Facts From Experimental Work, Obtained During Investigation Of Desertification Process Through Key Monitoring Sites At Gubdintau Mountain Range

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Abstract: This article submits the facts from experimental work, obtained during investigation of key monitoring sites at Gubdintau mountain range while the desertification process. It shows the process of how to prepare a map of monitoring sites, estimate the value of desertification by method of transect, to carry out instrumental surveys by means of special instruments and drawing up the map of desertification.

Key words: desertification rate, monitoring site, method of transect, capacity of pasture land, landscape, neighborhood, natural boundary of hill area.

1 INTRODUCTION:

Gubdintau mountain range is situated in the west part of Pamir-Alay range of mountains and belongs to Turkistan mountain system. In the East it is separated from Chumqortau range by Sangzor valley but it abuts with Korachatau range in the West. In the North it is separated from Nurata mountain systems by Gallaaral hollow (Quyitosh range) and it is surrounded by Zarafshan valley in the South. (Fig 1) Gubdintau mountain range is a medium sized range and its peak is 1672,8 m above the sea level. It stretched 38-40 km long from West to East, and 12-18 km from North to South. Desertification is one the global problems in front of the human being. Now it is spreading from crowded lowlands into sparsely neighbored uplands and very sparsely neighbored range areas. The increase of population and anthropogenic load (pollution), which is connected with that matter are the main problems for that situation. The anthropogenic load is set of influence, where population has direct and indirect influence to environment. The excess of influence will cause the quality change in natural constituent. As a result, it will cause the poverty of nature. Increase of population in mountainous areas cause rising number of cattle-stock. Subsequently, number of cattle-stock is several times more than pasture area (capacity). In most cases population graze cattle on the meadows ten times more than required. Let’s take that situation as an example of Eshmontup village, which is located in the East part of Gubdintau mountain range, i.e. increase of population and number of grazed cattle on the meadows as well. Eshmontup village is 750-800 m high above the sea level. There is lowland, which is covered by proluvial deposits in the southern part of the village. This area is used to grow non-irrigated crop production. There is a Samarkand-Tashkent high way passing in 2-3 km south of the village. The north part of the village is covered by Paleozoic deposits of Silurian period. That stony land is covered by gray soil (serozem) and well developed. In many places we can note crystal particles above the soil. That area is fully used as pasture land. Eshmontup village is one of the mid-sized villages and according to data taken in 2018, the population of village is 667 people.

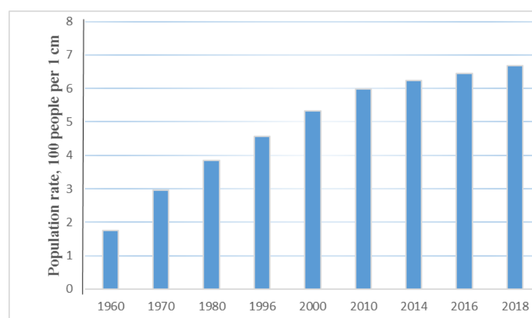

***Fig 1.** Population increase rate of Eshmontup village of Bulungur district*

The figure 1 shows population increase rate in the period of 1960-2018. The population of the village has increased three times during 58 years. We can note that the population increase rate has slightly slowed down during 2010-2018. Partial decrease in birth and moving to big cities were the reason why the increase of the population has slightly slowed down. The figure 2 shows increase of livestock during the period of 1968-2018. Number of sheep, goats and cattle, which are grazed in the village forms that number of livestock. Number of livestock was 666 in 1968 and in 2000 it was equal to 2000 pieces; i.e. even number of livestock has increased three times.

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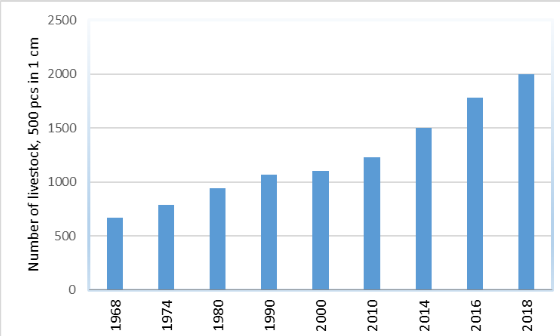

Fig 2. *Increase of livestock in Eshmontup village of Bulungur district*

Tend sheep makes 80% of grazed livestock in the village when goats and cattle-stock make the other 20%. There are limits to graze sheep and goats in the pasture land. It was calculated that it is required 1,5-2,0 hectares of pasture land in semi-desertificated pasture lands depending on the land capacity. In case if we take eastern part of Gubdintau mountain range as an example we need 2,0 hectares of pasture land per one sheep. So for total 2000 pieces of sheep, which are grazed in Eshmontup village, it is required 4000 hectares (2000 pcs x 2 hectares each = 4000 hectares). 4000 hectares (400 square kilometers) are vast area and it spreads 20 km out of the village. Maximum distance to hill grazing of livestock and lowland pasture per day is equal to 5 km. This is the maximum distance which is allowed. All livestock is grazed in pasture land and are returned home in the evening. Using this calculation, we can note that all livestock is grazed on the area of 25 square kilometers (250 hectares) around the villages. The main part of the area, where livestock is mostly grazed, is within a radius of 2,5-3,0 kilometers. If we make conclusion taking into the account of above mentioned calculation it is clear as day that the number of livestock, which are being grazed around Eshmontup village are 10 times more than the limits of pasture land. Such kind of situation is happening not only in Eshmontup village but in all villages, where the livestock husbandry is developed. The productivity of feed supplies around villages is decreasing and soil erosion is getting intensified. The area around each village is facing desertification at the distance of 2,5-4,0 km depending on number of livestock and points of desertification is encircling ring like the suburbs of villages. The main part (the results and their discussion). In order to compute quantitatively of desertification process, of course we have to take advantage of monitoring sites. For that purpose, we chose Eshmontup village and pasture lands around it, which are located at far end of eastern part of Gubdintau mountain range. First of all, we made a plot plan of the village and its surroundings at a scale of 1:10000. The hypsometric features were well indicated due to the exact marking of Y-line in the plot plan. There are three monitoring sites were identified in the plot plan of this village. The dimension of the first monitoring site was equal to 3 x 7 meters and it was located at 800 meters in the east side of the village just at the decline of the hill. The second monitoring site was located 1300 meters far from the village at the southern display of the hill when the third one is located 1800 meters far from village in the southern display of the hill. The dimensions of last two monitoring sites are 2,0 x 2,0 m and they are fenced with metallic wire-line retrievers. The purpose of establishing fenced monitoring pasture lands (monitoring site) and uncultivated grazing are to test the revegetation and growing rates of plants over period of time. The landscape map of the surroundings is drawn on 1:10000 scaled plot plan of the village (the followings are shown: landscape of mountain uplifts, piedmont plain and morphological types, (i.e. mountain natural boundaries and environment) as well). There was installed meteorological precipitation instrument by Tretyakov's method and wind meter, which was used to measure wind speed and indicate wind direction due to the absence of meteorological stations in the village. The purpose of installation of meteorological precipitation instrument was not only to measure the amount of rainfall but also to define the precipitation pattern, i.e. frequency of heavy rain. During heavy rain soil erosion will be intensified, which causes heavy shower. There were made several water pits dig out in order to define the erosion rate at hill areas. Their size of pit is 1 square meter (length 50 cm and width 20 cm). The installed wind meter will determine wind speed and direction. At meteorological stations wind parameters are measured eight times a day at Greenwich Times every three hours. In our case we measure four times per day at every six hours. The following wind parameters, i.e. wind's momentarily velocity, maximum speed and wind directions are logged in the register by Greenwich Time at local time 5:00, 11:00, 17:00 and 23:00. There are two ways to measure the wind speed. First of all, the displacement of soil particles of different sizes depends on the force of the wind. For example, as per the information of Kurbonov A.S. (1992) if there is a wind with a speed of 4 meters per second it may cause to move sand with diameter 0.25 mm. If the wind speed is 7-8.5 m / sec, it will cause to move the sand with diameter 0.5 mm and when speed is 10-11 m / sec then it will cause to move, the size of which is 1 mm. When the wind speed is 11-13 m/ sec then it will cause to land spreading sands with diameter 1.5 mm large to far distances. The hurricane-type winds at a speed of 20 meters per second may cause to move the rocks up to 4 mm in diameter. Since May 2014 wind and rain detector has been operating in Eshmontup village. The data, obtained for more than four years indicates that the average annual wind speed in this village is 4.0-5.0 m / sec. Wind with speed of 8-10 m / s and wind with speed more than 10 m / sec will reach 20% of the annual wind. It was found out that Eshmontop village in Samarkand region is most windy and with powerful wind blows (except for the hills). Frequent and strong wind blows are one of the natural factors that may cause desertification. The second importance of measuring the wind speed is to find out generation of wind power. Once the wind speed exceeds 3.0 m / sec, it starts generating efficient electric power. If the wind speed is less than 3.0 m / s, it can't charge the battery. Observations showed the development of natural plants cover in monitoring sites. During six years of observation (2011-2017), it increased up to 80% in the first monitoring site and the yield increased by 2.5-3.0 times. The natural plants cover was 25-30% in open pasture lands. Due to the fact that the second and third monitoring sites were located on the southern slopes of the range, the natural plants cover increased up to 70% and the pasture land productivity was one and a half times more than the open pasture lands. In the open pasture lands the natural plants coating is 15-20%. There was slowdown in development of plants in the second and third monitoring sites. It was associated with rapid evaporation of soil moisture and constant winds in the dry hills. In the first monitoring site, it was planted three types of local trees and shrubs: Elm tree (Ulmus pumila), Cedar (Juniperus seravschanica) and almond tree (Amygdalus spinosissima). The purpose of planting these trees was to test the growth or waste in natural conditions at the granitic soil. In order to plant the trees granitic soil was dig out at the depth of 10-15 cm, which is located 5-7 cm below the soft formation and the adjacent pits were made on the slopes. Water flowing from the slopes is accumulated in the pit soaking deep and the soil is well-watered and the moisture will be kept longer. Observation showed that these shrubs and trees, which were planted in 2011, have grown 2-3 times faster during these seven years (2017). (see the Table 1)

Table 1. *Growth rates of shrubs and trees planted in Eshmontup village of Bulungur district for the period of 2011-2017 (in cm.)*

Types of trees and shrubs	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
Cedar (Juniper)	*50,8*	*75,3*	*93,0*	*94,1*	*95,7*	*97,0*	*99,0*
Elm tree	*51,6*	*77,3*	*62,0*	*108 cm*	*1,31*	*1,52*	*1,70*
Almond tree	*90,1*	*1,05*	*1.30 cm*	*1,48*	*1,62*	*1,85*	*2,10*

Such kind of works proved that Gubdintau mountain range was covered with thick trees and shrubs when human being had less economic activity. Cedar (Juniperus seravschanica), elm tree (Ulmus pumila), almond tree (Amygdalus spinosissima), hawthorn (Crataegus turkestanica), Triassic (Lanisera nummalarifolia), sweet briar (Rosa cocanica) and others, which are drought-resistant tree shrubs. They are common not only in mountain slopes but also in mountain plains, which is over 700-800 meters above the sea level. There is another proof for this, an Ixota tree, which is planted along Samarkand-Tashkent highway in Bulungur and Gallaaral districts is a naturally well-developed tree. The transect method, which is used to define the desertification process in quantitative indications gives good results. Transect is an area, which has a narrow and long corridor, the quantitative index of which requires investigations. It is similar to transverse section of landscape, physiography (geomorphology), soil and geobotanic edges of the territory from tenor point of view. These transverse sections show the exact same linear changes when the transect method shows not only changes in a few meters but several or even one hundred meters in amplitude. In our research work, we have determined the transect direction starting from Eshmontup village towards the north-west to watershed divide area of Gubdintau mountain range. In the mountains as we have mentioned above the distance of cattle grazing during a day time is 5000 meters around the village. Taking into the account of this distance, we identified the transect corridor and other 4 key sites, which are 5000 meters far from the village. This transect corridor were identified as follows:

1) the first key sites are 500 meters far from the village;
2) the second key site is 1500 meters;
3) the third key site is 3000 meters;
4) 5000 meters. The reason for this selection of land plots is that the number of cattle-stock, grazed in the pasture lands decreases and of course, their impact to nature neither decreases. The pasture lands, which are located 5000 meters far from village, will be used time to time.

The study was conducted using the following method: At the beginning it was selected an area with 10 square meters' dimension (10x10=100 m^2) from each key sites and it was divided by 1 square meters. The coloured tapes were used while dividing into blocks. It was selected the most common plant species on the 100 m^2 sites. The names of these plants and their abundance are listed in the list from more spread into rare species, with the help of the Drude scale. If there is only one individuum was found in the field of investigation, it also was defined as the only one (Unicum flour). This only applied to rarely met shrubs, found in the conditions of Gubdin range. In Drude's scale the following definitions are given: Individuums found in a large amount, insufficient numbers, and etc. That's why we decided to use Kamarov's 6-point scale [4] (see Table 2).

Table 2. *N.F.Kamarov's scale on abundance of species (1992)*

Points	*As per the Drude's scale*	*Drude's scale (the number of Individuums, which is available in area)*
6	*Soc*	*There are more than 100 types in 1 m^2*
5	*cop^3*	*There are from 10-100 types of species in 1 m^2*
4	*cop^2*	*There are 10 types of species in 1 m^2*
3	*cop^1*	*There are from 10-100 types of species in 1 m^2*
2	*Sp*	*There are up to 10 types of species in 1 m^2*
1	*Sol*	*There are from 10-100 types of species in 1 hectares*

The number of each individuums in phytocoenosis varies in quantitative proportions. Individuums can be counted in 1m^2, 10 m^2, 100 m^2 and larger areas. The list and exact amount of each individuums plant species were is shown in 1 m^2. So, doing that it was determined which plant species encountered in this 100 m^2 base. Compared to the list established on the other experimental sites, similar to how far away the village is, it was well-defined more or less number and types of species on the list of species. At the same time, some of the most commonly encountered plants are shown on a 100 m^2 plot chart with separate conditional marks. By this method, the most common plants are placed in each square meter by means of legends. Once the squares have been filled, it will be clear what types of plants are widespread. S. Kudryashov (1930) [5] demonstrated in his scientific works that M.B. Kultiasov used this method his scientific works. Nowadays there are many vegetation free and outcropping fields around the village. These cavities appeared due to excavation of rocks from rangeareas for construction reason and heap of stones (shown in Figure 5), narrow pathways, which occurred due to animal tracks (shown in Figure 3) or erosion outlines and other forms, which were created due to water erosion.

***Fig 3.** The narrow pathways and animal tracks formed on the slopes, which formed due tocattle-stock and bush plants (Cphlomis thopsoides).*

We indicated on the plot plan of key sites vegetation free and outcropping fields in each square, when we conducted examination by netting method. We indicated by legend small land erosion forms, which formed due to livestock passing and water erosion in key sites. We summed up each outcropping fields and calculated their percentage in the area of 100 m2. This is very important indicator in assessment of desertification process. Thickness of vegetation cover, change in number of species, their quantity and the volume of outcropping areas are the main indicators when compared to the area in the process of assessment of desertification by "net" method while driving off the village. Research and drawing up the map of desertification in Uzbekistan began in the 1970s and 1980s of the last century. In 1988, there was published a monographic collection entitled "Desertification in Uzbekistan and struggle against it" [13] has been given a desertification map for arid zones of Uzbekistan and the degradation rate was divided into 6 sections: 1) No desertification; 2) low desertified soil; 3) average desertified soil; 4) strongly desertified soil; 5) very strong desertified soil; 6) desertified soil at different levels. [11] These divisions are based on the following processes: vegetation cover degradation, water erosion, wind erosion, the reduction of organic substances in soils, density of soils. We welcome six level chart of desertification. However, there are no standards that clearly distinguish them at this time. Indeed, there is no clear view as to the desertification, deterioration of the nature that has so far gone. Due to the diversity of human impacts on the nature, desertification can also be varied. If a human-caused impact to nature in areas with low level of desertification, average level of desertification is decreased there might be recovery or return to its original state after a certain period of time. Strong desert levels in many scientific studies [1,7,10] The nature of the crisis, that is, the degradation is greater than or equal to 50%. We also urge to call the 50% or more crisis a strong desertification. Due to the 50% loss of natural resources in the geosystems, 50% loss of natural resources is a major problem. For example, if 50% or more of the vegetation cover is degraded and if the soil is poor, the anthropogenic load should be stopped for several decades or even several hundred years. The question is why the number is 50%, and 30% or 40% more. This is true, 30%, 40%, 50% conditional, but 50% is a sign of equilibrium, resulting in an increase in equilibrium. 50% is a "breakthrough" in nature. As you go through this line, the degeneration of matter and energy in the geographical crust, its landscapes and its morphological units will intensify, without human intervention, natural recovery will be impossible. 50% critical points are also found in synergetic data [11]. There are no criteria for determining 50% of natural conditions in geosystems. In mountainous pasture lands, the decline of plants and 50% or more of crop yields, flood and mudslides can be used instead of additional desertification indicators. Significant indicators of desertification in the desert can be as high as 50% or more of the vegetation cover, strong soil washing, and overgrazing of over 50% of vegetation. According to A. Rafikov's (1988) [13] desertification degradation standards, current vegetation yields (in terms of potential crop yields) are 60% to 90% of the average desert and 30% in strong desert. In the water scarcity assessment criteria, the soil is exposed as follows: average desert density 10-25%; 25-50% in strong desert; In very strong desert> more than 50%. The level of desertification we propose is in line with the indicators of A. Rafikov [13]. Based on the desertification criteria above, we have created a schematic map showing desertification for the eastern part of Mount Harbinger. (Picture 4)

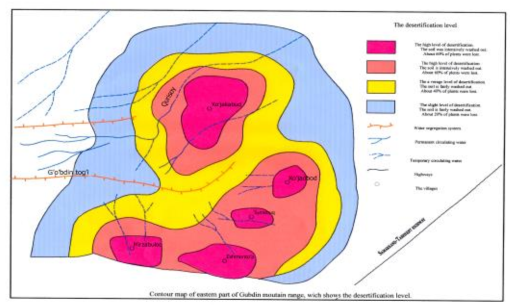

***Fig 4.** Desert mapping of the eastern part of the Mount Harbinger*

The location for the map was based on the landscape. This approach to the problem was favoured by G.S. Coust, 1991, I.S. Zonn, N.S. Orlovsky, 1984. A. Rafikov, 1988, AV Ptichnikov, 1991, Popov VA, 1990, EV Glushko, 1988 and etc. The reason for this was that landscapes have clear boundaries and obiogenic components have also been taken into account.

The desertification level on the card is given in four indices:

1) very strong desert (more than 60% of lost and replaced plants);

2) strong desert (up to 60% loss and replacement of plants);

3) mean deserted (lost up to 40% of plants);

4) weak desert (loss of plants up to 20%). On the map there are desertification zones, very strong and high-altitude meadows surround the villages. An increase in the number of livestock, depending on the population population, leads to a widening of the area of desertification.

2 CONCLUSION.

In order to investigate the desertification level of Eshmontup village, which is located at eastern part of Gubdin mountain range there were established monitoring sites nearby the village. It was established three monitoring sites to observe recovery of plants in monitoring sites, development of plants in open or closed monitoring sites. In order to observe the phytomass these monitoring sites were located at different distances far from the village and they were fenced with wireline. The transect method was used to study the level of desertification. To do this, four areas of the length and width of 10 meters (100 m^2) were selected from the village to the northwest of the village at the distance to the Mountain Mount (500 m, 1500 m, 2500 m, 3500 m, and 5000 m) and Kultiasov method, abundance (on the Drude's scale) and the washing of soil. Based on the data collected, a schematic map showing a 1: 25000 scale of desertification has been prepared for the eastern part of Gubdin mountain range. Degree of desertification in the card is given in four indicators: 1) very strong desert (more than 60% of plants are lost and frozen); 2) strong desert (up to 60% loss and replacement of plants); 3) average desert (up to 40% of plants lost); 4) weak desert (loss of plants up to 20%).Recent studies have shown that there is a correlation relationship between rural population and livestock and the poverty of the mountain nature, namely the desertification process. In homogeneous rural areas, desert areas are relatively small compared to smaller villages, where soil degradation and degradation of plants are intensifying.

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