



Estimates of gully erosion and development using GIS and RS

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Received: 19/06/2017

Accepted: 14/01/2018

Introduction

Background and objectives

Gully erosion is one of the destructive forms of soil erosions that may lead to a considerable volume of soil loss. This erosion type in addition to on-site and off-site effects has an important role in land degradation and forming in some watersheds. In this regard, due to gully erosion in some provinces of Iran such as Hormozgan, Bushehr, Fars, Khorasan, Semnan, and Zanjan vast agricultural areas are under threat of gully erosion. There are biological and mechanical methods that are available for controlling this type of erosion. One of the most important issues before designing any biological or mechanical practices is knowledge about morphological characteristics of gullies and process of their development. Therefore, this study was planned to assess morphological changes and development of gullies during 1955-2016 years in Idelo watershed in Zanjan Province, Iran.

Materials and Methods

In this study, morphological characteristics of 22 gullies were mapped using aerial photos, IRS satellite imagery, and GPS over two periods (1955-2008 and 2008-2016) of time. Also, in the downstream of the watershed, six gullies were surveyed in the four sections to obtain dimensions of the gullies especially depth. One-Way ANOVA and Duncan test were used to compare characteristics of gullies such as area, length, width, and radius of the head cut in years 1955, 2008, and 2016.

Results

The results showed that 77% of the gullies are located in downstream of the watershed especially on the red gypsiferous marl geologic unit, which latter cases are bigger than others. The areas occupied by direct gully erosion were 2.9, 4, and 7.4 hectares in 1955, 2008, and 2016 respectively. Also, the number and dimensions of morphological characteristics of the gullies have been grown during 1955-2016. The results of estimation and measurements of the extension of the gullies showed that gullies located on the red gypsiferous marl geologic unit had the highest rate of extension. Accordingly, the mean values of the length growth of the gullies located in marl and other geological units (i.e., young alluvial deposits and old alluvial clastics) were 2.15 and 0.3 m/year during 1955-2008 and 11.23 and

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0.96 m/year during 2008-2016, respectively. The results of surveying of the gullies showed that there is a consistency between the volume of soil loss with depth and length of the gullies.

Conclusion

overall, regarding the obtained results, the extension and growth of the morphological characteristics of the gullies in 1955-2008 are more severe than those in 2008-2016 especially in the red gypsiferous marl geologic unit. Accordingly, low levels of extension of the gullies during 1955 until 2008 can be attributed to the initial phase of the gullies, subsistence agriculture especially until 1990 and designed control measures such as gabions and check dams. Furthermore, according to the existing of the calcareous soils of the study area and field evidence, the severe extension of the gullies during 2008 until 2016 can be attributed to piping erosion and consequently appearance of hidden sections of the gullies due to ceiling collapse. However, for a comprehensive understanding and conclusion about this matter, further studies should be conducted.

Keywords: Gully area, erosion, Idelo watershed, Morphological change.