Georgian Geographical Journal

Paleoclimate and Archaeological Foundations of the Proposed Iori Upland Geopark

Zurab Janelidze[1,*], Giorgi Janelidze[1]
[1] Ilia State University, Tbilisi, Georgia
* Corresponding author: zurab_janelidze@iliauni.edu.ge

Georgian Geographical Journal, 2026, 6(1) 45-49

DOI:
https://journals.4science.ge/index.php/GGJ

Citation: Janelidze, Z.; Janelidze, G. Paleoclimate and Archaeological Foundations of the Proposed Iori Upland Geopark. *Georgian Geographical Journal* 2026, 6(1), 45-49. https://doi.org/10.52340/ggj.2026.06.01.06

Abstract

The proposed Iori Upland Geopark represents one of the most distinctive areas of Georgia, combining exceptional geological, geomorphological, archaeological, and ecological heritage within a single landscape. This study aims to evaluate the paleogeography, paleoclimate, and archaeological foundations that support the scientific justification for establishing the geopark and to demonstrate their importance for geoheritage conservation, sustainable development, and geotourism. A multidisciplinary approach was employed, integrating literature review, paleogeography and paleoclimate reconstruction, archaeological analysis, comparative assessment, and Geographic Information System (GIS)-based spatial analysis. Geological, geomorphological, archaeological, and environmental datasets were synthesized to reconstruct the long-term evolution of the Iori Upland and examine interactions between environmental processes and human occupation. The results indicate that the region preserves an outstanding record of landscape evolution from the Neogene through the Holocene, reflected in its geological formations, semi-arid ecosystems, and numerous archaeological monuments. Evidence suggests that the onset of desertification predates modern climate change and was primarily driven by extensive anthropogenic landscape transformation, particularly deforestation and intensive land use, which altered hydrological regimes and accelerated ecosystem degradation. Archaeological records further demonstrate continuous human occupation since the Bronze Age and reveal the close relationship between environmental change and cultural development. The integration of geological, climatic, ecological, and archaeological evidence confirms the exceptional scientific and educational value of the Iori Upland and highlights its potential as a geopark of national and international significance. Establishing the geopark would contribute to the conservation of Georgia's geoheritage, strengthen interdisciplinary research, support environmental education, and promote sustainable geotourism while enhancing public awareness of long-term landscape evolution and the impacts of climate and human activities.

Keywords: Iori Upland Geopark, Paleogeography, Paleoclimate, Desertification, Archaeological heritage

Introduction

Geoparks are geographical areas possessing outstanding geological, geomorphological, palaeontological, and cultural heritage, the protection, study and sustainable use of which is considered one of the important priorities of contemporary environmental management. The scientific basis for the establishment of the Iori Upland Geopark is based on the long history of the geological development of the territory, for the reconstruction of which paleogeography and paleoclimate studies are of particular importance. These studies provide the basis for understanding to determine the natural processes and environmental conditions that have created the modern landscapes, geological structures and unique complexes of biodiversity of the Iori Upland over millions of years.

Paleogeography factors in the study area reflect changes in the relief surface, including sea transgressions and regressions, the formation of sedimentary basins and the evolution of the relief. As

a result of these processes, many unique geological objects were formed, which today represent the main resource of the planned geopark. At the same time, paleoclimate changes had a significant impact on erosion, accumulation and denudation processes, which determined the transformation of landscapes, the formation of soil cover and the development of ecosystems.

In the concept of creating the Iori Upland Planned Geopark, the paleogeography and paleoclimate heritage is not only a source reflecting the history of the development of the natural environment, but also an important basis for the protection of geoheritage, scientific research, educational activities and the development of geotourism. Therefore, in the scientific justification of the geopark, particular attention was given to the study of those historical-geological and paleoclimate events that determined the uniqueness of a specific territory and its international significance.

Methods and Materials

The present study is based on a complex analysis of paleogeography, paleoclimate and archaeological factors important for the formation and scientific substantiation of the Iori upland. Both theoretical and empirical methods were used in the research process.

Literature review – international and local scientific publications, monographs, reports and legislative documents were studied, which relate to the concept of geoparks, paleogeography reconstructions, paleoclimate changes and cultural heritage protection. This method was used to determine the theoretical foundations of the study and evaluate the experience of different countries in establishing geoparks.

Paleogeography analysis – the geological structure of the territory, the history of relief development, the history of the study of sedimentary rocks, fossil material and geomorphological forms was collected. Based on this data, important stages of the geological past of the territory and their connection with modern landscapes were reconstructed.

Paleoclimate reconstruction – the analysis of existing paleoclimate data was used, including the results of palynological (pollen grains), paleobotanical, sedimentary deposits and isotopic studies. This method enabled the identification of the impact of climate change on the formation of landscapes, ecosystems and early human settlements.

Archaeological data analysis – materials obtained from archaeological sites, cultural layers, historical settlements and samples of material culture were studied. The analysis of archaeological material enabled to determine the relationship between human activity and the natural environment in various historical periods.

Cartographic and GIS-based analysis – analysis of topographic, geological, landscape and archaeological maps was used, as well as the capabilities of Geographic Information Systems (GIS) for processing and visualization of spatial data. Spatial integration of geoheritage, archaeological objects and paleoenvironmental indicators was carried out using GIS technologies.

Comparative analysis method – based on the comparison of examples from different regions and geoparks, the role of paleogeography, paleoclimate and archaeological heritage in the process of creating and developing geoparks was assessed.

The combination of the applied methods provided a multifaceted assessment of the natural and cultural heritage of the study area, which is an important foundation for the scientific justification of the creation of a geopark.

Results and Discussions

The Iori Upland Planned geopark is a unique natural and cultural heritage area of Georgia, where the diversity of arid landscapes, the dynamics of natural processes and the traces of centuries-old human activity are particularly evident. The study area is distinguished by the spread of semi-desert and steppe ecosystems, which gives the region distinctive geographical significance compared to other regions of Georgia. Against the background of modern environmental challenges, the study of desertification processes is particularly relevant, since climate change, soil degradation and anthropogenic impact have a significant impact on the natural environment of the Iori Upland.

The territory of the Planned geopark is also rich in historical and archaeological monuments, which clearly reflect human adaptation to difficult natural conditions and the centuries-old history of cultural development in the region. The ancient settlements, burial grounds, cult buildings and other cultural heritage sites present here are an important scientific source for studying the history of both Georgia and the Caucasus. In addition, the Iori Plateau is distinguished by its biodiversity - a number of endemic and rare species of plants and animals are found in the region, which are adapted to dry and harsh

environmental conditions. It is precisely the combination of natural, geological, historical-cultural and ecological values that defines the scientific significance of the Iori Plateau Geopark and determines the necessity of its research, protection and sustainable development. Of the many factors for creating a geopark on the Iori Plateau, the paleoclimate factor is important, because the formation and development of the landscape on the Iori Plateau, together with the anthropogenic factor, is determined by long-term and variable paleoclimate processes that have been developing since the Neogene period to the present day. Anthropogenic processes played a special role in the formation of modern landscapes during the Lower Holocene and especially during the Iron Age and Early Antiquity.

The intensification of the desertification process in semi-arid and partially subhumid regions, where the steppe, forest-steppe, savannah and forest biocenoses are being replaced by semi-desert and desert biocenoses. The importance of this problem is evidenced by the fact that in 1994 the United Nations adopted a special Convention on Desertification (United Nations…, 1994). The Convention also mentions Transcaucasia among the various regions of the world that are threatened with desertification. The main reason for the intensification of the desertification process is considered to be modern global warming and the negative impact of the anthropogenic factor on natural landscapes (Kiguradze, 1976).

In Transcaucasia, the desertification process is observed in the eastern part of its intermontane plain – the Mtkvari-Araks lowland and the adjacent foothills. In the eastern part of Georgia, this process is taking place in the Kvemo Kartli plain (Rustavi-Gardabani and Marneuli plains with the adjacent foothills) and on the Iori plateau (Gareja-Iori physical-geographical sub-district, Eldari plain, etc.).

The Gareja-Iori physical-geographical subregion (where the creation of the Ivor Upland Geopark is envisaged), which is located at an altitude of 300-900 m above sea level, is characterized by a hot and dry climate and a sharp deficit of precipitation. The study area is bordered by the Ivor River in the north and northeast, and its southern border coincides with the state border of Georgia and Azerbaijan. The relief of the Gareja-Iori subregion is represented by monoclinic mountains, strongly dissected by erosion-denudation processes, quester ridges and synclinal plains-tapas located between them. The annual total of atmospheric precipitation in this subregion does not exceed 400 mm, and evaporation reaches 1000 mm (Ukleba, 1968). Accordingly, the humidity coefficient is low, the annual rate of which is 0.50-0.65, and in summer - 0.20-0.30. In hot and dry climate conditions, the Gareja-Iori sub-district is devoid of permanent rivers and fresh springs. The presence of saline springs and brackish lakes is noted here and there. In the southern part of the sub-district (the mountains and ridges of the Great Desert, Desert, Yailajikha, Alajadara Taphobi) secondary dry fields, scattered xerophytic shrubs, semi-desert and partially desert Uroyan-Avshnian, Khurkhumoyan Avshnian and Choronyan-Avshnian plant associations are developed. In the central part (the desert plain, along with the surrounding hills and hills), floristically impoverished secondary steppe coenoses are represented, partly created by herbaceous species typical of semi-deserts, while in the northern part (the mountains and seres of Demurdal, Midlad, Natamarigori, Uzundara, Dzhikur and other plains and taphobys) – secondary jag-thorn-sedge-bark fields and xerophytic shrubs (Ketskhoveli, 1960; Ukleba, 1968).

The results of paleogeography and geobotanical studies (Ketskhveli, 1960; Vekua, 1984; Gogichaishvili, 1984) indicate that the process of desertification on the Iori plateau began much earlier than modern global warming and was due not to natural aridization of the climate, but to the strong impact of the anthropogenic factor on natural landscapes. It has been established that in the territories of the Gareja-Iori sub-district in the middle Holocene (4000-6000 years ago) broad-leaved (mainly oak-hornbeam forests), floodplain and arid sparse forests, steppe and meadow landscapes were widespread. The main edificators of forests - oak, hornbeam, sakmlishche and others, are currently preserved only as derivatives in single specimens here and there among the bushes of privet and fruit trees. The widespread distribution of forest coenoses in the past is also indicated by the fact that the black soil, chestnut and Russian-brown soils of the Kvemo Kartli Plain and Gareja-Iori sub-district have preserved signs of transition from forest soils to dry field and semi-desert soils. Traces of the development of soil-forming processes characteristic of dry field and semi-desert soils are more prevalent in these soils. This fact is explained by the rather long-standing spread of semi-desert and partially desert vegetation from the east (from the Mtkvar-Araks lowland) in these regions (Sabashvili, 1965; Nakaidze, 1979).

In recent decades, about two dozen archaeological sites (cities, burial mounds, kurgan burials) of all stages of the Bronze Age (second half of the 4th millennium BC - the end of the 2nd millennium BC) and the Early Iron Age (beginning of the 1st millennium BC) have been discovered in the Gareja-Iori sub-districts. The study of these sites has confirmed that the territory of the Gareja-Iori sub-district was completely inhabited by humans from the second half of the 4th millennium BC to the beginning of the

ancient period (Kakheti, 2005). The ancient population of this sub-district had highly developed agriculture and animal husbandry, and metallurgical activities (iron smelting and export) were the main lever of its economic development. It is noteworthy that the "Naoamari Gori" settlement discovered in the Gareja-Iori sub-district, whose age, according to a series of radiocarbon dates, is determined to be 12th-11th centuries BC, is so far the only monument of the 2nd millennium BC in the Caucasus whose stone architecture (a 1 km long and 5-6 m wide stone wall, etc.) is well preserved.

The available evidence suggests that the desertification process on the Iori Plateau began much earlier than modern global warming and was mainly due not to the natural aridification of the climate, but to the impact of irreversible anthropogenic modification of the natural landscapes of this region. The growing anthropogenic load on natural landscapes led, first of all, to deforestation, and, consequently, to a sharp aridification of the climate. The previously existing ratio between temperature in the soil and surface layers of the air and atmospheric precipitation was gradually disrupted, evaporation increased, soil moisture content decreased, and a negative moisture balance was formed. Paleogeography and paleobotanical data show that by the beginning of the ancient period, a hydroclimatic regime characteristic of a dry plain and semi-desert had already been established on a significant part of the territories of the Gareja-Iori sub-district, which gave rise to the beginning and development of the desertification process. The desertification process in these regions was first manifested from the east - from the Mtkvar-Araks lowland through the Eldari plain - by the spread of semi-desert and desert vegetation formations (Avshnian, Karaghani, Khurkhumoyan, etc.).

The negative impact of the development of the desertification process on the living conditions of the ancient population is clearly visible on the example of the Gareja-Iori physical-geographic sub-district. The evidence suggests that the need for fresh water of the ancient population of this sub-district should have been completely provided by local fresh springs. The sharp aridization of the climate led to the intensification of the process of leaching of easily soluble salts from the Neogene rocks of the sub-district's surface and, consequently, the transformation of fresh springs into brackish springs. This fact, together with the aridization of the climate, must have been one of the reasons why the permanent population gradually left the Gareja-Iori sub-district in antiquity. Here, only the Gareja monastery monuments founded in the 6th century AD continue to have uninterrupted monastic life.

Currently, the scale of the negative impact of human economic activity (agriculture, animal husbandry, improper land reclamation, etc.) on the landscapes of the Gareja-Iori sub-district far exceeds the self-recovery capabilities of the ecosystems of these regions. Due to this, a more or less irreversible process of ecosystem degradation and desertification is underway. The desertification process in these regions is so obvious that even in the floodplain forests that still remain as separate massifs, desert elements are being intruded. It is clear that, along with the anthropogenic factor, modern global warming also creates favorable conditions for the development of the desertification process in these regions.

Modern studies show that the Iori Plateau remains a region particularly sensitive to climate change, where increasing temperatures and decreasing precipitation may further enhance the expansion of arid landscapes in the future.

Conclusion

The creation and development of the Iori Upland Planned geopark is based on the complex combination of natural and cultural heritage that reflects the evolution of a specific territory. In this process, as we have noted, special importance is attached to paleogeography, paleoclimate and archaeological factors, since it is their interaction that creates the scientific, educational and tourist value of the geopark.

Paleogeography studies allow us to restore the geological past of the territory, identify the stages of relief formation and assess the role of natural processes that have shaped modern landscapes. Paleoclimate data provide information about past climatic conditions, environmental transformation and adaptation of natural systems, which is especially relevant against the backdrop of modern climate change. In addition, archaeological heritage confirms the centuries-old relationship of man with the environment and demonstrates the ways in which natural resources and landscapes have influenced the development of society.

Within the framework of the Iori Upland Planned geopark, the above-mentioned components create a single space where natural history and human history are closely interconnected. Their protection and popularization will contribute not only to the preservation of geoheritage, but also to the deepening of scientific research, strengthening of education and the development of sustainable tourism. Accordingly, an integrated assessment of paleogeography, paleoclimate and archaeological heritage is

one of the main scientific foundations for the creation and functioning of the Iori Upland Planned geopark, which determines their local, national and international significance.

Competing interests

The authors declare that they have no competing interests.

Authors' contribution

All authors provided critical feedback and helped shape the research, analysis and manuscript.

ORCID iD

Zurab Janelidze https://orcid.org/0000-0003-2608-8031

References

Gogichaishvili, L. (1984). The vegetation of the lowlands and foothills of Kvemo Kartli during the Holocene. In Man and His Environment. Tbilisi.

Kakheti. (2005). Kakheti: A generalized work on the past and present of Kakheti. Tbilisi.

Ketskhoveli, N. (1960). Vegetation of Georgia. Academy of Sciences of the Georgian SSR. Tbilisi.

Nakaidze, E. (1979). The gray-brown soils of Georgia. In "Genetic Types of Soils of the Subtropics of Transcaucasia". Moscow.

Kiguradze, T. (1976). Periodization of the early agricultural culture of Eastern Transcaucasia. Tbilisi.

Sabashvili, M. (1965). Soils of the Georgian SSR. Tbilisi.

Ukleba, D. (1968). Physical-geographical zoning of Eastern Georgia. Tbilisi.

United Nations. (1994). United Nations Convention to Combat Desertification. Paris, France.

Vekua, A. (1984). The fauna of Eastern Georgia during the Eneolithic period based on materials from the settlement of Arukhlo (6th–4th millennium BC). In "Man and His Environment". Tbilisi.