

Network Modeling of Settlements' Interaction for Sustainable Development of Remote Territories

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Abstract:

The indigenous peoples of the world continue to face serious challenges. These problems write into the context of Global indicator framework for the Sustainable Development Goals. Nevertheless, in practice, Indigenous peoples in various countries face ongoing and new challenges and risks. At the same time, it is important that the Sustainable Development Goals must be implemented at the local level, which demands carefully formulated comprehensive programs for the development of territories inhabited by Indigenous peoples, both southern and northern latitudes. [6].

Significant parts of Russian Arctic, Siberia and Far Eastern regions are sparsely populated areas, which are interconnected with the rest of the world through poor transportation arteries (infrastructures, corridors, gates). It is notable that remoteness, as a rule, concurs with tough climatic conditions and natural disasters episodes that indigenous people must face, such as long severe winter, earthquakes, avalanches, floods, etc. In this regard, it seems important to perform interdisciplinary works that reveals the problems and their solutions for the socio-economic and environmental systems of such remote areas.

The interdisciplinary science of networks occupies a special place among the newest scientific directions [1-5]. Experts believe that in any complex system, from objects and its processes, a network description can be given (ontology), with network models and network metrics. Meanwhile, the real structured and unstructured data of the system provides a network interpretation and its transformation into complex networks is carried out. This concept provides that in the network space for remote territories inhabited by indigenous ethnic groups, elements, groups and communities of not only the same, but also different nature is coordinated, thereby creating a topological basis for supporting its stability and security.

Network analysis is one of the most effective tools for understanding regularity, evolution and consequences in the study of complex systems. The author's idea is that, unlike the well-known approaches of separate disciplinary security, the security of a separate level of organization and management (personal, corporate, departmental and national) offers the development of new ontologies, models and realistic scenarios of key processes that take into account interests and contradictions. Those scenarios coordinate actions of multiple actors in remote territories and join new network indicators of sustainability and security for both, indigenous individuals and communities.

In this paper, the methodology of network modeling of the interaction of Arctic settlements of Yakutia, one of the largest regions of Russia, will be given. The settlements under study are geographically separated by considerable distances from each other (average 200 km), are located in different administrative and territorial districts, cultural and linguistic areas (the Yakut, Dolgan, Evenk, Even, Yukagir), landscapes (tundra and taiga), but this does not become a barrier to communication between residents of these settlements. Network interaction embedded in any social system, in this case indigenous societies, has a regularity. The author believes that the mechanism of network interaction can be considered in the context of information technology and mathematical support, contributing to the sustainable development of the northern territories.

Modern network interaction can act as a means of solving the tasks assigned to all state and social management stakeholders. A network model of social interaction of settlement residents was developed to identify complex interdependent socio-economic and ethno-cultural processes in the studied territory, characterized by remoteness, and the predominant indigenous population. The nodes of the network are settlements, oriented connections define aggregated relationships stratified by occupation between settlement nodes. Evaluation of parameters of the entire network and its individual thematic layers include such metrics: number of nodes in a network, Number of links, average degree of a node, network diameter, density, number of connected components, modularity, average clustering coefficient, average path length.

With the help of the developed model, the analysis of network interaction was tested on the example of the Arctic settlements of Yakutia. Directed graphs were constructed depicting the relations between settlements, allowing us to study their interactions. The values of the centrality of settlement nodes were normalized by 1. The Author identified, for studied territories, the following types of interaction: family relation, purchase of consumer goods and food, cultural interactions, employment, traditional exchange, buying fuel.

This work is aimed at creating a platform for assessing the optimal ways of managing the territory with the selection of appropriate projects for its development. Geographical details, accompanying multifaceted interviews that clarify the needs of residents, and network models contribute to further understanding of the prospects for territorial sustainability development. The creation of a network model allows to identify new metrics, determine future indicators, and assess sustainable development of remote territories.

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