



## **FACTORS AFFECTING THE MANAGEMENT OF HILL REGION ECOSYSTEMS AND THEIR CHARACTERISTICS**

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<b>Article history:</b>	<b>Abstract:</b>
<b>Received:</b> 20 <sup>th</sup> April 2025 <b>Accepted:</b> 14 <sup>th</sup> May 2025	This article analyzes the main characteristics and specific features of the document that affect the management of high-altitude ecosystems. High-altitude areas have a complex structure, which requires a specific ecosystem management. The article focuses on the impact of the "Anthropogenic" factor, that is, the "Human" factor, which affects high-altitude ecosystems, that is, weakens them, ultimately bringing them to a completely irreversible level, and its specific features, using the example of the high-altitude areas of Andijan region (Uzbekistan), one of the most densely populated regions.

**Keywords:** Ecosystem management, ecosystem change, densely populated areas, Central Fergana Plains, permanent and seasonal flows.

**INTRODUCTION.** It is well known that any ecosystem has two separate factors or components (i.e., abiotic and biotic). Abiotic factors or components are inanimate, such as rocks, climate, relief, moisture, etc. Biotic factors or components include all living organisms on Earth (such as bacteria, animals and plants). In an ecosystem, these two factors or components are interconnected. If these ecological factors are in crisis, the ecosystem of our planet will fail and expose humanity to various disappointments.

The factors mentioned above are, of course, natural factors. Studies conducted by ecologists show that there is also an "Anthropogenic" or "Human" factor that affects ecosystems, that is, weakens them, ultimately bringing them to a completely irreversible level. So, the Human factor is constantly changing natural ecosystems, which is why the expression "Ecosystem Change" is used in science. Of course, this mainly refers to events or processes that disrupt the functioning of the ecosystem. As mentioned earlier, these are changes that are not internal (i.e., natural factors), but external (anthropogenic factors). In some cases, an external event or activity can completely destroy an ecosystem.

**RESEARCH MATERIALS AND METHOD.** The world economy and its economic activities, although existing in a single global ecosystem, differ from region to region and country to country and change rapidly over time. This can be called the "Definition of our Changing Economic World"[1].

As the geographical latitudes move away from the equator, climatic conditions also change. Especially at these latitudes, the location of the Seas and Oceans, Mountains, Deserts and rivers also form a complex ecosystem. Some regions (countries) have many rivers

and if they are wet, this indicates the presence of high mountains in this region and the fertile soil of the plains. Naturally, people have lived in these regions from the beginning and have increased in number and density. Therefore, the natural growth of the population has a great influence on the existing ecosystem.

In this article, we will examine the factors affecting the management of hilly ecosystems and their specific characteristics, using the example of the hilly areas of the Andijan region, the most densely populated region of our Republic.

Hill - geomorphologically understood in the sense of a highland region and landscape. So, from a geomorphological point of view, hills are elevations located in front of a mountain, up to 1000 m. high. From the point of view of the Hill region, the highland region is understood as a semi-desert and dry steppe between the desert and the mountain region.

### **Natural conditions of Andijan region.**

Andijan region (area 4.2 thousand km<sup>2</sup>) is located in the easternmost part of the Republic of Uzbekistan, therefore it is considered the "Eastern Gate" of the country. It is located in the eastern part of the Fergana region, mainly in the Karadarya basin, between the Fergana and Aloy mountains, on the Kashgar - Osh - Kokand - Tashkent route of the "Great Silk Road", in the center of a region of intensive irrigated agriculture and a large and very densely populated area. It borders the Kyrgyz Republic (Jalal-Abad and Osh regions) to the north, east and southeast, Fergana region to the southwest, and Namangan region to the northwest.



**ANALYSIS AND RESULTS.** In the mountainous regions of our country, due to the different nature and strength of tectonic movements, one part of it rises, while the other part subsides. The raised parts correspond to mountain ranges, and the lowered parts correspond to intermountain depressions. Under the influence of water flowing from the raised parts and other natural processes, the eroded rocks began to accumulate in the places of subsidence, as a result of which layers of sedimentary rocks were formed in the depressions. The Fergana Depression, including the Andijan region, is characterized by the fact that it is covered with such sedimentary rocks. We can clearly see this in the exposed places of the earth's layers, in steep cliffs [2].

The flat part of the Fergana Valley is called the "Fergana Basin", and it is surrounded by hills and mountains that differ from each other in terms of geological features and relief. The fact that the territory of Andijan region is also administratively located in the Fergana Valley is largely similar to the geological development history of Namangan, Fergana, and the Osh region of Kyrgyzstan and the Khujand region of Tajikistan. Due to this, the surface of the region is filled with proluvial-alluvial rocks. In addition to the mountains, the region is surrounded by a region consisting of young (anthropogenic) folds. This young structure is called a "hill" or "hill divide". While Cretaceous rocks occur on the ground of the heights, sand, clay, loam and sandstones, gravel occupy the main place in the plains.

As the Fergana Valley became dry, proluvial-alluvial deposits consisting of gravel, sand, clay, and loess-like rocks were eroded by the wind, forming mobile sand dunes. This sand hill is clearly visible in the western part of the region, in the Ulugnar district.

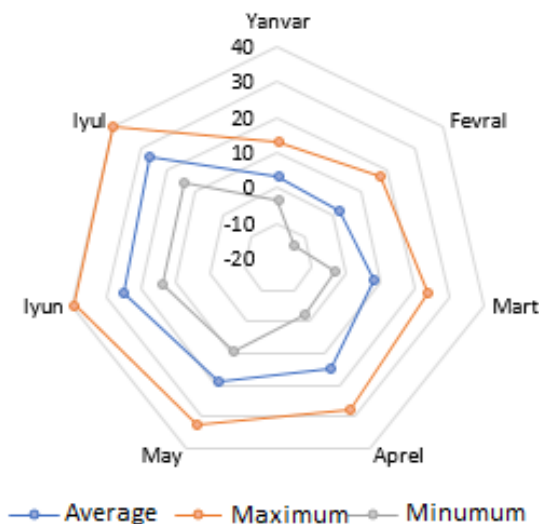
In the Fergana Valley, including Andijan region, in the Mesozoic era, there were shallow sea water and swamps, and dense forests grew around them. Then, coal layers were formed based on the remains of these plants, and oil and natural gas were formed based on the remains of animal organisms that lived in water bodies in the Paleogene period. These natural resources can also be seen in the example of oil and oil and gas extracted from the Andijan, Polvontash, Asaka, and Khojaabad hills.

The topography of the Andijan region is quite different from that of other regions of Uzbekistan. This is due to the fact that Andijan region is located in the

eastern part of the Fergana Valley (tectonic depression), and the territory is surrounded by hills and low mountains. In fact, the valley is surrounded by the Turkestan and Aloy mountain ranges from the south, Fergana and Otoynoki from the east, Karamozor from the north, and Mogultog from the west, which indicates the unique complexity of the region's relief. In addition to the mountains, it is surrounded by low mountains, including Kara-Chatyr, Kara Hill, Ulug' Tog, Kok Saray, Kaklik Tog, Kirtoshtov to the south, the Karatog Mountains to the east, and the hill ranges up to 1,200 meters high formed in the foothills: Asaka, Marhamat, Bulokbashi, Marhamat to the south, Ottiz-Adir to the southeast, Khanabad to the east, and Bazarkurgan and Pakhtaabad to the north.

The land surface of Andijan region rises from west to east. Ulugnor district, which is considered the westernmost part of the region, is located at an altitude of 400-406 m above sea level, rising to the east, Balikchi 414 m, Boz, Altinkul, Shahrikhan districts 424 m, Izboskan, Pakhtaabad districts 444 m, Asaka 472-659 m, Marhamat up to 800-1200 meters, Bulokbashi, Khojaabad, Jalolquduk up to 801-1545 meters, Kurgantepa 600-911-1350 meters, Andijan city and district are located 400-500 meters above sea level. The climate is sharply continental and dry. The western part of the Andijan region's surface corresponds to the eastern part of the Yozyavon desert, where it consists of low sand dunes and dunes of the Oqqum sands. The current appearance of the surface of the region is largely influenced by natural factors, namely tectonic movements, wind, flowing water, and anthropogenic factors. If it has become concave as a result of geological processes, then ravines, hills, and terraces have been formed as a result of erosion, erosion, and the movement of rivers. For example, the city of Andijan is located on four terraces of the Andijan stream, resembling a staircase. The surface of the region, as we have said above, is divided into hilly, foothill, and low mountains in the south, southeast, east, and northeast, surrounding the region like a "wall". These "natural walls" keep cold air out, which helps to keep the weather relatively stable in winter. Summers are hot, with an average July temperature of 26.3° (Figure 1), and winters are relatively cold, with an average January temperature of -3°. The growing season is 217 days. Annual precipitation is 200-250 mm[3].

**Air temperature in Andijan region**



**Figure 1. Air temperature in Andijan region.**

Andijan region is rich in water resources compared to other regions of Uzbekistan. Its rivers receive water from seasonal precipitation, perennial snow and glaciers in the mountains. The main river is the Karadarya (one of the tributaries of the Syrdarya). Its tributaries are Moylisuv, Akbora, Aravonsoy, etc. The soils consist of gray, brown, meadow, meadow-swamp soils, sandstone, marl, loess, and limestone. In spring, the hills are covered with ephemeral plants. In the uncultivated plains of the region, wormwood and saltwort plants grow, and pistachios and almonds grow

on the slopes of the mountains. Wild animals (wolves, foxes, wild boars, etc.) are rare; there are reptiles, rodents, birds, and fish in water bodies.

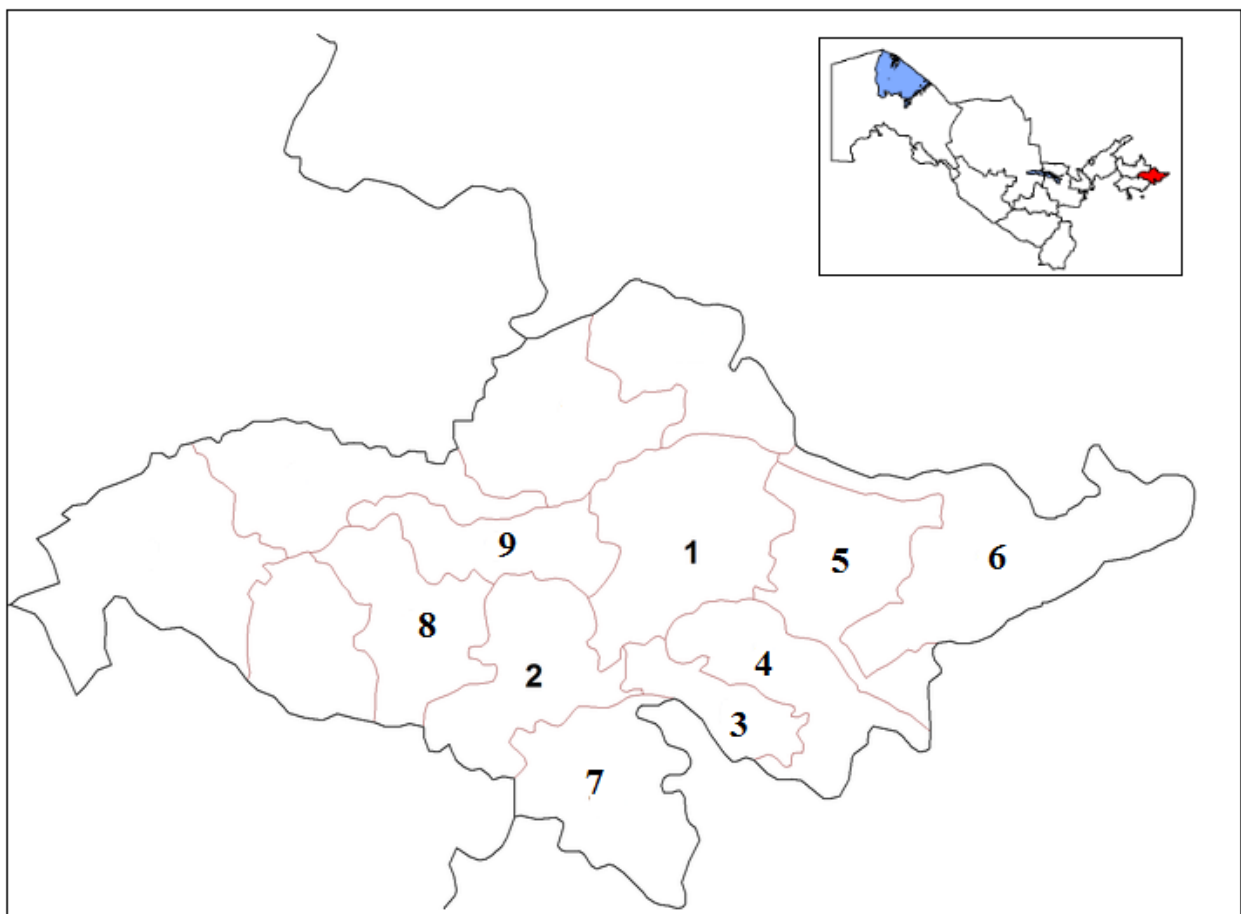
There are hilly areas (Table 1) in the Andijan region - Andijan, Buloqbash, Khojaabad, Asaka, Marhamat, Jalaquduq, Altynkol, Shahrikhan and Kurgantepa districts - with a total area of 44,034.6 hectares. About 22,484.2 hectares of these hilly areas (85 hectares in Altynkol and 2,778.4 hectares in Shahrikhan district) are not irrigated (Figure 2).

**Table 1  
 Hilly area in the Andijan region**

Land area (in hectares)	Total in Andijan region	Districts where the Hill people live								
		1. Andijon	2. Asaka	3. Buloqboboshi	4. Xo jaobod	5. Jalaquduq	6. Qo' g ontapa	7. Marhamat	8. Shahrixon	9. Oltinko' l
<b>Total land area</b>	44034,6	13446	5543,2	922,8	2313,2	9932,2	1476,7	7537,1	2778,4	85
<b>Of which: Irrigated area</b>	21550,4	7496,3	2505,1	78,4	1225	4631,1	791,3	4823,2	0	0

<b>Unirrigated area</b>	22484,2	5949,7	3038,1	844,4	1088,2	5301,1	685,4	2713,9	2778,4	85
<b>Generally unused space</b>	0	0	0	0	0	0	0	0	0	0

*Source: Obtained from the Andijan Regional State Cadastre Agency*



*Figure 2. Districts with hilly areas.*

The hilly areas are divided into 2 regions, namely the lower hilly and the upper hilly. The relief of the lower hilly areas is relatively flat, partly consisting of ridges and small hills. Its height is up to 900 meters above sea level, and it consists of light and typical gray soils. The humus content of the soils is low (on average around 1-1.5%). As the soil layer deepens, the amount of humus and other basic nutrients decreases.

The upper hilly terrain is quite uneven, consisting of low-lying and large-small hilly areas, located at an altitude of 900-1200 meters above sea

level, and is mainly soil, the type of which is dark gray soil.

The lithogenic (geological-geomorphological quality) basis, geological structure, development history, tectonics, geomorphological features of hilly areas play an important role in the formation of the ecological conditions of the region. Many scientific studies have been conducted by our and other foreign scientists on the geological structure, tectonics, development history and geomorphological conditions of hilly areas - A. Amberger (Soil fertility and plant



nutrition in tropical and subtropical regions)[4], A. Gafur et al. (Lost soil and nutrients in the Chittagong hilly areas of Bangladesh)[5] V.V. Miloserdov[6], V.Sadikov et al.[7], O. Mirzamakhmudov, K. Boymirzaev (2011, Problems of landscape-ecological conditions of hilly areas)[8], F.A. Mavlonov, G.F. Tetyukhin, N.A. Kogay, N.P. Vasilkovsky. Below, we will examine the explanations given by these scientists regarding the structure of the lithogenic base of the hill region, based on their data.

**Geological structure.** According to N.P. Vasilkovsky (1951), in the Pliocene period of the Neogene (the Neogene is divided everywhere into the Miocene and Pliocene complexes. The Miocene consists of marine and gypsum deposits, and the Pliocene consists of clayey sand deposits), only continental deposits were formed in the Fergana Basin. The Central Fergana plains and hilly areas became an area of accumulation of rocks eroded and broken down from the mountains during the Pliocene period of the Neogene. During this period, the thickness of the accumulated continental rocks reached 3000-4000 m. The deformations occurring as a result of tectonic upheavals that continued during the Miocene period of the Neogene gradually covered the high pre-tuff areas of the valley. As a result, the hill zone and synclinal (folded) zones between the hills and behind the hills were formed.

**Geomorphological structure.** According to their geomorphological structure, the hills are formed by: erosional tectonics; erosional-denudation (washing); permanent and seasonal water flows, and are divided into alluvial (muddy deposits) and proluvial (porous rock deposits) terraces.

1. The rocks of the Hillians are broken down into erosion-tectonic types;

2. Alluvial-proluvial flat plains of the Upper Pleistocene (Pliocene epoch - 2.6 million to 12,000 years ago), strongly dissected by erosion-denudation;

3. The alluvial-proluvial type, formed under the influence of permanent and seasonal flows, includes alluvial-proluvial fragmented plains of the Middle Pleistocene, alluvial-proluvial and alluvial flat plains of the Upper Pleistocene, correlative (interrelated) cone spreads, and plain terraces carved by river flow.

According to Y. Carton et al.[10], differences in soil properties associated with landscape location are usually due to differences in flow, erosion and deposition processes that affect soil genesis (the origin and formation of soil). According to the studies of W.J. Vreeken[11], changes in the properties of hilly soils can be attributed to changes in the topography of the

soil. On broad hills with gentle slopes, rainwater allows rapid vertical movement of the soil. Landscapes of this level have thick soil profiles and well-developed horizons.

Studying soil properties, particularly morphological and physicochemical properties, provides fundamental information for good plant growth and soil resource management (Md. Akhtaruzzaman, 2014)[12].

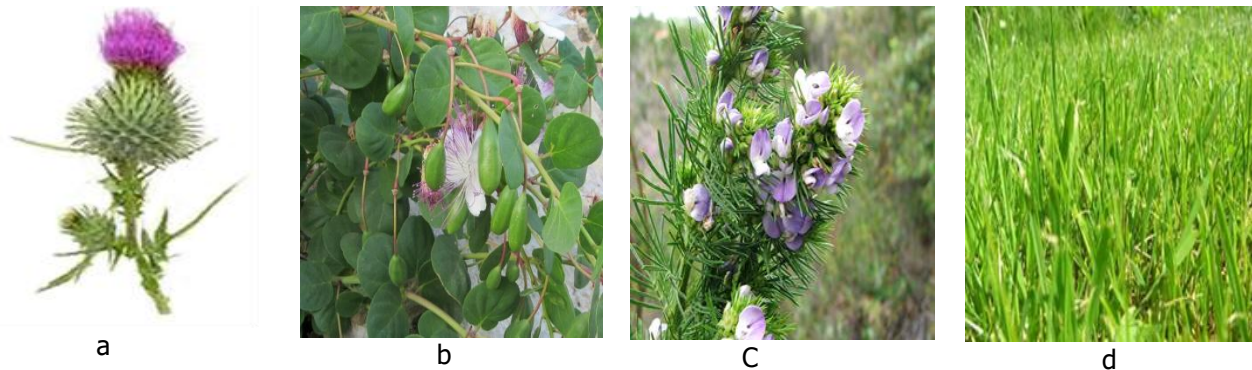
**Plant productivity and factors affecting it.**

There are four major factors that affect the productivity of any crop: soil fertility, water availability, climate, and disease or pest-related factors. These factors, if not controlled and properly managed, can pose a significant threat to the ecosystems of the area, including agriculture.

The flora and fauna of the hilly regions are very poor. The main plant cover typical of the lower hilly regions is ephemeral (with a short growing season, growing mainly in spring and autumn, when the soil is moist) and ephemeroïd (flowering and bearing fruit in spring, seeds ripening and falling, tubers, bulbils or rhizomes remain underground, and the above-ground parts dry out). Their root system is mainly distributed in the surface part of the soil (0-50 cm), forming a dense turf. This process is one of the important factors in protecting hilly soils from erosion.

These areas are home to ephemeral plants, such as daisies, crocuses, tulips, and other species that have similar growth rhythms. They grow in the fall, winter, and spring seasons, and stop growing during the hot summer months. The climate of the Hills is somewhat different from that of other desert regions. The Hills have fewer hot summers and more rainfall. The rainy season lasts much longer than in the plains.

In the hilly regions, along with plants with a short vegetative period, some annual and perennial complex flowering plants, umbellifers, and legumes with a long vegetative period also grow. For example: a) Karrak; b) Kavar (in fact, our people also call the Kovul plant kavar. Experts associate the origin of this name with the "Dashti Kavir Desert" in Iran. Because Kovul is the most common plant in this region); c) Aqqurai; and d) Bug'dayik are most common. The upper hilly regions are occupied by a dry steppe where various herbs grow. Shrubs grow on the rocky and gravelly highlands of the hilly regions. Among these, one can usually find pistachio, almond, red currant, as well as old lady's broom and botakoz (Figure 3).



*Figure 3. Some annual and perennial plants with a long vegetative period that grow in hilly areas.*

One of the factors affecting plant productivity is the carbon dioxide gas absorbed by the leaves, which is exchanged with water evaporated by transpiration, resulting in the formation of carbohydrates. During photosynthesis, solar radiation falling on the leaf surface is converted by chloroplasts. This creates proteins, lipids, enzymes and dozens of compounds that are complex in their composition. As a result, metabolism occurs.

In some parts of the Hilly region, shifting cultivation is practiced, mainly growing wheat and barley. In the upper part of the Hilly region, where there is a lot of rainfall, grain crops grow well. Grain-legume plants, compared to other crops, accumulate free nitrogen from the air through their roots. Of course, this natural process can satisfy the biological need of the plant for nutrients.

**CONCLUSION.** As in other ecosystems, there are inextricable links between plants and soils in hilly ecosystems. Therefore, certain plant species or groups can act as indicators for soils. Plants are influenced to some extent by the chemical (humus, salt regime), physical properties (mechanical composition, structure, moisture, density, etc.) and associated microorganisms (bacteria, fungi, etc.) of soils.

Changes in ecological conditions lead to changes in the geochemical properties of the soil and, through it, to a stage of gradual development. As a result, "the genetic layers in the soil section, its natural properties and characteristics begin to change, and this leads to an increase in the level of natural fertility."

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