

Formation Clusters of Nature Using in Agrarian Regions of Dagestan: Theory and Practice

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ABSTRACT

The principles and methods of strategic analysis of processes of using natural resources of Dagestan are justified. The purpose of the study is determined by the tasks of forming territorial clusters capable of ensuring the growth of the competitiveness of the regional economy and the intensification of the mechanisms of public-private partnership. The term "cluster of natural resource management", underlying the basis of the work, on content corresponds to the notion of a territorial cluster that is at the initial stages of its development. The formation of territorial clusters in rural areas of Dagestan is aimed, in particular, to overcome the dominant trend of monopolized for many decades, it means the indifferent in solving the problems of low level and quality of life of the rural population, resource use.

Keywords: Dagestan; Natural Resources; Cluster of Nature Using; Nature-use Management; Agro-tourist Cluster

1. Introduction

(1) The relevance of the study is determined by the alarming economic reality of Dagestan. There is the high resource and row orientation of the economic system in the most southern republic of the Russian Federation. Highly effective processing productions are poorly developed there, and that is the reason for a low level of incomes and quality of life. As a result, the migratory balance of Dagestanis has been negative for many decades. Therefore one of the strategic objectives of the economic development of Dagestan is to create conditions for doing business that would maximally contribute to the growth of efficient and competitive industries based on using of local natural resources and, ultimately, the improvement of the living standard and quality of life of the local population.

On closer inspection, Dagestan, with its exceptionally diverse natural and economic and ethnocultural structure, has resemblance to the "geographical portrait" of the whole of Russia, which still maintains the "resource curse" (a negative impact of the economic structure on the country's economic growth) as a legacy from the USSR. This circumstance gives the additional importance to the scientific development of *environmental management* issues in Dagestan from the position of strategic management objectives.

(2) The *methodological basis* of the study is determined by modern theories of cluster analysis of spatial production processes and the formation of territorial clusters in the region. The methodological apparatus includes general scientific methods of modeling, comparison, and expert opinions of the studied processes. In order to solve the problems put forward in the work, methods of system and statistical analysis, logical-graphical and cartographic methods of investigation were applied.

(3) The *scientific novelty* of the study is the development of a methodological apparatus for studying clusters of nature management in rural areas in order to enhance the competitiveness of enterprises and expand the practice of public-private partnership in the region's economy.

(4) The *practical importance* of the work is determined by constructive proposals for the formation of effective clusters of nature management in rural areas of Dagestan, strengthening of competitive advantages, expanding the practice of import substitution in the agrarian sector and reducing the level of threats to the socio-economic systems of the territories in question.

2. Resource system clustering

The cluster approach to the study of problems related to the environmental management in the region includes two main aspects of the systemic research: analytical and synthetic.

(1) The analytical aspect involves the identification and classification of ecosystem elements, and also the structuring of their channels to the office. Such an analysis is usually accompanied by the indexation of disparate elements of the natural environment, capable of acting as generating or realizing, promoting or restraining, negative or positive factors in the development of the studied territory^[4,9]. The methodology of such an analysis is improved primarily in the field of statistics, so in this case it is rather a statistical-analytical approach to clustering ecosystems.

(2) The synthetic aspect of clustering is a traditional approach to geographic and economic science. It is aimed at rationalizing the whole cycle of the movement of substance, energy and information within the studied spatial system: from the development of the natural resource (deposit) to the transport-geographic (logistic) optimization of links between the nodes of supply and demand^[11]. At the same time, the information is mainly drawn from the documentation of enterprises and industries to identify clusters as integral spatial systems.

2.1 Analytical Aspect of Clustering

On the basis of statistical analysis, the various relationships between resource users and environmental components in the region were indexed, which subsequently served as the formation of a computer database for environmental management. The algorithm for such an analysis consists of the following main steps: the definition of the set of variables by which objects in the sample will be evaluated; normalization of values of variables; calculating the values of the measure of similarity between objects^[15].

An important point in cluster-statistical analysis is the definition of "similarity" of objects^[12]. In this case, one vector of the object's characteristics can be oriented to its numerical values (for example, the amount of reserves in tons, the possible lifetime of the resource), and the other on qualitative parameters (geocological hazards, medical and environmental consequences, tourist attraction of a natural monument, etc.).

Clustering of the spatial resource system begins with the designation of its main morphological elements – Natural, Human, Production – specific symbols (N, H, P). In this scheme, the Human subsystem is located at the top of the triangle, and the controller functions of the remaining elements of the system are assigned to it (**Figure 1**)^[9]. An important theoretical premise is the notion that the entire variety of the studied functional connections and relations in the system Natural-Human-Production is reduced to the flows of substance (including people), energy and information within a particular territory^[1,5].

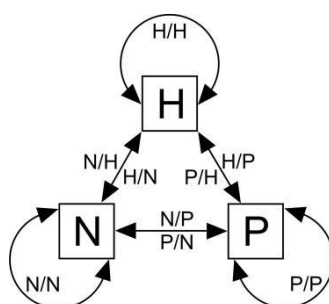


Figure 1; Morphology of the resource system.

It should be noted that the scope of this study was limited to analyzing the central morphological relationships between the two regulated resource blocks of the system – Nature (N) and Production (P). At the same time, in the analysis of cluster processes in the agrarian and tourist spheres of the region, serious attention was also paid to the links and conflicts along the lines of interaction between Nature (N) and Human (H).

The main communication channels between the resource system blocks can be designated as N/N, P/N, H/H, H/P, H/N, P/P, and the direction of the links – PH, NP, etc., where the first character indicates the source, and the second – on the final communication agent. The difference in pairs H/P and P/H, P/N and N/P, N/H and H/N is determined by the dominant influence of one or another morphological element of the resource system.

When introducing additional symbols (i – information, e – energy, s – substance, p – people), the symbolism can be concretized by indices (a combination of symbols) characterizing some state of this element. For example, the HPP index will refer to the movement of people to and from production facilities, etc.

Further, we list the indices of resource links along the main channels and directions of interaction: N/N – a set of links between individual components of the natural environment; H/H is a set of social connections, among which are demographic links (HHp – all kinds of natural, migration and social movement of the population), social information links (HHi – Internet information flows, telephone conversations, mail correspondence, money transfers, etc.), not related to the maintenance of production) P/P – a set of production links, including technological links that combine individual elements of production along the line of changes in the state, properties, shape or size of raw materials, mothers or semi-finished product in the process of obtaining the finished product, as well as almost all types of movement of raw materials and material from the supplier to the consumer.

The first stage of clustering the regional system of nature management in our study was the mapping of 100 major deposits for 22 types of natural resources of Dagestan. At the same time, the administrative boundaries of the territorial districts of the republic – the Northern, Central, Mountainous and Southern (**Figure 2**) acted as spatial limits of statistical compilation. On the basis of such a map, it was determined that these districts were provided with resource deposits (in%) and, accordingly, a promising specialization of the districts on specific types of subsoil use.

The second stage of clustering relied on a computer-software basis. In this, the information on natural resources in accordance with the principles of development of geoinformation databases was grouped into 14 classes and 54 species. The catalogue of natural resources of Dagestan is denoted by the root index [nature]:

(I) Space resources [index: space]: 1. Territory resources [ter_are]; 2. Resources of the sea water areas [sea_are]; 3. Resources of lake water areas [lake_are]. (II) Climatic resources [climat]: 1. Republic-wide climate resources [rep_clim]; 2. Regional climate resources [reg_clim]. 3. Atmospheric air in settlement [atm_settl]. (III) Water resources [water]: 1. Seawater [sea_water]; 2. Lake water [lake_water]; 3. River water [riv_water]. (IV) Land resources [land]: 1. Republic-wide land fund [rep_land]; 2. Surface geomorphological structures [surf_geo]; 3. Deep geomorphological structures [deep_geo]; 4. Geomorphological structures of the sea coast [coast_geo]. (V) Soil resources [soils]: 1. Republic-wide soil cover [rep_soil]; 2. Regional soil cover [reg_soil]. (VI) Vegetation [flora]: 1. Republican vegetation cover [rep_vege]; 2. Grass cover [grass]; 3. Forests and shrubs [forest]. (VII) Animals [fauna]: 1. Wild animals [wild_faun]; 2. Hunting resources [hunt_faun]; 3. Fish resources [fish_res]. (VIII) Natural recreational resources [rekrea]: 1. Resources of ecological tourism [eco_rekr]; 2. Balneological resources [baln_rekr]. 3. Resources of seaside holidays [sea_rekr]. (IX) Hydromineral resources [hydrom]: 1. Underground industrial waters [under_wat]; 2. Artesian water [artesi_wat]; 3. Healing mineral water [heal_wat]. (X) Energy resources [energy]: 1. Geothermal energy [geo_therm]; 2. Hydropower of rivers [rive_ener]; 3. Solar energy [solar_ener]; 4. Wind energy [wind_ener]. (XI) Fuel resources [fuel]: 1. Oil [oil_res]; 2. Natural gas [gas_res]; 3. Coal [coal_res]; 4. Peat [peat_res]; 5. Combustible shales [shal_res]; 6. Wood [wood_res]; 7. Biogas [biog_res]; 8. Agricultural waste (straw, dung) [dung_res]. (XII) Building materials [build]: 1. Construction sand [const_sand]; 2. Sand-gravel mixtures [sand-grav]; 3. Building stones [stone_res]; 4. Construction and refractory clays [clays_res]; 5. Limestone for lime production [lime_res]; 6. Gypsum [gyps_res]. (XIII) Mineral-chemical raw materials [minchem]: 1. Glass sands [glass_res]; 2. Sands molding [moldi_res]; 3. Carbide limestones [karb_res]; 4. Sulfur [sulf_res]; 5. Phosphorites [phosp_res]; 6. Rock crystal [cryst_res]; 8. Sea shell for bird feeding [shell_feed]. (XIV) Nonferrous metal [nonfmet]: 1. Copper [copp_res]; 2. Strontium [stront_res].

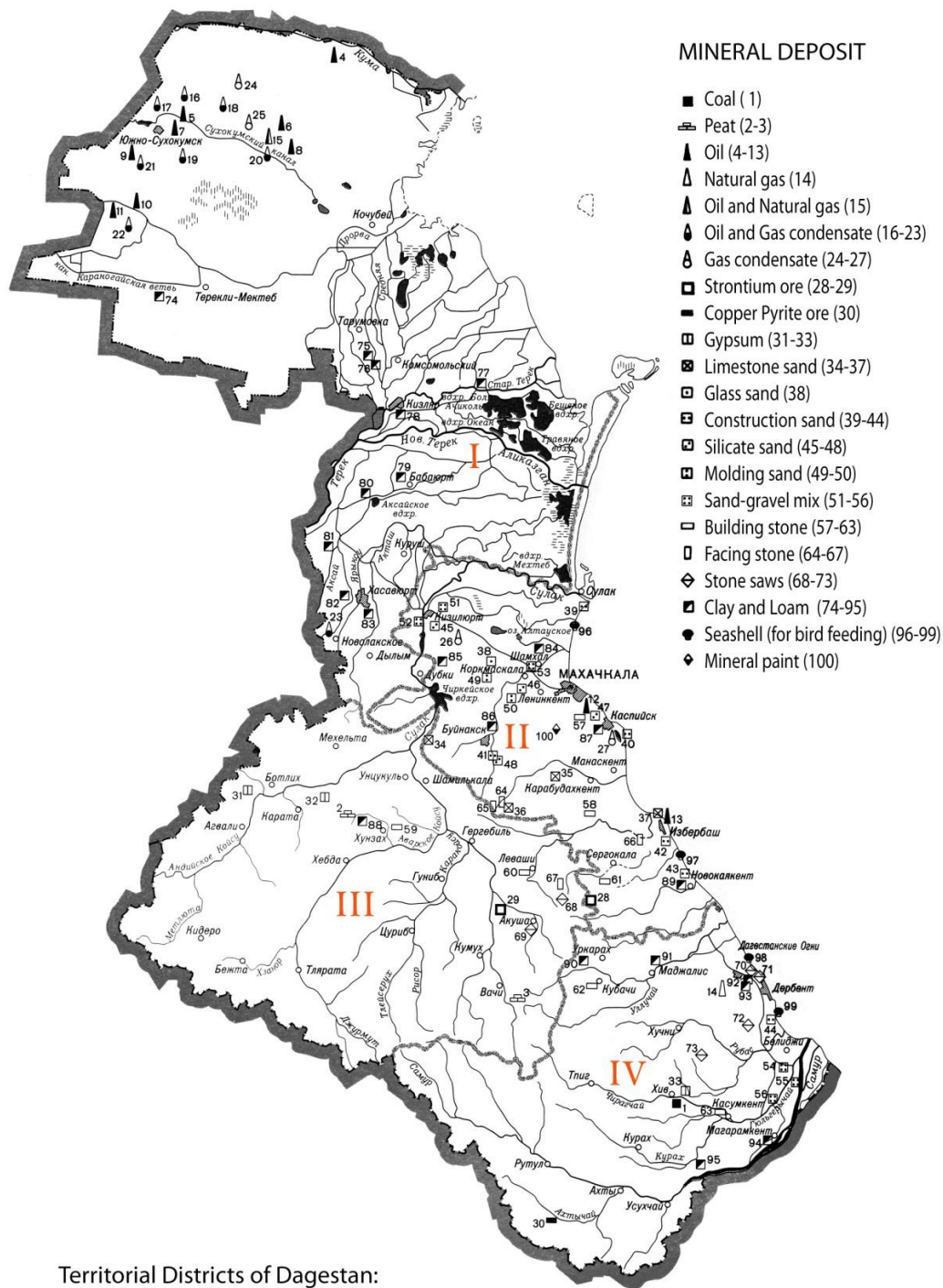


Figure 2; 100 major deposits of 22 types of mineral resources within the territory of Dagestan.

A special object of ecological clustering of the territorial districts of Dagestan is the occurrence of natural and industrial conflicts^[2]. Each such a conflict indicates a tendency of degradation of natural resources and conditions of the region: ambient air, ground and surface water, soil and forest cover, fauna, marine shores, nature monuments, resort areas, protected areas, etc. In total, 26 types of natural and industrial conflicts (k) are considered in the work, each of which has its own serial number (index): k1 – mechanical pollution of the atmosphere; k2 – chemical pollution of the atmosphere; k3 – destruction, flooding and waterlogging of sea shores; k4 – destruction and flooding of river banks; k5 – siltation of water bodies; k6 – depletion and pollution of waters of small rivers; k7 – depletion of lakes and lagoons; k8 – pollution of groundwater; k9 – pollution of surface waters by domestic sewage; k10 – degradation of the

environment of populated areas as a result of anthropogenic impacts; k11 – destruction of the environment of populated areas under the influence of natural forces; k12 – degradation of delta complexes as a result of anthropogenic impacts; k13 – destruction of delta complexes under the influence of natural forces; k14 – degradation of natural forage lands; k15 – extermination of valuable and rare animals; k16 – violation of land by mining; k17 – decrease in the quality of resort areas; k18 – degradation of forests under the influence of non-forest activities; k19 – forest cutting; k20 – pollution of sea waters; k21 – intensive gully formation; k22 – blowing (deflation) of soils; k23 – secondary salinization of soils; k24 – chemical contamination of soils; k25 – accelerated erosion of soils; k26 – depletion of fish stocks. This made it possible to determine the diversity of environmental problems and the level of environmental tension in each of the territorial districts of Dagestan.

2.2 Synthetic aspect of clustering

The spatial-synthetic approach to clustering concentrates on the territorial integrity of the processes of using natural resources. These are the problems and prospects for the formation of clusters as groups of interconnected enterprises (firms, companies) in the production and use of local resources with common territorial interests and in many cases with strict self-restraints (in order to achieve social and environmental consensus) in the nature of their development [20]. The identifying element of a territorial cluster is its innovative core in the form of a separate enterprise, their cooperation or economic sectors that ensure the spread of technological innovations and, at the same time, increase the competitiveness of industries that extract and process resources.

In the functional model of the resource cluster, its objective function is designated as a "competitive advantage". The main stimulating factor of such a system is the "economic initiative" of people. The main regulating factor in the cluster is associated with the notion of "effective management" (Figure 3).

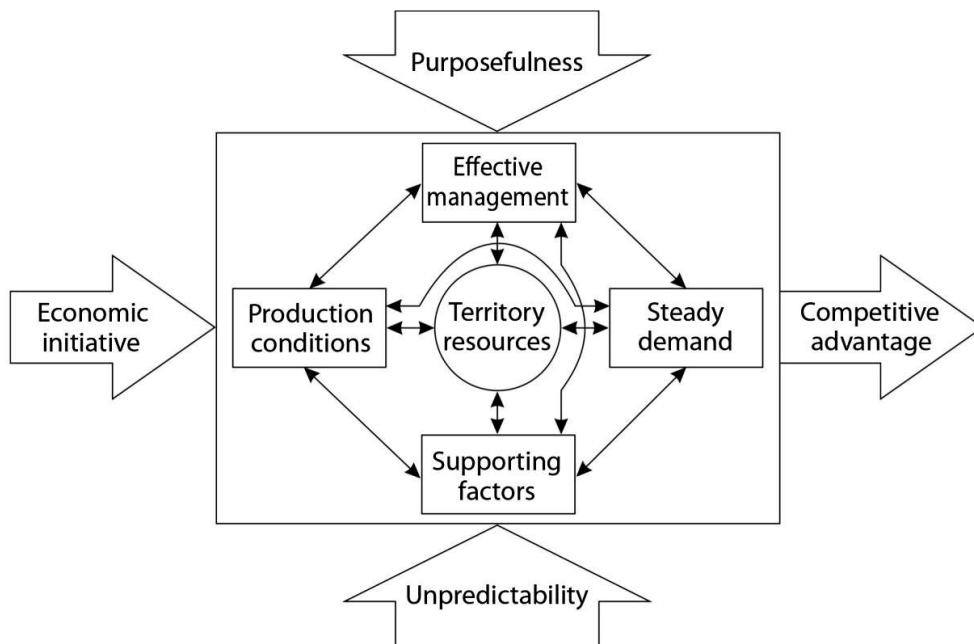


Figure 3; Basic functional model of the resource cluster.

(the scheme was compiled according to^[19] with the author's additions).

The solution of problems of cluster formation in the sphere of nature management is impossible without effective interaction of government and business, formation of public-private partnership (PPP) between them. For this, it is necessary to strengthen mutual interest between specific authorities (environmental, industrial, agrarian, tourist, trade and marketing, etc.) and representatives of small businesses representing the countryside^[21]. Such a partnership can significantly improve access to natural resources, facilitate the procedures for registering a lease, the right to use, ownership of resources. Unfortunately, in Dagestan there is no experience in implementing investment environmental

projects based on PPP. Meanwhile, such a partnership is able to ensure mutual respect and a balance of interests in determining the ways and stages of the solution of the tasks, the implementation of mutual agreements, and regular and proper monitoring of their implementation in the use of the region's natural resources^[7].

The main attention was paid to the study of the genetic and functional structure of clusters. The genetic structure of clusters assumes the identification of resource cycles, taking into account the three main stages of their evolution: (1) initial (prevalence of production and initial processing), (2) intermediate (deep processing) in the region, (3) final (implementation outside the region). The functional structure of clusters reflects real and potential real-energy-information cycles of production activity within the space under study.

In the course of the study, it was revealed that the natural resource potential of Dagestan's agrarian landscapes at the current level of technology and technology development can ensure the formation of at least 11 functional types of nature use clusters of different scale: 1) ore-industrial, 2) construction-industrial, 3) oil-chemical, 4) geothermal-industrial, 5) hydropower-chemical, 6) waterintake-irrigation, 7) agrarian-industrial, 8) agrarian-tourist, 9) fish-production, 10) protected-tourist, 11) spatio-logical.

When solving problems of forming clusters of environmental management of a regional scale, the General Scheme of social and economic development of the territorial districts of Dagestan: Northern, Central, Mountainous and Southern, adopted in 2013, is adopted as a basis^[6]. At present, these districts are the largest objects of strategic planning in the republic (**Table 1**).

Districts	Nature-use clusters
Northern	1) fish-production 2) agro-industrial 3) reserved-tourist 4) watertake-irrigation 5) agro-tourist 6) oilgas-chemical 7) geothermal-production
Central	1) space-logistic 2) buildmaterial-industrial 3) watertake-irrigation 4) agro-industrial 5) agro-tourist 6) geothermal-production 7) oilgas-chemical
Mountain	1) agro-industrial 2) agro-tourist 3) reserved-tourist 4) watertake-irrigation 5) hydroelectric-chemical 6) buildmaterial-industrial 7) ore-industrial

Southern	1) agro-industrial 2) agro-tourist 3) reserved-tourist 4) space-logistic 5) hydroelectric-chemical 6) buildmaterial-industrial 7) oilgas-chemical
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Table 1. Prospective of nature-use clusters for territorial districts of Dagestan

To determine the production specialization of districts for each of them, a ranked scale of 7 clusters of resource use on a district scale was established. Ranking of district clusters was carried out on the basis of a detailed analysis of the resource potential of the territorial districts of the Republic of Dagestan, as well as strategic goals and objectives substantiated by an expert way.

The methodology of strategic planning of regional resource systems presupposes the allocation of two forecast-extreme trends of their development. The first trend is the result of the influence of internal and external factors. The second trend is a consequence of possible positive and negative trends in the development of the system under study. This kind of "parametric" approach to the strategy of development of spatial systems of nature management is usually based on the application of PEST- analysis and SWOT-analysis techniques. PEST-analysis focuses on the study of external competitive environment, SWOT-analysis – with the identification of features of functioning and development of internal competitive environment (**Table 2**).

<i>External</i> competitive environment (in the first approximation)				<i>Internal</i> competitive environment (in the first approximation)			
The main <i>positive</i> processes		The main <i>negative</i> processes		The main <i>positive</i> processes		The main <i>negative</i> processes	
External competitive environment (in-depth study)				<i>Internal</i> competitive environment (in-depth study)			
Political	Economic	Social	Technological	Strengths	Weaknesses	Opportunities	Threats

Table 2. Matrix of strategic analysis of spatial systems of nature management

The results of PEST- and SWOT-analysis were taken as a basis for the development of forecast scenarios of nature use within the traditional objects of statistical analysis in the region under consideration – its territorial districts and municipal districts.

2. Formation of clusters of agrarian specialization in the region

By now, there is a wealth of experience in studying the processes of agrarian cluster formation abroad^[13,14,16-18,22-24]. Such experience is quite applicable in the practice of creating clusters of nature management in rural areas of Dagestan.

The main measures and, at the same time, the stages of implementing cluster economic policy within rural areas include the following:

(1) Disclosure of opportunities and motives, as well as all-round support of initiatives of association of agricultural producers and related structures in clusters.

(2) Substantiation of the goals, prospects and effective forms of integration of participants in a cluster association in rural areas.

(3) Development of an environmental management cluster project, including: the identification of the participants, the formation of a central cluster company, the development of a cluster management structure, the division of responsibilities between cluster members, and the establishment of close collaboration between the cluster leadership and the local administration.

- (4) Substantiation of legal documents of a cluster of nature management in a particular territory.
- (5) Development of a system of financial and credit relations in a cluster.
- (6) Feasibility study of the environmental management cluster project.
- (7) Determination of the efficiency of cluster operation (its main indicators).
- (8) Organizational activities, including: the development and signing of the Treaty on the creation of a cluster.
- (9) Preparation of normative documents jointly with the administration of the municipality.
- (10) Development of the Charter of the central company of the cluster.

Dagestan is characterized by a natural interaction of mountain nodes, trails and ranges of the location of valuable natural resources (glaciers, waterways and reservoirs, soils of river valleys, basins and mountain plateaus, mineral deposits, etc.) with nodes, paths and areals located on the plain formation of productions for the processing of natural raw materials, transportation and sale of finished products^[8]. Ultimately, through this interaction, production links between depressive mountain areas and the main poles of the socio-economic growth of the lowland zone are activated.

The seaside and mountainous rural landscapes of Dagestan with their extremely diverse and sometimes unique natural and cultural and historical sights create a fertile environment for the development of various tourist and recreational technologies for serving the population^[2,3]. Tourist and resort institutions in the agrarian zone are able not only to successfully fit into the natural landscapes, but also harmoniously combined with local ethnographic and economic colors, which serves as a guarantee of the formation on the territory of Dagestan of unique agro-tourist "conveyors" along the chain: the seacoast – the plain – foothills – low mountains – middle mountains – high mountains. The spatial configuration of such "conveyors" is determined by the nature of the location of river basins, which should be the basis for the development of strategic plans for agrarian and tourist cluster formation in the republic.

3. Research results

- (1) A theoretical model of the spatial resource system of the region was developed.
- (2) The author's approach to the systematization of factors and the scientific explanation of the mechanisms for the functioning and development of environmental management clusters in the region are outlined.
- (3) The main production functions and the structure of environmental management clusters in the projection of the territorial districts of Dagestan are described.
- (4) The mineral resource potential was investigated and the main directions for the formation of territorial clusters of nature management in Dagestan was established.
- (5) The concept of "conveyor" tourism development in the region based on the chain is substantiated: The seaside – Plains – Foothills – Lowlands – Highlands – Highlands.
- (6) The horizons for the formation of agrarian and tourist clusters of various specializations in the scale of Dagestan are highlighted.

4. Conclusions

The strategy of socio-economic and ecological development of the region should be based on a sufficiently deep knowledge of the functional, spatial and temporal structure of the process of using the resource potential of the studied territory. At the initial stage of such structurization, two methodological approaches to research of the resource use scheme (statistical-analytical and spatio-synthetic) are implemented, which create the necessary deductive base for clustering regional ecosystems.

One of the tasks of clustering as a statistical-analytical procedure is not only the analysis of various factors and processes, but also the structuring of control channels. Clustering as a spatio-synthetic procedure is aimed at optimizing the entire cycle of spatial movement in the region of substance, energy and information from the development of natural resources (deposits) to specific centers for their processing and implementation with the formation of integral systems of nature management.

The most rational is the general scheme of nature management in Dagestan, in which, at the level of planning

decisions, cluster interaction of the depressive mountain zone with economically active plains territories is provided.

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