

Development of Meta-Geosystems of Tourist and Recreational Clusters

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Abstract. The study aims to find a key to the problem of managing cultural heritage systems in the example of the Temnikov-Sanaksar cluster located in Eastern Europe. This area is situated between the forest-steppe of the layered-tier Volga upland and the forest geosystems of the layered Oka-Don lowland. The article applies an interdisciplinary approach to solving the problem of optimizing inter-component relationships in the meta-geosystems of tourist and recreational clusters. The sustainable development of meta-geosystems should be based on multifactorial information support, which implements the most important condition for the effective economic development of landscapes through the formation of the regions' spatial data infrastructure. In order to consistently optimize meta-geosystems of different hierarchical levels, it is necessary to solve several emerging issues, such as assessing the strength and nature of inter-component connections in geosystems, determination of factors describing the territorial variation of the properties of geosystems, interpreting and substantiation the semantics of the selected basic factors.

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1. Introduction

The modern world is being transformed into a single global system, which is manifested in the formation of a single international economic, legal, and cultural space (Ringer, 2013). Scientific and practical activities in the field of conservation of natural and cultural heritage show that sustainable development planning of the regions' economic development processes minimize the manifestation of environmental problems (Kazakov, 2019). Moreover, it forecasts that the development of anthropogenic and natural emergencies should be focused on a deep analysis of the spatial and temporal structure of cultural landscapes (Dunets, 2019).

The foregoing shows that the following principles of the study of meta-geosystems can be distinguished as starting points: genetic, historical, systemic, and managerial (Gordon, 2018; Vos, 1999). Genetic and historical principles determine the search for patterns of functioning, dynamics, and development of meta-geosystems. This approach follows from the chronological paradigm, which is firmly embedded in the methodology of geographical research and involves the combined study of all aspects of changing cultural landscapes, taking into account the relationship of factors that determine the features of the spatio-temporal organization of meta-

geosystems under conditions of spontaneous and technogenic change (Miklós et al., 2019; Yamashkin, 2020). The principle of consistency makes it possible to present the objects under study as integral spatio-temporal formations, the functioning of which is ensured by the flows of matter, energy, and information between individual elements, subsystems, and the external environment (Van Ree et al., 2017; Voda et al., 2019). The principle of manageability is implemented through the development and implementation of projects to enhance the progressions of landscapes development while preserving natural and cultural heritage (Hall, 2002). It lays the foundation for the conscious spatial organization of the cultural landscape.

In an integrated approach to the effective synthesis and evaluation of the spatio-temporal organization of ecological, and socio-economic systems, the similarities and differences should provide for the integration of geographical, archaeological, historical, ethnographic, and other information resources. In the studies of meta-geosystems of cultural landscapes, a range of interrelated approaches is distinguished that determine the formation of digital map systems and databases, such as: landscape, archeological, historical, ethnological, culturological, demographical, and other related

approaches. Moreover, tourism has a vital role in preserving cultural and historical heritage (Grmuša et al., 2020).

Of particular importance in the cultural landscape of Russia is the ancient town Temnikov, in the suburbs of which there is the Sanaksar Monastery of the Nativity of the Theotokos. The main shrines of the monastery are the relics of the righteous warrior Theodore (Ushakov), a Russian naval commander. The Russian Orthodox Church canonized him as the righteous warrior Theodore Ushakov. To the north of Temnikov stretches the Mordovian State Reserve, designed to preserve and protect the wealth of the unique landscapes of central Russia. The research presented in the article is aimed at solving a scientific problem of developing an interdisciplinary approach in the study of meta-geosystems of natural and cultural landscapes for the management of cultural heritage systems on the example of Temnikov-Sanaksar cluster. The cluster is located in the central part of European Russia, in the zone of interaction between the Volga upland and the Oka-Don rivers lowland formation.

The strategic goal of modernity is to combine the unique diversity of natural and cultural heritage for the development of pilgrimage and ecological tourism – travel – to the world of untouched nature and the contact with the national spiritual values of the Russian Federation. In its development, it is designed to integrate with the pilgrimage and tourism cluster “Arzamas-Diveevo-Sarov”, to unite recreational, ethno-cultural, and ecological objects of the Republic of Mordovia into a single system with the creation of comfortable living conditions in its cultural landscapes.

The creation of a general information infrastructure of the pilgrimage and tourism cluster Temnikov-Sanaksar is significant for solving the issues of remote monitoring of cultural heritage sites of the region to ensure the information connectivity of the territory. The effectiveness of geoinformation technology’s introduction into the practice of proper decision-making in the field of strategic planning lies in the deployment of an information environment in which spatially distributed natural and socio-economic information is available to both practitioners and the general public.

Particular focus in the project should be on the problem of developing and implementing an effective geoportal system as an instrument for explaining the difficulty of incorporation, cataloging, distribution, and conception of spatial data on the meta-geosystems of the Temnikov-Sanaksar pilgrimage and tourism cluster in order to provide support in proper decision-making in the field of natural environment optimization, social and production systems in the conditions of digital economy development.

An informative source of data on the geosystems of the Temnikov-Sanaksar cluster is the data of remote sensing of the Earth (remote sensing), for the effective interpretation of which it is necessary to use modern intelligent data analysis tools. The scientific problem of enlightening the precision of the existing algorithms is proposed to be solved from the standpoint of a geosystem approach by providing the possibility of analyzing the genetic homogeneity of spatially adjacent objects of different scales and hierarchical levels. When developing data analysis models, it is necessary to focus on ensuring a sufficient number of degrees of freedom when configuring the model in order to form the possibility of flexible configuration of the model depending on the project task being solved.

2. The Methods

The study conducted the meta-geosystems research in the territorial development of both large territories of the country (subjects of the federation), and relatively small territories (in district planning) by examination of documents and projects and their socio-economic justifications; monitoring the state of meta-geosystems; and formulating recommendations for improving their management. The methodological procedure includes several stages:

- **Program stage** – strategic document of scientific research, defining goals, objectives, methodology and methods, justifying the content of sections, work schedule, the number of performers, the cost of work, and the expected result, as well as methodology and methods of research based on the specifics of the meta-geosystem and the formulation of practical tasks to be solved;
- **Analytical stage** – analysis and synthesis of primary information, generalization, systematization, and interpretation of processes and phenomena, establishing patterns of formation of meta-geosystems of different hierarchical levels;
- **Informational stage** – formation of spatial data infrastructure, mapping of invariant and variable elements of meta-geosystems, identification of territorial combinations, their boundaries and properties;
- **Model stage** – development and implementation of digital models of meta-geosystems, forecasting their development for making management decisions;
- **Conceptual and constructive stage** – designing optimal spatial combinations of elements of meta-geosystems, substantiating design decisions, developing recommendations for heritage management.

Modern directions for solving the problems of modeling meta-geosystems are associated with the introduction of GIS technologies and geoportal systems. Solving the problem of constructing problem-oriented geoinformation systems that ensure the process of interdisciplinary research of meta-geosystems of the cultural landscape in order to solve the problem of managing territorial heritage systems should be based on fundamental principles and methods that determine scientifically sound methods for analyzing large arrays of spatial data, synthesizing new knowledge about natural and social industrial systems (NSIS), building hardware and software systems for storing, visualizing, and distributing spatial-temporal data through modern web-technologies. Geoportal systems as an external component of spatial data infrastructures are web-based systems, which leaves an imprint on the features of their design, development and implementation. The digital map of the geoportal, which provides information support for interdisciplinary research in the field of analysis of meta-geosystems of the cultural landscape for the management of territorial heritage systems, should provide layer-by-layer visualization of thematic layers, the optimal register of which is determined by the list of interrelated approaches presented above that ensure the formation of electronic map systems and databases of the region for the study of meta-geosystems: landscapes, history and archeology, culture, ethnography, demography, economics, and ecology. An imperative place is occupied by the development of tools for analyzing the relationships between the layers of the geoportal digital map. During the initial deployment of the geoportal, it is necessary

to have guarantees of the system's stability to safety and loads to ensure high quality of work.

3. Result and Discussion

The features of the formation of geosystems in the territory of the Temnikov-Sanaksar cluster are determined by the position of the region in the center of the Russian Plain. In the Alpine stage, the development of geosystems had a pronounced cyclical character due to tectonic and climatic processes. The beginning of the erosion network formation dates back to the end of the Lower Cretaceous era when the territory was brought out from under the sea level. The composition of the bedrock deposits that make up the erosive surface of the pre-Quaternary relief includes formations of different lithology and age. Tectonically, the area is located within the Alatur thyroid uplift, complicated by a number of local ups and downs. A general gradual decrease in absolute marks occurs to the southwest from the axis of the fold. The approximate amplitude of local uplifts of the brachianticlinal fold against the most submerged reclinal part is 30–40 m. A feature of the tectonic structure is the complication of anticlinal uplift by large neotectonic zones characterized by the subvertical fracturing of carbonate Paleozoic carbonate rocks (Nikolaev, 2000). General patterns of relief morphology are reflected in the hypsometric model of the territory (Figure 1).

A characteristic feature is the asymmetric structure of the Moksha valley: significant erosive dismemberment of the left mainboard and the dominance of gentle slopes along the right bank. Erosion processes continue to influence the formation of the modern appearance of the relief, as evidenced by the presence of a large number of active ravines, the fairly frequent over-deepening of their channels (the height of over-deepening is usually 1–2 m, sometimes 3–4 m) and the appearance of an episodically traceable high floodplain with a ledge height above

the thalweg of the ravine up to 3–4 m, and in some places up to 6 m. A characteristic feature of the area under consideration is the absence of permanent watercourses in the upper and middle reaches of the tributaries of the Moksha River.

By the beginning of the Holocene, three main areas were distinguished in the relief: 1) gently undulating water-glacial plains with karst landforms in the north, 2) water-glacial and secondary moraine plains in the south, 3) a sub-latitudinal elongated valley of the Moksha River with well-defined floodplain terraces (Figure 2).

The Moksha River is the oldest route of landscape development, in the floodplain of which Neolithic settlements are located. Its length is 656 km. The river is fed by mixed sources (snow – from 60 to 80%, ground – 15–30% and rain – up to 10%). The hydrological regime of the river is characterized by the presence of a high spring flood, summer-autumn low water, broken in rainy years by two or three floods, and a stable winter low water with a rise in water level during thaws. Features of the water regime of geosystems are determined by the wide development of karst rocks, which creates favorable conditions for the absorption of precipitation and surface water, and affects the regime of groundwater levels.

The development of geosystems in the Pleistocene and Holocene determines the high saturation of the territory with rare and endangered species. On sandy terraces in rare coniferous and mixed forests, steppified forests, on the edges and pine forests wastelands among rare and endangered species there are Wolfgang's milkwort, hawkweed curvidentate, small fluffweed, dark-winged orchis, in fresh light coniferous and mixed forests, meadow - wavy hair grass.

There are moneses uniflora and red helleborine in damp coniferous and deciduous forest cenoses, along the edges of the marshes – a real lady's slipper, spotted orchis, rattlesnake fern, Lithuanian manna are registered (Nikolaev, 2000). On the outskirts of moss swamps, the banks of forest rivers and

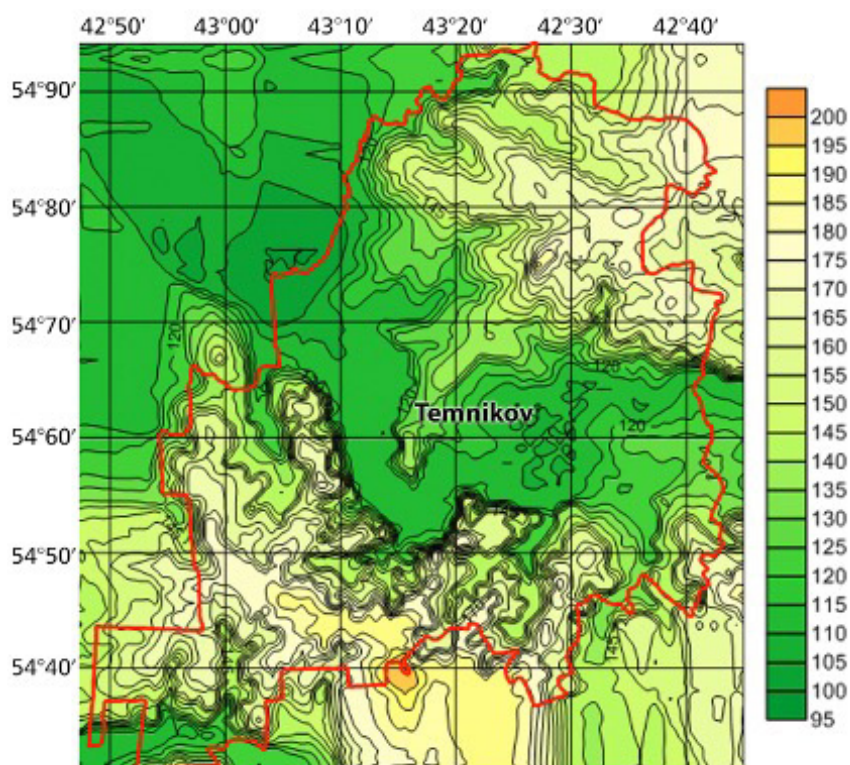


Figure 1. Hypsometric model of the territory of Temnikovsky district (Source: Authors)

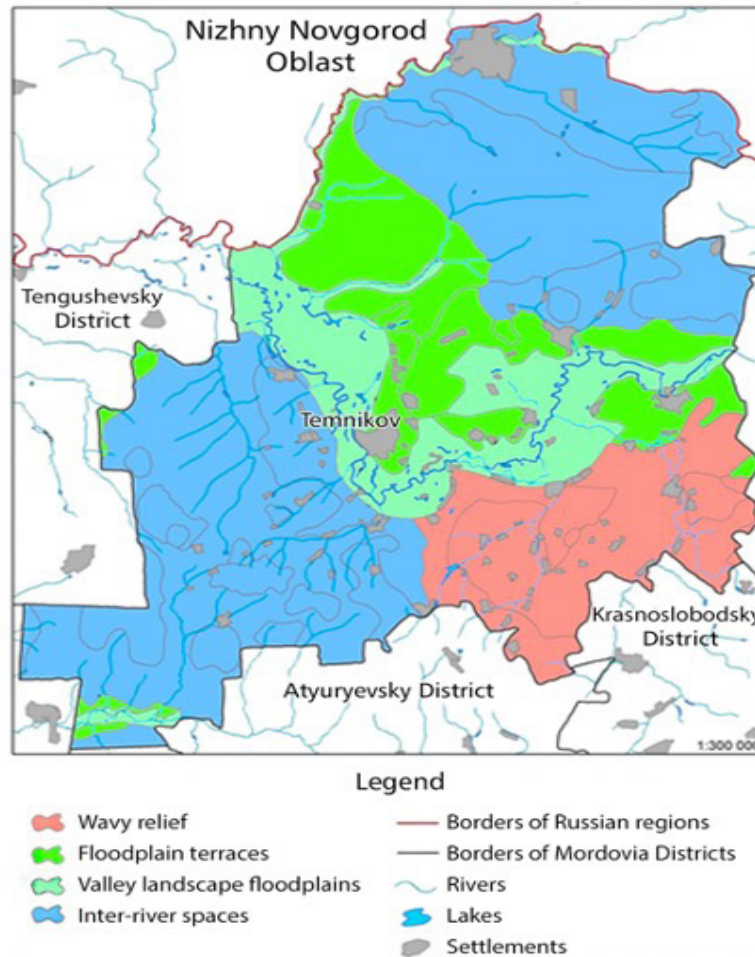


Figure 2. Geosystems of the tourist and recreational cluster (Source: Authors)

streams we can find two-seeded sedge, single-leaf orchis, squirrel-ear, heart-leaved twayblade, Magellan sedge, Siberian spleenwort. Along the upper sphagnum marshes, moss floats, there are wattle-shaped sedge, or double raw sedge, white beak sedge, bog clublike, marsh scheuchzeria.

In addition, climate dynamics, changing states of geosystems, and the effects of self-development of societies are reflected in the process of economic development of landscapes. It is important to note that many archaeological sites are multi-layered. This may indicate selective residential development of geosystems and favorable conditions for the life support of the surrounding natural landscapes (Figure 3).

A significant transformation of the cultural landscape begins with the construction of forest fortification systems to protect the roads of the southeastern outskirts of the Russian state on Kadom and Kasimov. Three guarded passages were created on the defense line: Nogai gates near the village of Kishaly (Atjur'evskij district of the Republic of Mordovia), Babeevsky and Chizhikovskie – near the settlements of the same names in the Temnikovsky district.

The Temnikovskaya Fortress was based on fragments of floodplain terraces stretched from north to south in the form of a cape to the left root side of the Moksha valley. Upstream and downstream, its floodplain had a width of more than 4 km and in the narrow part it was about 1 km wide. The fortress occupied a key location in the central part of the defense line of the same name, which stretched to the outskirts of the forest from the village Kulikov on the Windrey River to the confluence of the Sarovka River with the Satis River.

An idea of the Temnikovskaya fortress and the city layout can be drawn from the preserved description of wooden fortifications in a document of 1713. The fortress was an irregular quadrangle with an area of about 0.7 hectares. The fortress was surrounded by a moat, except for the western side, which was protected by a steep slope of the terrace. There were at least five towers: the entrance tower and four corner towers. Streletskaya, Pushkarskaya and Rassyl'shhikovskaja settlements arose in the territorial proximity. In 1755, all Temnikov's town buildings were surrounded by a rampart with a fortified wall. During the development of the city, the settlements gave the place a semblance of a radial-ring system, in the central part of which is Cathedral Square. In the second half of the twentieth century, a citywide center was formed in the urban planning structure of the historical center, to the east of which there was a residential area with a typical five-story building and an industrial zone on the northeastern outskirts of the city.

The town-planning monument of the second half of the 18th – early 19th century included the Nativity of the Theotokos Sanaksar Monastery, built under the leadership of I.I. Ushakov and F.I. Bylinin. Erected on the forested over-floodplain terrace of Moksha, it is well viewed from the ancient Temnikov. In the center of the spatial composition is the Cathedral Church in the honor of the Nativity of the Most Holy Theotokos (1774), the church in the honor of the Icon of the Mother of God "Vladimirskaia" (1782). At the main entrance is the church in the honor of the Transfiguration of the Lord, in the bell tower (1776).

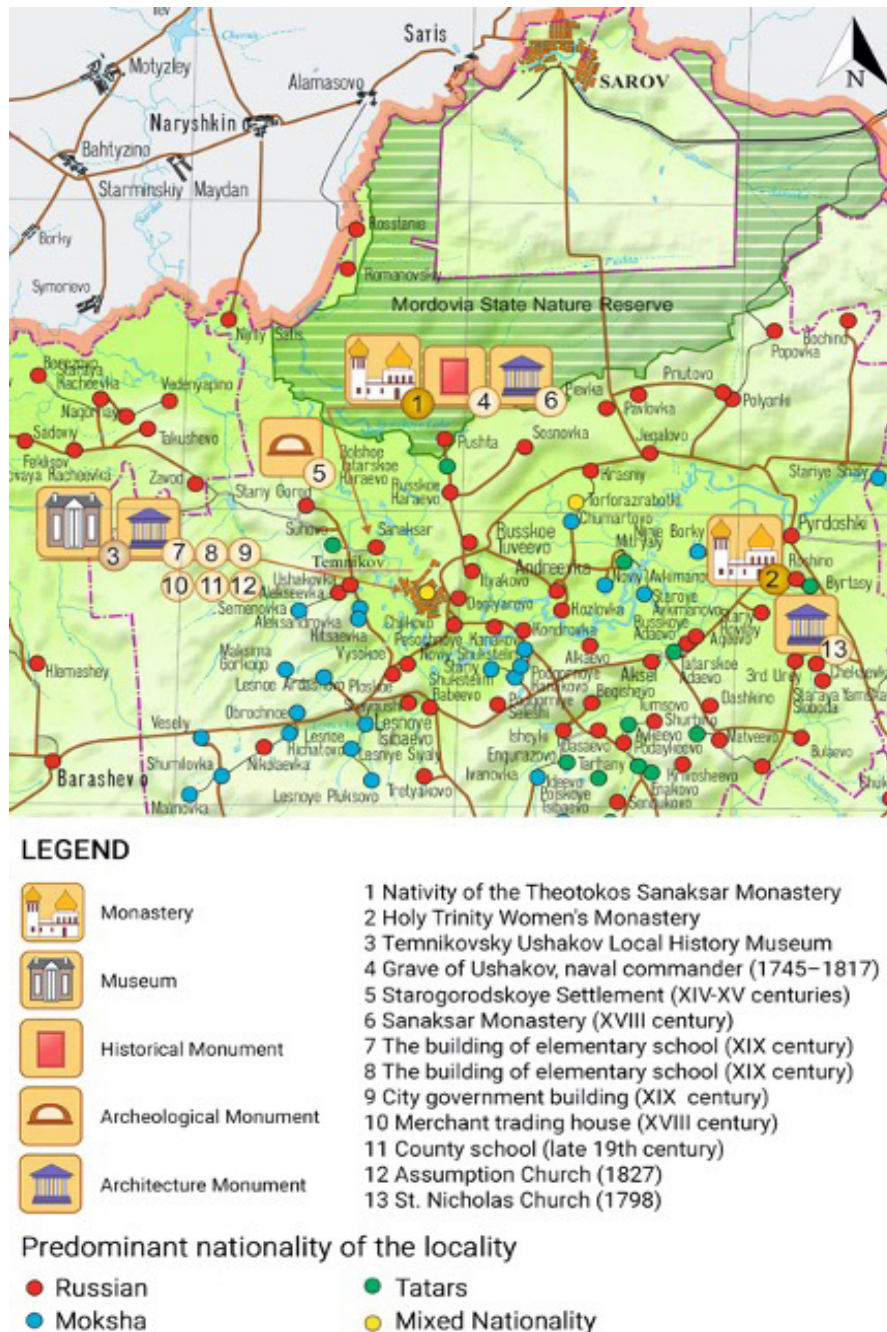


Figure 3. Objects of historical and cultural heritage of Temnikovsky district (Source: Authors)

The main shrines of the Nativity of the Theotokos of Sanaksar Monastery are the relics of the holy righteous warrior Theodore (Ushakov), a Russian naval commander, Admiral F.F. Ushakov (1744-1817), the commander of the Black Sea Fleet and the Russian-Turkish armada in the Mediterranean Sea. Under his command, 43 victories were won, in which not a single ship was lost. The admiral spent his last years in the village of Alekseevka near the Sanaksar monastery. All his multifaceted activities were aimed at serving the Fatherland and the development of the Russian fleet. In 2001 he was canonized by the Russian Orthodox Church as a locally venerated saint.

The centuries-old process of economic development of landscapes is reflected in the spatial structure of settlement. The current population density is 9.4 people/km², the highest density and population is characterized by the valley of the Moksha River (Figure 4).

Currently, the Temnikovsky district includes one urban center – the town of Temnikov, and 96 rural settlements. The main part of the population is concentrated in the valley of the Moksha River, characterized by high landscape diversity and for many centuries it has been the route of economic development of the region. The district is agrarian and the main cultivated agricultural lands are concentrated in the forest-steppe landscapes of the south-eastern part of the district. The northern and south-western parts of the district are mostly covered with forest vegetation.

4. Conclusion

The study analyzes the problem of optimizing inter-component connections in the meta-geosystems of the Temnikov-Sanaksar pilgrimage and tourism cluster from the interdisciplinary approach. The modern practice of organizing work on the development of landscape and ecological

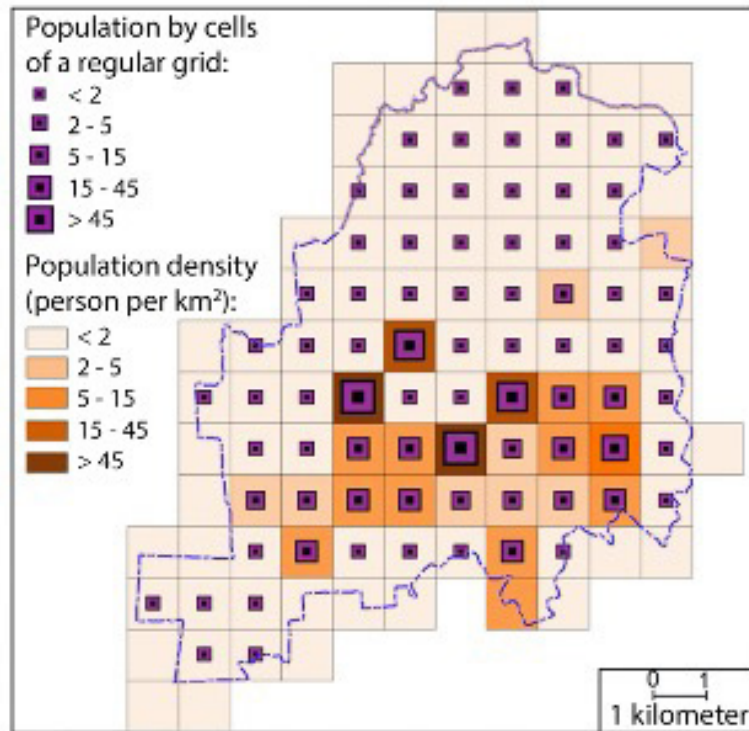


Figure 4. Population density cartogram of Temnikovsky district (Source: Authors)

foundations for the sustainable development of meta-geosystems shows that the most effective form of organizing information resources are electronic maps systematized in the regional geoinformation system. The maps optimize the solution of scientific and applied tasks on inventory, analysis, assessment, forecasting the development of natural, social, and production systems, and making managerial decisions to optimize the state of the environment and the territorial organization of society. Moreover, they allow to quickly present the desired information to the final consumers.

The natural environment in the concept of the formation and development of the cluster should be considered as a spatial basis for the placement and development of socio-economic systems, therefore, the paper analyzes the origin, development, and current state of both individual components and meta-geosystems to determine the development parameters of the system of specially protected natural territories, the selection of optimal landscape-planning regional, and local measures for the recreational development of the region.

The cores of the cultural landscape of the pilgrimage-tourist cluster are the following objects of natural and cultural heritage:

1. The forests of the Oka-Volga interfluvium covered with legends, where the Mordovian State Nature Reserve named after P.G. Smidovich (1936) was created, formed under the conditions of repeated changes of glacial and interglacial epochs of the Pleistocene and Holocene. To get acquainted with the unique landscapes in the Reserved Mordovia, a wide range of sightseeing tours has been developed, among which are "Visiting the reserve", "Walks in the reserved forest", "Reserved Mordovia", "Ancestral path", "Our animals", "Survival course in the forest", "Family", "Reserved paths", "Reserved winter", "From the past to the future", "National cuisine", and others.
2. The oldest route of economic development of the region is the Moksha River, the riverbed of which is embedded in sandy sediments. Segmented bar plains abounded with ancient lakes, over which rise sandy mounds ("veret'ja"), with small woodlands. On the sandy residual mountains near floodplain lakes there are numerous archaeological sites testifying to the ancient development of the region.
3. The wide distribution of multi-layered archaeological sites from the Neolithic to the present indicates the stable functioning of favorable ecological life support systems of the population.
4. Of particular importance in the cultural landscape of the suburb of the ancient town of Temnikov is the Sanaksar Monastery of the Nativity of the Theotokos. The main shrines of the monastery are the relics of the righteous warrior Theodore (Ushakov), a Russian naval commander, who was canonized by the Russian Orthodox Church as the righteous warrior Theodore Ushakov.
5. Unique objects for the development of the tourism-pilgrimage cluster are numerous cultural and sacred landscapes, especially the Sarov settlement – a Mordovian settlement of pre-Mongolian times, possibly the center of the Purgas district from Russian chronicles. In the 17th century here is based the Sarov Hermitage, a universally recognized shrine of Russia, where the Russian saint St. Seraphim of Sarov lived.
6. Strategic partners for the further development of the pilgrimage and tourism cluster on the territory of Mordovia are: modern health centers based on local mineral springs as a health resort "Moksha", located on the picturesque bank of the river of the same name, the Moksha Center of National Culture in the village of Staraya Terizmorga, modern Saransk city, the Mordovian National Park "Smol'nyj", and other objects of natural and cultural heritage, united by a system of tourist routes.

When designing the cultural landscape of the pilgrimage and tourist cluster, it is necessary to rely on numerous multi-temporal characteristics of anthropogenic, natural, and economic systems, as a result of which heterogeneous volumes of archival, stock, and current information must be processed to form a holistic view of the spatio-temporal structure of meta-geosystems.

The organization of the tourism-pilgrimage cluster at the current phase of the growth of social interactions places elevated demands on information support. This is due to the increasing variety of international and domestic tourism markets and, consequently, the growing diversity of tourist flows, in the formation of which the information factor has a relevant function.

In the context of globalization, information system development, and the growth of IT, fast approach to consistent spatially distributed information is of paramount importance for all the subjects involved in the travel industry – starting from the local, national and global stakeholders to the final consumers (visitors). Any tourist information portal accumulating information about distinguishing characteristics of the territory's natural potential, cultural characteristics, objects to show, tourist infrastructure, routes, and applying interactive maps can be a useful tool in the contemporary trends of promoting clusters. In this respect, the outcomes of the study contribute to the knowledge on this topic.

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