Climatic conditions of Samarkand region and their impact on agriculture

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Abstract: This article analyzes the geographical location and climatic characteristics of the Samarkand region and their impact on agricultural production. The study examines key climatic indicators - temperature, precipitation, wind direction, humidity, and solar radiation - and their influence on crop productivity. The findings show that Samarkand's continental and arid climate provides favorable conditions for cultivating crops such as cotton, wheat, vegetables, grapes, and fruits. However, limited rainfall, water scarcity, and high summer temperatures pose certain challenges to agricultural sustainability.

Keywords: Samarkand region, Climate conditions, Temperature, Precipitation, Continental climate, Drought, Water scarcity, Irrigation system, Crop yield, Cotton cultivation, Horticulture

Introduction. Samarkand region is located in the central part of Uzbekistan, within the Zarafshan River basin. It borders Navoiy region to the north and west, Kashkadarya region to the south, Jizzakh region to the northeast, and Sughd region of Tajikistan to the east. The central part of the region consists of valleys and foothills stretching between the Zarafshan and Turkestan mountain ranges. Most of the irrigated lands are concentrated in this area.

Due to its favorable natural-geographical conditions - clean air, fertile soils, and abundant water resources - the region has been inhabited since ancient times. The diversity of its landscapes, from mountains to plains, determines variations in climate and agricultural activity.

Climatic Characteristics. The climate of Samarkand region is continental, dry, and warm. It can be divided into two climatic zones:

Northern and western parts - more continental, with cold winters and hot summers.

Central, southern, and eastern parts - subtropical tendencies with mild winters and warm summers.

The average annual temperature is about +16.5°C; the January average is 0.2°C, and July averages +27°C, with recorded extremes from -22°C to +44°C. The annual precipitation ranges between 310-330 mm, mostly occurring in spring and autumn. The vegetation period lasts about 218-220 days.

The region's soils include meadow-gray, sandy, and saline types, which influence agricultural productivity and irrigation needs.

Impact of Climatic Factors on Agriculture

Temperature. Temperature plays a decisive role in determining crop types and vegetation periods. During winter, temperatures may drop to -20°C to -25°C, which can damage early-blooming fruit trees such as apricots, almonds, and peaches. For instance, in January 2022, frost in Pastdargom and Urgut districts reduced apricot yields by 35-40%.

In summer, temperatures often rise to +40-45°C, accelerating the ripening of cotton and wheat but intensifying water shortages. In Kattakurgan district, temperatures above +44°C have reduced cotton yields by up to 9%. Moderate spring temperatures (+15…+25°C) are optimal for cereal and vegetable growth, increasing productivity by up to 10%.

Precipitation. The region receives an average of 310-330 mm of precipitation annually, with 60-70% falling in March-April. This period provides sufficient moisture for rain-fed crops such as wheat, barley, and alfalfa, raising yields by 10-12%. In summer, rainfall drops to 5-10 mm, and soil moisture decreases by 25-30%, increasing irrigation demand. In mountain areas (Urgut, Qushrabot), annual precipitation reaches 450-480 mm, suitable for rain-fed farming.

Empirical data show a direct correlation between rainfall and yield: when annual precipitation exceeds 400 mm, wheat yields reach 32-35 centners/ha, while less than 300 mm reduces yields to 25 centners/ha. Therefore, water-saving technologies such as drip irrigation and moisture-conservation methods are essential for arid zones.

Atmospheric Pressure. Atmospheric pressure fluctuates seasonally with temperature. According to the Uzbek Hydrometeorological Service (O‘zgidromet, 2023), the lowest air pressure is recorded in summer-965-968 mb-when high temperatures cause rapid evaporation and soil moisture loss. Consequently, irrigation intensity must increase to maintain yields. In contrast, winter pressure rises to 980-982 mb, bringing cold air masses that can harm winter crops and vineyards. Implementing greenhouse technologies, wind barriers, and cold-resistant varieties can mitigate these effects.

Agricultural Structure and Regional Differences. In 2025, the agricultural sector of Samarkand region accounted for 12% of Uzbekistan's total agricultural output. The largest agricultural volumes were produced in Urgut (896.1 billion UZS), Ishtikhon (624.9 billion UZS), and Toyloq (620.9 billion UZS) districts. The smallest outputs were observed in Kattakurgan city (25.2 billion UZS) and Samarkand city (31.0 billion UZS) (4).

Temperature, precipitation, and soil conditions vary across three main zones:

Mountain zones (Urgut, Qushrabot) - cooler climate; fruit-growing and livestock farming dominate.

Foothill zones (Ishtikhon, Nurobod) - moderate climate; cereals and vegetables are common.

Valley zones (Samarkand, Kattakurgan) - hot and dry climate; cotton and melon cultivation prevail.

Discussion. Climate change and global warming have become increasingly evident in Samarkand over the last four decades (1980-2020), with rising average annual temperatures and declining water availability. This necessitates the modernization of irrigation systems, development of climate-adapted crop varieties, and improved agro-meteorological monitoring.

Rational use of climatic resources, efficient water management, and modern irrigation technologies are key to maintaining stable productivity. Agro-climatic zoning should guide crop placement, while scientific monitoring of the “temperature-yield” relationship supports adaptive decision-making in agriculture.

Conclusion. Samarkand region’s natural and climatic conditions are favorable for diverse agricultural development. Its warm and sunny climate, long growing season, and fertile soils provide a strong foundation for cotton, wheat, vegetable, fruit, and grape cultivation. However, the region faces challenges such as low precipitation, water scarcity, and summer droughts, which limit agricultural sustainability.

Adopting water-efficient technologies, climate-resilient crops, and scientifically grounded agro-technical methods can stabilize yields and support long-term productivity. By integrating natural potential with modern agricultural policies, Samarkand can achieve economically and ecologically sustainable rural development.

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