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MOUNTAIN GEOSYSTEMS: DEVELOPMENT AND PROBLEMS

***Summary.** The research area relates to the north-eastern part of Azerbaijan Republic. The available natural-geographical and soil-climatic conditions of this area, high biodiversity, unique and low-inclined relief and fertile lands along the river valleys were favorable places for settlement of population and development of farmlands throughout the history. Nevertheless, serious environmental problems related to nature use activities of humans are present even under conditions of high-level scientific and technological development. For this reason, one of the main objectives the contemporary global science is the protection of land resources, standing as the main food provider of the ever-growing world population. The geography of the area has been studied by some researchers in different years and in various aspects (Museyibov, 1998; Alizade, Tarikhazer, 2010; Mammadov Khalilov, 2002; Mammadov 2007 et al.), whereas the main emphasis was laid mainly on the formation and development of the area's landscapes. The territory of studied country is mountainous and here the per capita area of lands is less (0.18 ha). However, although land use has been led intensively in all times in the country, the problem of efficient use of mountain slopes has been studied weakly. The presented article deals primarily with scientific ways of solution of relevant problems.*

***Key words:** arid and denudational relief, degradation, mountain terraces, phytomeliorative measures.*

According to the carried estimates, each year 8 million hectares of arable lands in the planet become useless due to activities of farms, while 7 million hectares are degraded connected with various reasons. In other words, the Earth loses 15 million hectares of productive lands annually (6). This is a serious environmental problem and hazardous situation as well since the upper 1-1.5 meter layer of the Earth crust accounts for 99.8% of the planet's biomass and 90% of nutrients necessary for the world population. The problem of conservation of land resources is to be considered as one of most urgent global issues, with considering the fact that the planet's population continues to grow considerably and it is expected to see growth at 3.3 billion by 2050 and reach 9 billion people. The protection of soil cover as well as the more efficient use of lands under the conditions of forcing degradation, erosion, sliding and other adverse natural phenomena seems very topical issues at modern times.

Farming experience of the world population settling in the mountain geosystems as well as long relevant researches confirm that the consideration of inclination of slopes in the mountainous areas is of great importance to the protection of soil and vegetation cover of those areas. It is known that the inclination of relief is among the main factors considerably affecting the water regime of soil, as well as the working conditions of the agricultural machinery, including water erosion. The world centuries-old experience of farming continues to serve as the guidance for defining the appropriate ways of considering relief factor in agriculture at the contemporary period. The history of rational use of limited land reserves of mountain slopes is measured by millenniums. Humans used mountain slopes since the ancient times in India, China, South America, South-East Asia, as well as in Azerbaijan.

Based on the results of the field research carried out in the study area, it can be remarked that soil erosion is almost not observed at the terraced slopes of up to 17-25° of inclination, while 780-840 m³/ha of land layer is subjected to water erosion at slopes without terrace despite the same inclination angle even at lands

that do not require irrigation. During summer, the moisture in the existing soil cover is 1.5-2% as much compared to other regions, and the snow cover in the winter equals 7-12 cm, remaining 8-10 days longer than the regular snow cover.

The northeastern part of the Greater Caucasus is rich in slopes of different direction, favorable for the development of agriculture. Among works dealing with the efficiency of intensive development of slopes, those of Alakbarova (1961), Ivanov, Zaltser (1965) and others are remarkable. These authors have identified the inclination of slopes based on the following classification: 0-5° – smooth slopes, 6-12° – low slopes, 13-25° – steep slopes. According to some authors, the slopes of more than 25-30° of inclination are less effective in economic and farming terms. However, while significant part of our study area covers slopes of above 25-30° of inclination, use of these slopes in livestock and forest development seems possible. For the first time a map of surface inclination was drawn up by us with taking into account the importance of the terracing of the area (Figure 1).

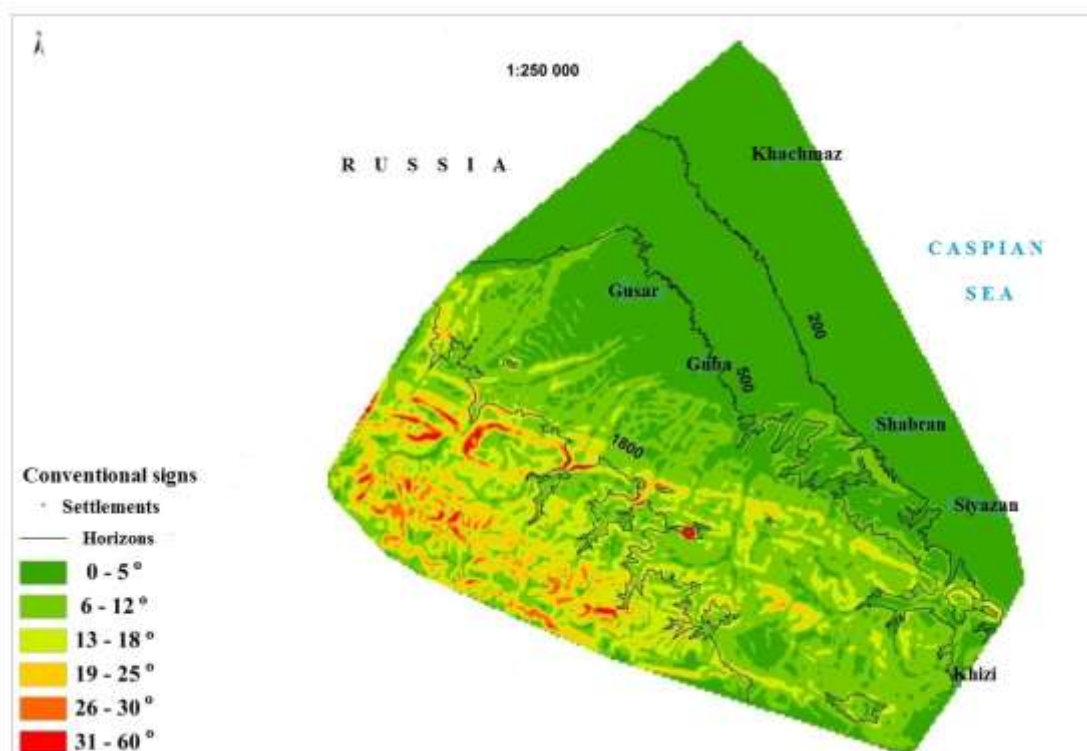


Fig. 1. Map of surface inclination of northeastern Greater Caucasus

As Figures 1 and 2 reflect, out of the territories of 200-500 m of absolute height, 86.7% are the areas of 0-5° of inclination, while out of the areas of 500-1800 m of elevation, 89.0% are the areas of 20° of inclination. At the areas above 1800 m, 98.1% is accounted by places of 30° and more of inclination.

As seen, the area of inclined territories increases in line with the elevation: the more elevation, the more inclined places are available. Correspondingly, increasing natural and man-made impacts are observed related to the development of territory, growth of settlements and economic activities. With considering these negative factors, there is a need in terracing slopes in accordance with their inclination.

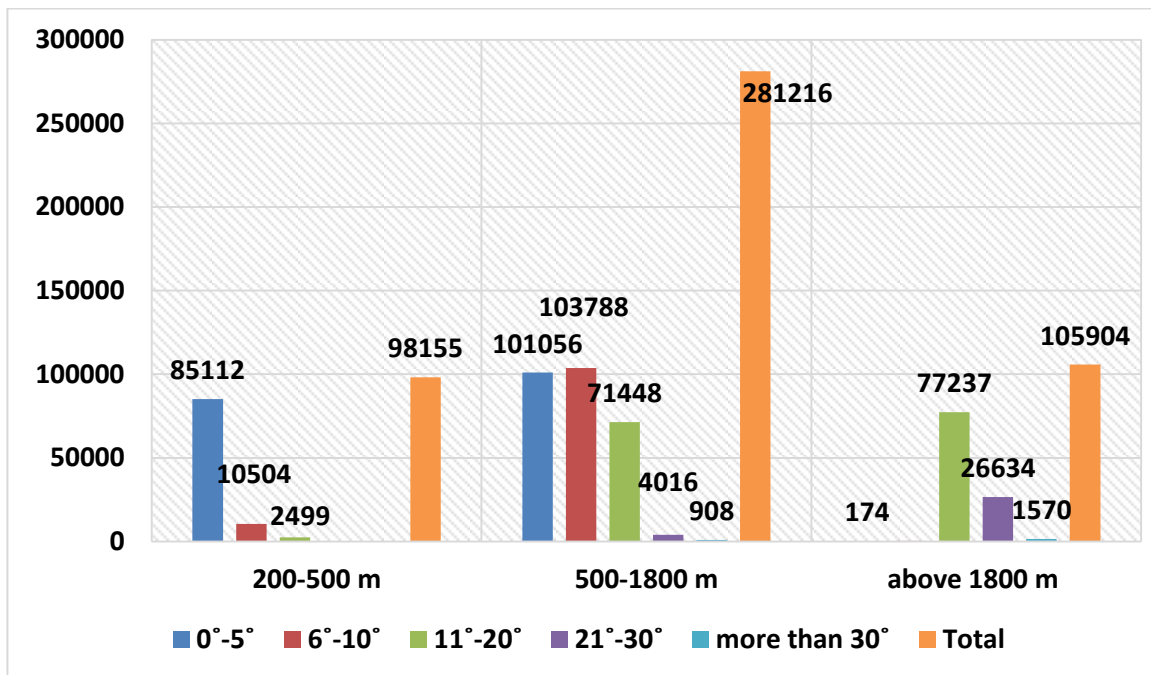


Fig. 2. Distribution of inclined areas in the northeastern Greater Caucasus (in ha)

Territories of up to 5° of inclination are 85.112 ha in total. The elevation of these foothill areas is typically 200-500 meters. Since foothills are the less inclined areas, they are characterized with the availability of thick soil layer and relatedly are plenty in nutrients, while agrotechnical works are needed in conditions of intensive land use as well.

About 90% (95,616 ha) of the territory is composed of the places,

inclination angle of which is less than 10° . Considering that this territory is a significant horticultural area, it is advisable to conduct ploughing between trees in opposite to the direction of slopes. 50.7% of the cultivated areas are located at this hypsometric altitude.

In accordance with the regular standards, terracing of slopes of more than 10° of inclination by heavy machinery is advisable. Due to the high droughts typical for the southeastern part of the territory, here bare slopes are observed more in conditions of the arid denudational relief. The conduction of phytomeliorative works is important in those areas where highly eroded low mountains combine with plains.

In the areas up to 500-1800 m above sea level, the very close villages on smooth mountain slopes forms chain complexes. In this altitude land use is considerably restricted since the relief is shattered much more and also eroded in some places. Economic activities in this territory, the presence of villages at high density due to favourability of the relief, and also relatively high precipitations contribute to the increase of landslide risk. The intensity of landslides leads to arising of many challenges for settlements that are located here. In this regard, it is very important to create terraces on appropriate slopes of these areas as well.

Many researchers unanimously agree that the upper boundary of the forest zone in the research area is falling (2,7,8). Forest on the lower inclined southern and eastern slopes are completely eradicated and replaced by dry forest fields. Here, without depending on the inclination, the forests are kept only in forms of small areals at the humid northern slopes. It is important to take appropriate measures for the protection and restoration of the unique and exotic natural forests of the country in these altitudes. For this purpose, it is advisable to conduct forestation at the areas of lower inclination (up to 10°) of roughly 200,000 hectares which have been intensively used by humans for a long period.

The main cause of weak land use in the high mountainous zone of more than 1800 m is related primarily to the shattered relief and less favorable climate

conditions. However, these areas are favorable for livestock due to plenty grass cover. The population is concentrated mainly in small villages and temporary houses. The cultivated areals typically include small courtyards that satisfy the basic needs of the population for food.

Being very suitable for cattle breeding, the meadows of up to 10° of inclination are 462 ha in area. These areas have very important role in the development of livestock. Slopes of more than 30° make up 103,871 ha (Figure 2).

The role of inclination factor in the concentration of phytomass reserves is high here as well. The carried out studies (A.Aliyev, G.Hajiyeva, 2014) show that since less-inclined (mainly southern) slopes are used mainly as hayfields, mowing is used as the main way for providing fresh forage in regard to about 90-95% of the all concentrated phytomass. However, in other areas, a considerable mass (6.8 t/ha) of vegetation is naturally mixed with soil. Meantime, the erosion develops considerably in the areas of irregular pasture. This process goes much intensively in the higher parts of the area, i.e. in the alpine zone because of the harsh climate. Relatedly, phytomass reserves are formed at lesser amount and participate in biological circulation weakly. Because of the severe climate, the short duration of vegetation process as well as the weakness of microbiological processes, the transformation of decayed organic substances into humus goes feebly as the result of which "rough" humus is formed. Therefore, the intensity of the biological circulation is typically low, and the annual sediment coefficient drops to 1.1-1.5 (M.Salayev, 1991).

For the mentioned reason, soil cover and its humus content is poor and more fragile. Therefore, it is important manage pasture activity much carefully at steeper slopes of these elevations. Intensive pasturing in this area is responsible for the degradation of lands, as well as leads to the growth of different weeds and the removal of the herbs eaten by animals. It is not by chance that the rural population historically settling here used those terraces since ancient times.

Currently, these areas are used as pastures.

In general, the intensified cultivation of lands of the study area and the poor agrotechnical service are the responsible factors for the worsening of quality of lands and the listing of these lands into a group of lower quality. This concerns especially the pasture areas and the sown lands owned by the low-income rural population. As a result of long-term improper use of these lands, they are listed as middle, low and even useless lands. Obviously, this process will go faster if the needed works on the prevention of deterioration of the fertility properties of the lands will not be implemented in time.

In order to foster settlement of population and territorial development in the mountainous areas, the establishment and development of appropriate infrastructure is needed as one of most necessary works. The works to be done include the creation of jobs, establishment of road network, as well as solve problems related to resort business, health care, cultural facilities and demographic development.

Results and recommendations

1. The main role in the development of the mountain geosystems of the northeastern Greater Caucasus is played by the altitude differentiation, whereas the larger land use is typical for the areas of up to 200-500 m of altitude. The ploughing of gardens in the areas of low inclination (which cover 90% of the overall territory) should be led in opposite to the direction of slopes, while the areas of more than 10° of inclination should be terraced by heavy machinery in accordance with the accepted standards.
2. In the medium mountainous areas having unique nature, beside with the agricultural activities, it is necessary to pay particular attention to the protection of relief, soil, vegetation and other ecosystem units during the conduction of works on the establishment of recreation facilities, public catering service and construction. In the areas of vulnerable landscapes where soil cover is fragile and vegetation is poor economic activities

should be led strictly in line with the requirements of restoration of natural components.

3. Regarding the areas of alpine meadows above 1800 meters, it was revealed that 45-48% (pastures) to 90-95% (hayfields) of surface part of phytomass reserves is not involved in the biological circulation due to human activity. Taking into consideration the role of severe natural conditions, such condition may cause humus to be much poor and more fragile that may lead to the increase of vulnerability towards erosion processes.

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