

A SURVEY OF GEOMORPHOLOGY HAZARDS OF LOESSIC LANDS IN NORTH EASTERN PART OF IRAN (GORGAN)

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ABSTRACT: Loesses are fine grain sediments of quaternary period with separated and unattached structures. These deposits do not contain cement, but due to the excessive presence of clay and lime minerals, reach to a special adhesiveness providing the capability of remaining over even an angle of 90 degrees section. However, Loesses are of falling soils and saturation of soil may result in sudden and accumulative movements. The city of Gorgan is located in the south part of Loessic lands of east-north of Iran with humid climate. The urban population of the city has increased, leading to an increase in outnumbered human activities such as: construction of multi-floor buildings on Loessic hills, construction of villas in Naharkhoran valley, changing of forest lands of south part of the city for construction, changing the type of natural plants for gardening and agricultural operations and other developmental activities like road construction on Loessic lands and removing Loessic soils for use in other industries (like break making). All these human activities as well as an increase in rain falls in south parts (higher parts) and the rate of salts and minerals in loess of the region have made the loesses unstable and have increased the possibility of widespread movements like Solifluction and slippage. Therefore in this article, a survey of human and natural factors and geomorphologic endangerments of unstable environment of Gorgan has been conducted, the effects of these processes over feeble loessic deposits of the region are considered and appropriate strategies for the possible control of the situation will be offered.

KEYWORDS: loess, Geomorphology, land slide, Solifluction, Geomorphologic

INTRODUCTION

Geomorphologic surveys can be generally regarded as the basis for geographic & environmental studies, and the possibility for planning and managing the logistics of land without considering its topics is undoubtedly an unscientific matter. In this area, geomorphologists can best contribute to this issue by considering forms and effective processes in the region ([Ahmadi, 1999](#)).

The geomorphologic survey of loess as sediment highly sensitive to the effective natural and unnatural processes has caused loess to be the focus of the studies done by geographers, pedologists, managers, geologists etc.

These pneumatic sediments are mostly small-grained, powder-like and without layering in Iran, and they accumulate once exposed to the rain with low erosion. loesses in the northeast of Iran have been reported to be up to 160 meter thick.

REVIEW OF LITERATURE

The word "loess" was first used by Leonhard from Heidelberg University of Germany in 1825 to a sample of yellow lumla he had found in an area in near Heidelberg. The subject of loesses was later extensive thanks to the studies done

by richthofen and his trips to china. Since then, diverse, various information on the nature & origin of loesses in different areas was presented in such a way that nowadays most of them are only historically valuable. Upon visiting Rein Valley in Germany, Karl Lail drew the attention of the international community to the properties and mode of formation of the loesses in that region., Huber in the national Oil Co. of Iran performed the first survey on the loessic sediments in the province of Gulistan in the geology map of Iran with the scale of 1: 1000000 provided by huber in the national oil Co. of iran ([Darvishzadeh, 2001](#)).

A number of studies have been conducted on loesses in Iran. Bobek and Barbier reported about the loesses of the valley of Sefid Rood and Mazandaran province. Ehlers has conducted a literature review on loessic sediments in the southern margin of the Caspian Sea. [Ongh, \(1991\)](#) studied the loesses in this area for his doctoral dissertation. As in the geomorphologic map of Iran, the relevant loessic surfaces and landforms are among the geomorphologic units of Iran. Yet, a systematic study of this geomorphologic unit seems to be taking its first steps.

GEOLOGY

The studies conducted on the loesses in Iran indicate two sources 1) air-stricken with local materials, 2) transfer with the materials of the Central Asia. Thus, due to much significance of transfer with the materials in the Central Asia and the certainty of proving this issue, most major relevant reasons are dealt with here. Evidence and reasons for investigating the source of loesses in the region under discussion with the materials of the Central Asia:

1. Settlement of the region of Gorgan province in the southern margin of the deserts in the Central Asia.
2. Mountainous, high wall of Alborz with the western-eastern direction (southern margin of the desert in the Central Asia).
3. Small-grainedness and homogeneity of the materials forming loesses and non-existence of stratum building in them.
4. Fossil & organs of the land animals like helix snail.
5. Underlying topographic axis and generation of a new topography.
6. Short relatively warm and dry periods and the step-like plant coverage in the region of Gorgan province.
7. Forest coverage and humidity of the northern foothill of Alborz for the settlement of particles and floating dust.
8. Lack of air between the less and the underlying stones.
9. Formation of current less in large scale, in many warm, dry & step-like areas in the margin of iceboxes, and adjacent icebox regions.
10. Bedland-like morphology & landscape.
11. Sand small-grained hills in the north of Gorgan road.
12. High thickness of loessic materials and their change from some centimeters to 80 meters in Gorgan province.
13. Pea yellow to light brown as the index of the sediments in the dry & windy areas.

The author noticed two interesting, noteworthy points: first, the more remote the loesses get from their main source, i.e. the very deserts in the Central Asia, the less thick they become Nabavi has reported maximum thickness at 160 m. and Onagh has reported it at 80 m. Of course, this difference may be defined by how remote the area is from the desert ([Eteraf, 2005](#)). The region Onagh has studied is more in southern areas, to the extent that in the margin of Gamishan Village in the 5-kilometer distance from the city of Behshahr, thickness of the loesses in this area reaches even 5 meter. The second point is a reduction in the size of the particles in proportion to the main source, in

such a way that the farther one gets from the main source of these windy sediments, the less the size of these sediments become due to the pneumatic force.



Figure 1: The position map of case study (khel.m.2005)

3.1. Characteristics of Loesses

The most important and major characteristics of the loessic sediments which should be duly taken into account are as follows:

1. Structured loesses are separated and detached, their particles are not attached together and lack the required cement. But they are especially adherent and due to the presence of clay and lime stones.
2. Durability of loesses even to the 90-degree cutting angle.
3. Lesses are among the falling soils in which sudden and accumulative motions may be observed after treating the soil with water.
4. The sequence of limy particles inside loesses and, process of dissolution result in (a) superficial generation of loam soil, and (b) the dissolution & accumulation of lime by penetrating the lower layers.

WEATHER

The weather of the province of Gulistan varies from dry to highly humid based on the climatic divisions of Marathon race. Thus, by possessing the required information concerning the climatic properties of the region in question as well as characteristics of the loessic sediments, we can achieve positive, invaluable results ([Isaei *et al.*, 2005](#)).

According to a general survey and the studies done on 3 synoptic stations, namely, Gorgan, Gonbad and Maraveh Tappeh in the province of Gulistan, the rainfall increases from the north to the south as altitude increases, and the degree of temperature reduces to the south. Also, the more we go from the north to the south, the more humid the climate of the region becomes. This issue is also one of the important factors of the erodibility and generation of erosive faces along with other natural and unnatural factors.

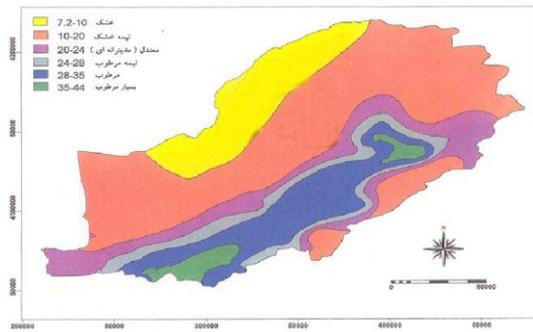


Figure 2: The climatological map of Golestan province and case study (Domartan)

GEOMORPHOLOGY

Considering the most principal characteristics of the loessic sediments (sponginess and low density 1.25-1.65) and high percent of lime materials up to 40%, and also the size of particles up to 40%, and the degree of their accumulation which reduce due to distancing from their main source, the most important causes and effective natural processes in the generation of the morphologic forms and generation of environmental and geomorphic endangerments causing problems to the regional planning are broadly categorized as natural and unnatural or human changes. Among the natural factors, geology and the amount of loessic stones, climatic characteristics, plant coverage, etc., and among the unnatural or humane factors of change in the regions, the change in the use of lands, change in the type of the plant coverage and wrong methods of agriculture, unnecessary grazing of the livestock, implementation of the civil & road construction projects are considered to be of utmost importance in instability of loesses (Khajeh, 2002).

All the factors mentioned above can cause problems to the region, or even urban managerial planning, e.g. in northern parts of the province of Golestan and in such areas as Gonbad & Aghband, due to warm, dry climate and waste of the less soil, we see the formation of gullies as well as piping erosion, which are accelerating, causing problems for all regional planners. Also, destructive floods occur in the region very often (Neka flood). Yet, in the area of Gorgan, due to more humid climate (as the result of raining conditions) and based on the geographical location of the region, as well as the above-mentioned causes and reasons in the section of natural & human factors, we see another type of environmental, geomorphic endangerments as well as landslide. The most important types of this slide have happened in a region named Khalil Darreh, from the counties of the city of

Fazelabad, within the distance of Gorgan and Aliabad Katool.

5.1. Slide

The mechanism of this phenomenon is in such a way that it has lost its cloide property and, therefore, gravity force moves on toward the foothill. In the farthest end of the southern areas of the region in question, the amount of the falls of the stream increases considerably due to the existence of altitudes in such a way that the rainfall in the city of Fazelabad reaches average amount of 670.2 mm per annum. Together with the increase in humidity and rainfall in this region, destructing loessic lands of the forest for agricultural purposes and using the wrong methods of farming like plowing in the direction of slope have caused slide in Fazelabad. As observed in the map No. 1, the region under discussion (Gorgan) is located in humid climate and any type of planning in this type of environments should be made with cautious and consulting with the relevant specialists. Otherwise, we will witness a series of unwanted and undesirable geomorphologic events in the city of Gorgan (Nabavi, 1976).

5.2. Unnatural Factors

Numerous factors are effective in the issue of unnatural or human factors. the most important of which that emerge due to the unscientific activities and that can cause formation of morphologic forms and cause irremediable environmental harms and results in the formation of slides, gullies, etc. are cutting forest's trees, changing type of forest's trees (for planting fruit trees and establishing gardens, changing use of land, bringing of livestock into the forest for grazing (more than the capacity) in the part of high, forest areas as well as unreasonable, unscientific harvesting of loessic soil for brick-manufacturing industries and constructing roads in the loessic lands (Pashaei, 1997).



GEOMORPHOLOGY, LESS, PLANNING AND CITY

Formation of the city of Gorgan on the loessic lands in the past is regarded as a considerable and highly important point. Yet, considering the spread of the city, whether by residing (in the district of Broadcasting Organization) or as other human and economic activities, including: building villas and other tourist projects (Naharkhoran Valley) on the lands and Foothill area, loesses can serve as an alarm to urban planners and managers, since as mentioned earlier, less in lax and sensitive highly capable of erodibility and foothill movements like slide. Also, underlying lime stone will also increase this type of movements after penetrability at the time of rainfalls happening in the region (dissolution phenomenon). One of the factors which is effective in the occurrence of the danger of slide is weight or high mass of the sliding surface (which is less here). Thus, any type of construction as well as other types of civil activities in the district of Gorgan should be carried out with scientific studies from the beginning. To this end, regional & local managers and urban planners can, by relying on their environmental knowledge and management which are dealt with in geomorphology, achieve and use positive, useful results to make remarkable successes ([Servati, 2003](#)).

RESULTS AND DISCUSSION

1. Loesses are fine grain sediments which are especially sensitive to natural & human erosion factors.
2. The thickness of loessic layers reduces from the north of the province of Golestan to the south, reducing from 160 m. thick in the more southern parts to 5 m.
3. Underlying structure of loesses is mostly lime in the region in question, sensitive to the act of dissolution.



4. According to the map of climatic divisions, the region under discussion was located in the part of the humid climate of the province, and the rainfall of province in the southern

part and the forest is high in proportion with the northern areas of the province.

5. The most important causes of formation of faces of erosion and the effects of environmental and morphologic endangerments in the region are geology, amount of sediments and the stones available in the loesses, climatic conditions & plant coverage in terms of natural factors, and, in terms of unnatural & human factors, cutting forest's trees, changing the type of coverage of forest's trees to build gardens, bringing livestock into the forest, building construction, building villas, harvesting less for brick manufacturing industries, road construction, etc. can be mentioned.
6. Care should be taken for choosing the appropriate types of building considering the thickness of loesses. Thus the permission for building construction in less thick areas should be issued only if, the amount of concreting and founding goes up.
7. In the southern areas of Gorgan, where buildings are constructed considering the thin layers of loesses, the marginal wall should be duly reinforced by the concrete structures.
8. Changing the type of coverage of the forest's trees in order to build gardens can lessen the loesses' biological ability and increase the erodibility. Thus, , type of forest trees and use of lands in such areas should remain without change as much as possible, or better methods and species should be used.
9. Bringing any type of livestock, especially in large amount, into the forest should be avoided, and the reduction in the plant species in the forests should be prevented by managing the gaze of livestock.



10. Performing the operations of road construction and implementing similar projects should happen only when consulting with the geomorphologists.
11. The projects of harvesting loesses from the loessic hills in order to manufacture brick should be implemented in the areas where

the loesses are very thick and should not be carried out in the margin of roads and residential centers ([Zand-e-Moghaddam, 2007](#)).



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