazur 2003, 140-171). It was included in the local subsystems of settlements and often performed an intermediary function in their interaction. Together with the communal way of life of connections, this gave rise to a hierarchy and self-organization of connections, in which, along with the main center of the settlement, there were several centers of a smaller scale. Today, under the influence of external factors, this complexity has been destroyed or is being destroyed.

Speaking about the reduction in the rural population and the degradation of the economic complex of the Russian Non-Black Earth Region in the 2010s in territorial cells of various hierarchical levels, K.V. Averkieva notes that "along with the center-peripheral contrasts, territorial differentiation remains, due to landscape factors and the characteristics of local settlement systems" (Averkieva 2012, 8). However, in management decisions this differentiation is not taken into account; numerous decisions on consolidation, justified from an economic point of view, essentially do not take into account the external and internal organizational complexity of rural settlement systems.

At the same time, such local rural settlement is, as it were, "withdrawn" from general economic processes: for example, when studying disproportions in regional development, speaking about more competitive industrial regions, the authors do not mention their rural component at all (Mironova 2011, 23-34). But it exists, has a natural quality of self-organization for living systems, which is important for stability, as well as a number of other characteristics.

Thus, in rural settlements at a distance from large Russian cities, linear structures of various planning forms can be distinguished. The most common (typical) are linear structures formed by linear objects – rivers and roads. This confirms the analysis of the settlement networks of the Tyumen region, according to which it is the rivers that play the main role in the formation of the network, while the administrative division may not be taken into account by it at all. We see the same on the territory of the Sverdlovsk region (Fig. 1). We see a fairly dense, fractally organized system that takes into account the initial characteristics of the landscape and the river. In addition to paths or grader roads, the river is also a transport connection. It is not too wide, along with steep cliffs, there are places where a boat can land. Their parameters largely coincide with the viable settlement systems identified by historians in different regions with distances of up to 25 km between settlements (though with their own crafts as a basis for centralization) (Drennan 2007, 79). Let us note that in order to move to a higher level of scale, such subsystems lack not only roads (external factor), but also population (internal connections).

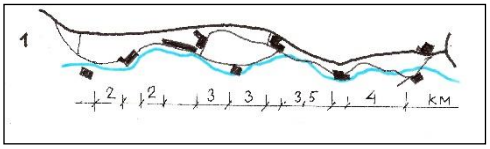

Figure 1: 18 km local linear rural system in the Alapaevsky district of the Sverdlovsk region in Russia: (from left to right) Vogulka, Yaroslavskoye, Kostroma, Vetlugina, Klevakino, Kochneva, Sokhareva, Kuzino, Kostino along the Rezh River. Author: G. V. Mazaev. 2022.

These subsystems have internal connectivity that is not related to the next levels of the hierarchy, for example, regional or federal roads (Wegren 2008). Although the dates of their origin are overwhelmingly not reported in documents and other sources, it can be assumed that they arose in an earlier period and persist to this day, despite the decline in population.

Complicated planning systems are formed by several linear systems. Thus, the layout in the area of the city of Rezh in the Sverdlovsk region of Russia developed in the absence of a clearly defined linear-forming natural element. The main linear system consists of four settlements. Adjacent to it is a smaller system of two elements. The largest population center of the main system becomes the center of a small beam system of two beams. That is, the original linear systems are not static, but are capable of development with the complication of their overall planning structure. Rural settlement acquires the most complex planning forms in the largest agglomeration cities.

Isolating rural settlement systems at different levels with an understanding of their specifics and potential relationships with each other can and should influence the policy in the field of rural-urban settlement, moving away from unification towards a greater variety of planning, architectural, and social solutions. The main attention must be paid to roads and transport communications; local systems are often ruined by their location in a dead end, especially in settlements on the administrative borders of a region or even districts. For example, the village Rastress, built on the famous ancient Babinovskaya road, was one of the largest in the Sverdlovsk region. Later, when the road network changed, all the inhabitants left it.

In recent decades, instead of improving its inherent forms of organization, the task of transforming the rural settlement system into an urban one has been constantly set, primarily through consolidation. Attention to local subsystems shows the unnecessary and even harmful nature of such consolidation. What is convenient in administrative and economic terms is unacceptable from the point of view of urban planning.

It is also necessary to change the research position towards greater flexibility and variability. To increase the sustainability of ecosystems, the designed structure of the territory must be more developed, diverse and more complexly organized than the original one. In urban planning, it is necessary to introduce a concept implying a transition from an industrial agricultural landscape (disproportionate to the natural structure of the area and people) to a biosphere-compatible one (polyzonal, mosaic and polymorphic). What hinders this is that the issues of assessing traditional forms of settlement, understanding their historical and cultural value, and the need for protection by local specialists are not raised at all, although international organizations are already talking about this, as well as specialists in regions with historical background (Wang 2023, 1399). An important criterion for the high assessment of rural settlements is the continuity of the vernacular tradition in their architecture, but the potential and wisdom of vernacular objects and historical settlement patterns are underestimated, and need a special researches (Dwijendra 2021).

3.2.2 Real centers of rural settlements: development potential

Design and practical work with the theory of centers is necessary because in rural settlements today it is possible to record such phenomena as:

- loss of the center, in which the planning structure would coincide with the value-semantic content, or its replacement by a quasi-center (1-2 shops in buildings from the 1970s–2010s) – in 93% of those studied by the author during field expeditions 2022–23s of rural settlements in the Sverdlovsk region in Russia, including those, which are not roadside, but located "in the depths" of the settlement subsystem;
- the emergence of more significant areas for the life of the settlement on its periphery, the inversion of the rural settlement structure;
- loss of status by traditional objects that marked the center (school, monument to soldiers, temple, etc.);
- loss of the integrity of the settlement, which mechanically combines different types of settlement – urban and rural.

V. Kristaller's theory of centers is not extended by specialists to the internal structure of rural settlements. And vice versa, the attitude of specialists based on the ideas of "new urbanism" when developing connections at the lower levels of the hierarchy – between parts or residents – does not reach the meso- and macro-level. In the most favorable situation in real life, a larger-scale center organizes the system so that smaller centers appear in it to support it. For example, public space in the physical center of a village is supported by more local areas within blocks or streets where people are more often to meet.

Thus, located away from the Irbit – Artemovsky highway, the village of Shogrinskoye (former volost village, now Artemovsky district, Sverdlovsk region, about 730 inhabitants according to the 2010 census) provides an example when a restored church, a cultural center and a monument to soldiers standing on one axis, separated from the main routes of movement of residents to the school and kindergarten. Having been founded in 1662, it now suffers from a discrepancy between the original and modern structures. The formal and even semantic center is not associated with the maximum movement and communication of residents. The administration building, despite the significance of its functions, is not surrounded by additional points of attraction and is separated from the rest of the settlement.

As a result, it turns out that points that are "central" in terms of planning and administration do not perform the functions of a center. In many cases, this situation is provoked by the arbitrary transfer of the official center from the original historical one, which can be identified by the church. In turn, the objects in this "center" have partially lost their original meaning. A school or club in only a few

villages retains the status of cultural centers; more often there are not many people around them or not at all.

Fences introduced by townspeople significantly destroy the patterns and the hierarchical organization of connections inside and outside the rural settlement. The structure becomes discrete, more one-dimensional, primitive. is accompanied by the appearance of more significant points for the life of the settlement on its periphery. A store, service station, mini-market may be located on the edge, for example, closer to the road. At first glance, there is nothing special about this, but no one takes into account the spatial and value inversion of the rural settlement structure – the important is on the outskirts or to the side, but not in what is called the "center". These phenomena lead to the loss of the original integrity of the rural settlement. It is with them that you need to work, strengthening its stability. Taking into account real communications and movements, eliminating obstacles, and creating points of attraction are the tools of urbanists, which can easily be transferred from cities to elements of rural settlement.

4 CONCLUSIONS

The rural settlement subsystem differs in its properties from the urban one: being much larger in the number of elements, it has a simple type of spatial organization. The level of its stratification is also low, which does not allow the development of level models for constructing a rural settlement system. Being inextricably linked with land as a means of production, it is inert in its development possibilities and can only develop extensively. The very construction of the rural settlement system does not create opportunities for the development of its generalized theoretical models, which leads to the weakness and underdevelopment of the methodological base of the study and explains the "statistical" and abstract-typological options for studying. We could add, that the reduction of small and tiny rural settlements occurs in the 2000s. not only in Russia (Antipova 2012, 132), but it does not follow from this that administrative measures for consolidation will make rural settlement subsystems more stable.

We strive to record the diversity of types of rural settlement and its components with maximum consideration of history, landscape, and economy. However, we are forced to admit that this area of knowledge does not yet have appropriate scientific models, including due to the limited current empirical material and its asymmetry towards quantitative data.

The ideas of consolidation implemented in different periods lead either to the complete destruction and practical disappearance of rural settlements, or to the creation of an ineffective system that does not have an economic basis for existence. The search for new ways and mechanisms that are more adequate to modern realities is impossible without taking into account the uniqueness of individual settlements and their context, which enhances their sustainability.

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