Geoecological Characteristics Of Namangan Region Under Climate Change Conditions

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Abstract
This article analyzes the geoecological characteristics of the Namangan region under the conditions of climate change. It examines processes such as rising temperatures, changes in precipitation levels, depletion of water resources, and soil degradation within the region. The study also explores the impact of human activities on the natural environment and provides recommendations to ensure ecological sustainability. The article aims to present a scientifically grounded understanding of regional environmental issues.
Keywords: climate change, geoecology, Namangan region, water resources, soil degradation, ecological sustainability, natural environment, anthropogenic impact, biosphere, environmental problems.

At present, the ongoing global climate change and associated climatological transformations are exerting significant influence—and in some cases, posing serious threats—to the social, economic, and ecological dimensions of human life. The steady rise in average temperatures has the potential to cause severe negative ecological consequences. The increasing frequency and intensity of heatwaves are altering the natural cycles of water resource formation, leading to more extreme atmospheric phenomena such as prolonged droughts and heavy rainfall events.

Moreover, glaciers and snow reserves—which play a crucial role in regulating natural water flow within ecosystems—are being adversely affected by the rise in mean temperatures. This, in turn, may result in destructive environmental outcomes. Currently, global climate change is impacting various components of the environment and their specific properties, as well as influencing multiple socio-economic sectors.

According to climate monitoring data across the territory of Uzbekistan, a steady warming trend has been observed since the 20th century and the beginning of the 21st century. The rate of temperature increase exceeds 0.2°C per decade, which is about 40 percent higher than the average rate of warming in the Northern Hemisphere. Global climate change has complicated the climatic conditions of the region—intensifying summer droughts and heatwaves, while prolonging cold winters. In the Aral Sea region, the number of days with temperatures above +40°C has doubled over recent decades.

Uzbekistan is considered one of the countries most vulnerable to climate change. Without timely adaptation measures, the nation may face serious challenges related to water scarcity and land degradation. As a consequence of global warming, snow cover is decreasing, and evaporation rates are increasing. The growing frequency and intensity of droughts can disrupt the stability of agricultural production and undermine food security. Additionally, summer heatwaves, spring floods and mudflows, and winter landslides may negatively affect populated areas and critical infrastructure throughout Uzbekistan. The lower reaches of the Amu Darya River are currently suffering from acute water shortages and frequent dust storms.

Similar to other parts of Uzbekistan, the use of natural resources in the Namangan region has become increasingly complex under the conditions of a market economy. In the present era,

studying the consequences of human impact on the natural environment—as well as understanding the changes occurring in the interrelations of natural-geographical components resulting from human economic activity—holds great scientific and practical significance.

The Namangan region, located in the temperate climatic zone of Central Asia, is primarily influenced by solar radiation, which serves as the main climatic factor determining the thermal regime of the area.

Despite its relatively small area, the Namangan region encompasses several distinct climatic zones. In the southern desert areas, the average annual precipitation does not exceed 200 mm, reflecting an arid desert climate. In the foothill depressions and intermountain plains, annual precipitation ranges between 200 and 400 mm, corresponding to a steppe climate. The foothill zones experience a moderate climate with precipitation exceeding 400 mm per year, while the upper basins of the Chodaksay and Ohangaron rivers are dominated by a mountain climate. These climatic contrasts distinguish Namangan markedly from its neighboring regions, Andijan and Fergana.

The climate of the Fergana Valley is shaped by its geographical location, remoteness from the ocean, and enclosure by high mountain ranges, as well as by radiative and atmospheric circulation processes. As a result, the region exhibits a strongly continental climate, with clearly pronounced semi-desert characteristics.

The climate of Namangan region is determined by a combination of factors including its geographical position, solar radiation, atmospheric circulation, topography, surface conditions, vegetation cover, and the influence of human economic activity under specific environmental circumstances. Among these, the geographical position and the associated level of solar radiation play the most significant role.

Solar radiation constitutes the primary energy source for all natural processes. Its intensity, in turn, depends on the geographical latitude, the degree of atmospheric transparency, and the duration of sunshine throughout the year.

The formation of the distinct climatic features of the Namangan region is influenced by the Arctic air masses moving from the north and the tropical air flows advancing from the south. Although these air currents are often obstructed by the surrounding high mountain ranges, upper atmospheric flows can freely penetrate the territory of Namangan, producing the major portion of the region’s precipitation.

In autumn and winter, the intrusion of cold Arctic air masses causes a sharp drop in air temperature, while humid Atlantic air masses contribute to an increase in precipitation. During summer, the prevalence of moderate and tropical air currents results in dry and hot weather conditions across the region.

The southern, lowland parts of Namangan region are characterized by a strongly continental climate. The average temperature in January ranges between –0.2°C and –2.4°C, with absolute minimums reaching –27°C to –29°C. In July, the average temperature varies from +20°C to +28°C, and the maximum temperature can reach +44°C. The annual precipitation amounts to 150–180 mm (according to data from the Namangan meteorological station), most of which falls during winter and spring, while summer precipitation is minimal—around 10–15 mm. The average snow cover thickness is 10 cm, occasionally exceeding 20 cm, and it persists for 20–40 days.

In the plains, western winds (Kokand winds) prevail from May to February, while eastern winds dominate from December to February. Notably, winds exceeding 15 m/s may last for over 30 days, causing serious damage to agricultural activities.

In the foothill, piedmont, and low-mountain zones, the climate varies considerably from west to east and from south to north (Kosonsoy meteorological data). Daily and annual temperature fluctuations are significant, reflecting the highly continental nature of the local climate. The average January temperature ranges between –6°C and –8°C, with extreme lows of –29°C to

–30°C, while in July, the average temperature is +26°C to +28°C, and maximum values reach +43°C to +44°C.

In the mid- and high-mountain regions, winters are cold (–3.5°C to –4°C), while summers are relatively cool (+20°C to +21°C). As altitude increases—and moving from west to east and toward the northeast—the amount of precipitation also changes noticeably. For instance, the annual precipitation averages 161 mm in Pop, 148 mm in Paxtalikul, 256 mm in Qizilrovot, and 315 mm in Kosonsoy.

In the Namangan region, hailstorms that recur annually cause significant economic losses, particularly in the foothill and piedmont districts such as Chust, Kosonsoy, Yangiqorgon, and Chortoq. According to long-term meteorological data, hail events most frequently occur during the crop planting, growing, and harvesting seasons, as well as during fruit tree flowering and ripening periods—that is, from mid-March through April and May, and especially during June and July, when fruit trees bear mature crops.

The average wind speed of the northern winds in the region ranges between 1–3 m/s, with a recurrence rate of 30–80 percent. Northwesterly winds also occur frequently. The northern winds, known locally as “Kosonobod winds,” are mountain-valley winds that move through river valleys primarily at night.

In the development and specialization of agricultural sectors, factors such as relief, climate, soil composition, water availability, and natural pastures play a crucial role. The existing agroclimatic conditions and socio-economic factors have contributed to the formation of a diversified agricultural structure in the Namangan region. This includes the cotton industry complex (encompassing cotton cultivation, processing, and manufacturing), as well as fruit growing, viticulture, vegetable and melon farming, potato cultivation (adapted to the region’s terrain, soil, and climate), and livestock breeding, which is based on crop rotation between cotton and alfalfa and the use of natural pastures.

At elevations where the average air temperature exceeds +10°C, the accumulated temperature sum reaches approximately 4700°C at 500–550 m, 4400°C at 550–750 m, and 4100°C at around 750 m above sea level.

In the plains, cotton and rice cultivation are well developed. These territories are characterized by a continental climate, with average January temperatures between 0.2°C and 2.4°C, and July averages from +20°C to +28°C. The annual precipitation ranges from 150 to 180 mm, and the vegetation period lasts 230–240 days. The sum of temperatures above +10°C averages 4600–5000°C. The predominantly clear skies during the growing season enhance the sweetness and flavor of fruits while also reducing the incidence of plant diseases.

In the foothill regions of Chust, Pop, Kosonsoy, Chortoq, To‘raqo‘rg‘on, and Yangiqo‘rg‘on, the average annual air temperature ranges between +20°C and +25°C, with maximum values reaching +40–41°C. The average temperature in January varies from –1.5°C to –4°C, while the absolute minimum reaches –20°C to –28°C. The vegetation period lasts 220–230 days, and the amount of precipitation is relatively higher compared to the plain zones.

Until recent decades, these foothill areas were mainly used as spring and partially summer pastures. Since the 1970s, however, intensive land development, the construction of irrigation facilities, and the introduction of pump-based watering systems have expanded the cultivated lands, particularly increasing cotton-growing areas through the establishment of specialized farms.

The foothill zone of the region is characterized by a comparatively cooler climate. The average air temperature in January ranges between –2°C and –4°C, while in July it reaches +20°C to +21°C. The annual precipitation varies between 250–500 mm, and the vegetation period lasts 180–200 days. Agro-climatic conditions in this zone are favorable for rain-fed farming, horticulture, viticulture, fodder crop cultivation, and livestock breeding.

Under the influence of favorable agro-climatic and socio-economic factors, a distinctive system of agricultural production has formed in the Namangan region. The region specializes in the

cultivation of cotton, as well as a wide variety of fruits and vegetables. The total agricultural land area amounts to 230,000 hectares, of which 42% is occupied by cotton, 42% by grain crops, 8% by vegetables, 4% by fodder crops, and 4% by other types of crops. The soil and climatic conditions of Namangan region are highly suitable for vegetable and melon cultivation. However, hailstorms and heavy showers often cause significant economic losses to croplands. To mitigate these natural hazards, an anti-hail military unit was established in 1969. Despite the implemented preventive measures, severe rainfalls and hail events continue to occur. Moreover, the silver iodide particles used for cloud seeding have been found to fall with rain, contaminating fruit and vegetable crops and increasing the spread of various plant diseases. This situation suggests that, in the long term, it may be advisable to abandon the use of militarized anti-hail services in the Fergana Valley — one of the most densely populated regions of the country.

In addition to favorable agro-climatic conditions, the Namangan region provides excellent opportunities for the development of greenhouse farming. Greenhouse agriculture plays a vital role in meeting the population's demand for fresh vegetables during the winter and spring seasons. In recent years, greenhouse vegetable production has significantly expanded. The total area of greenhouse facilities in the region exceeds 157 hectares, with an average yield of 6.1 kilograms of vegetables per square meter.

According to the classification proposed by L.N. Babushkin, N.A. Kogay, and Sh.S. Zakirov (1985), the territory of the Namangan region can be divided into the following agro-climatic zones: Hot zone (≥5000–4500°C), Moderately warm, hot, and dry zone (4500–4000°C), Warm and humid zone (4000–3000°C), Cool and moist zone (3000–1000°C).

In accordance with this classification, the agro-climatic zones identified within the Namangan region possess distinct features and are distributed differently across its districts. Specifically, the territories of Mingbulok, Namangan, To‘raqo‘rg‘on, Uychi, and Norin districts, as well as the southern parts of Pop, Chust, and Chortoq districts, fall within the *hot zone*. The foothill plains and piedmont areas of Pop, Chust, Kosonsoy, To‘raqo‘rg‘on, Chortoq, and Yangiqo‘rg‘on districts belong to the *moderately warm, hot, and dry zone*. The *warm and humid zone* encompasses the mid-altitude mountain areas of the region's foothills, while the *cool and moist zone* corresponds to the high mountainous areas.

Considering the agro-climatic characteristics of Namangan region, the following zoning of agricultural crops is recommended. In the *hot agro-climatic zone*, it is advisable to cultivate late-maturing (fine-fiber) varieties of cotton, grain crops, and melon crops. In the *moderately warm and dry zone*, cultivation should focus on medium- and early-maturing cotton varieties, orchard crops, vineyards, vegetables, potatoes, and grain crops (especially wheat). The *warm and humid zone* is suitable for potato cultivation, vegetable growing, viticulture, and forage crops, while the *cool and moist zone* provides favorable conditions for the development of fodder crops and natural pastures.

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