

CAUSES OF GULLY EROSION IN ARID ECOSYSTEM: CASE STUDY SOUTHERN PART OF I.R.IRAN

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1. Introduction

In spite of many research efforts on gully erosion, there is an argument about causes of gully erosion among researchers. Causes of gully erosion can be classified into three categories: human impact (Bork et al., 2001, Starr, 1989), climate change (Gregory and Moore, 1931) and intrinsic changes (Schumm and Hadley, 1957). Examples and causes of gully erosion include: land use change and changing vegetation cover in ninth and tenth century by human in England (Harvey, 1996); intensive land use in combination with rain storms in Germany (Bork and et al., 1998); increasing the area of corn in Central Belgium (Nachtergaele, 2001); almond planting without terracing after clearing the Mediterranean native vegetation in southern Spain; road construction on sloping area in different ecosystems (Moyersons, 2000; Wemple and et al., 1996; Crok and Mockler, 2001).

Gully erosion is known as a main problem in the southern watersheds of I.R. Iran. One of the famous watershed is Lamerd and Ala-marvdasht watersheds which is located 40 km north of Persian Gulf. Gullies are developed in the flat alluvial area and caused many damages to roads, crop and rangelands, bridges. The linear extension of gullies threatens villages. It is a long watershed with northwest- southeast aspect. The area of the watershed is about 8549.1 sq.km. Average annual rainfall is equal 268 mm (20 years period). Rains are usually as storms with short duration. In some years total annual rainfall occurs in a few days and sometimes twice of annual rainfall happens in two or three days. This watershed is one of the selected sites for research on gully erosion and many researches have been conducted in the past 10 years.

2. Material and Methods

Anecdotal evidence, historical evidence and intensive field observation and measurements are used to determine causes of gully erosion. Our data collection include talking with old residents and rural people, and analyzing aerial photos from different times, Topographic maps are produced by photogrammetric method. Area of gully erosion, cropland and residential and length of roads were measured from the topographic maps. Rainfall and flood data were used and analyzed between 1951 and 2002. Soil samples were taken in location with gully erosion. Soil chemical properties such as pH, EC, OM, Na, Ca, K, Mg, ESP and SAR were either measured or estimated.

3. Results and Discussion

Results of this research show that after four decades, 1955-1994, the area of gully erosion, residential area and cropland are increased respectively 4, 10 and 3 folds in the Lamerd and Ala-marvdasht watersheds. Gullies are located in lowlands with slopes less than 1%. Seventy five percent of gully erosion was developed on saline/non-saline soils while the remaining located on sodic soils. Historical evidence show that gully erosion was limited to the sodic soil in early time but after urban development and road construction, a vast area of rangeland was changed to dryland farming (wheat). After a few drought periods, these farmlands changed to barelands. Gully erosion on the sodic soil was mainly caused by high ESP and low OM. Table 1 shows sites of gully erosion larger than 10 sq.km in the Lamerd and Ala-marvdasht watershed.

Table 1. Main gully sites with area larger than 10 sq.km.

No	Site name	Area of gully erosion (sq.km)	Total length of gullies (km)	Gully density (km/sq.km)
1	Sigar	24.63	309.615	12.57
2	Mohr	10.99	115.21	10.48
3	Kashkoo	30.70	278.485	9.07
4	Chahvarz	12	101.35	8.44
5	Chaheini	25.6	150.27	5.87
6	Kahnooye	9.29	59.45	6.4
7	Kamali	91.74	480.82	5.24
8	Keirgoo	35.65	455.5	12.78
9	Chahkoo	15.48	141.323	9.13
10	Labshekan	37.24	213.45	5.73

In order to identify causes of gully initiation and development, factors such soil, rain and floods, vegetation cover, were surveyed in detail. Our results show that for sites with similar rainfall and soil properties, gullies tend to be found at sites with more barelands or roads around them. In other words this evidence reveals that gully development is associated with human impact (Table 1). In these watersheds rainfall occurs as rainstorms and in some years total annual rain falls in two or three days. Using area of gully erosion (Y_1) and total length of gully (Y_2) as dependent variables and area of mountain (X_1), area of plain (X_2), length of roads (X_3), area of bareland (X_4), area of cropland (X_5), area of residential sites (X_6) as independent variables, a multivariable regression was conducted with the SPSS statistical software. The results show that two factors, area

of bareland (X_4) and length of roads (X_3) are dominant factors for gully development in different sites. These two factors interpreted 78 percent of variations in the area of gully erosion in the Lamerd and Ala-marvdasht watersheds. The impact of bareland area and length of roads was not equal in all sites. In some sites such as Kamali (table1) the impact of bareland is more important than length of roads but in other sites such as Kashkoo (Table 1) the impact of road length is more than bareland area. The overall impact of bareland area is 58 percent and length of roads has 20% percent impact on gully development.

4. Conclusions

This research demonstrated that the I.R. region is prone to gully erosion. The study area had limited gully erosion four decades ago. With accelerating urban development during the past, two to three decades, areas of gully erosion increased. Comparison of gully advancement showed that the area of gully erosion increased 4 times in four decades before. Gullies are located around urban areas with more deteriorated cropland and roads. Statistical analysis revealed that area of gully erosion could be attributed to the area of bareland and road length. The overall the impact of bareland area is more significant than road length in study watersheds, although their contribution in individual site is completely different.

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