

Available online at www.sciencedirect.com

ScienceDirect

Procedia - Social and Behavioral Sciences 120 (2014) 506 – 512

Procedia
Social and Behavioral Sciences

The 3rd International Geography Symposium - GEOMED2013

Factors controlling gully erosion development in Toroud basin - Iran

Fatemeh Mousazadeh*, Khairulmaini Osman Salleh

University of Malaya, 50603 Kuala Lumpur, Malaysia

Abstract

Gully erosion, is often associated as one of the most severe forms of soil erosion processes. And often results in much displacement of the soil mass, culminating in sedimentation, and degradation of the land. Gully erosion has tremendous impacts on human activities which includes decreasing soil nutrients and agriculture productivity, river channel sedimentation and increasing floods and impact on water resources development within a river basin. Considering the challenges faced in semiarid regions, this research tries to evaluate all the factors controlling gully erosion in Toroud basin that there is no comprehensive study on this gully and basin. In order to achieve this goal and providing greater assistance for obtaining all the elements to stop gully erosion expansion, the research examines two major objectives, which focuses on the formation of gully erosion and the short term or long term approach in the extension of gully erosion in Toroud basin- Iran. This research is using software of Ilwis in GIS for preparing the maps and Excel for preparing the graphs. By considering the importance of the subjects and with regard to the fact that studied region contains large and extensive gully which introduces potential hazards for croplands and habitats, and also make it difficult to pass through them, it is required to perform all possible actions which lead to bring an end to the development and expansion of gullies.

© 2013 The Authors. Published by Elsevier Ltd. Open access under [CC BY-NC-ND license](http://creativecommons.org/licenses/by-nc-nd/3.0/).
Selection and peer-review under responsibility of the Organizing Committee of GEOMED2013.

Keywords: Gully erosion; formation; expansion; control.

* Corresponding author. Tel.: 0060-12-9711057 office: 0060-3-79675696
E-mail address: f_mousazadeh52@yahoo.com

1. Introduction

Gullies are watercourses marked by steep channel walls, a stepped longitudinal profile, and commonly an abrupt channel head. Gully erosion is an important form of erosion and gradually draws more and more attention from researchers in recent years. During the past twenty years, many researches of water erosion mainly paid attention to the process of gully erosion which they exist in many settings; they are prevalent in dry lands and are often considered a signal of disturbance and accelerated erosion by climate or land-use change (Morgan, 1995).

Also Gullies may be initiated and commence in three ways; by linear landslide, surface flow or piping. Gully erosion is a serious Geo-environmental issue in most Middle Eastern countries including Iran. Erosion by gullies can be an acute problem causing high sediment yield, removal of fertile soil, destabilization of hill slopes, and the lowering of water tables in alluvial aquifers (Patton & Schumm, 1975).

Gully erosion in Toroud basin has created big problems and has had many negative effects on human life. Also, gully erosion is the cause of hardship in passing through the land and every year there are many soil erosions and soil carryings and sediment productions and it is a serious threat to surrounding lands and areas.

There are some theories on formation of gully erosion by several researchers (NSW Soil Conservation Service 1986; Gomez et al, 2011; Jianrong et al., 2008; Hudson, 1985; Joel et al., 2003; Morgan, 1995; FAO, 2012; C. J. Francis).

According to the theories, the following diagram, fig. 1, is showing how gully erosions form, extend and abrupt during the time in many places, and some places do not follow this way and a huge gully can occur during just some hours of heavy rainfall and flood.

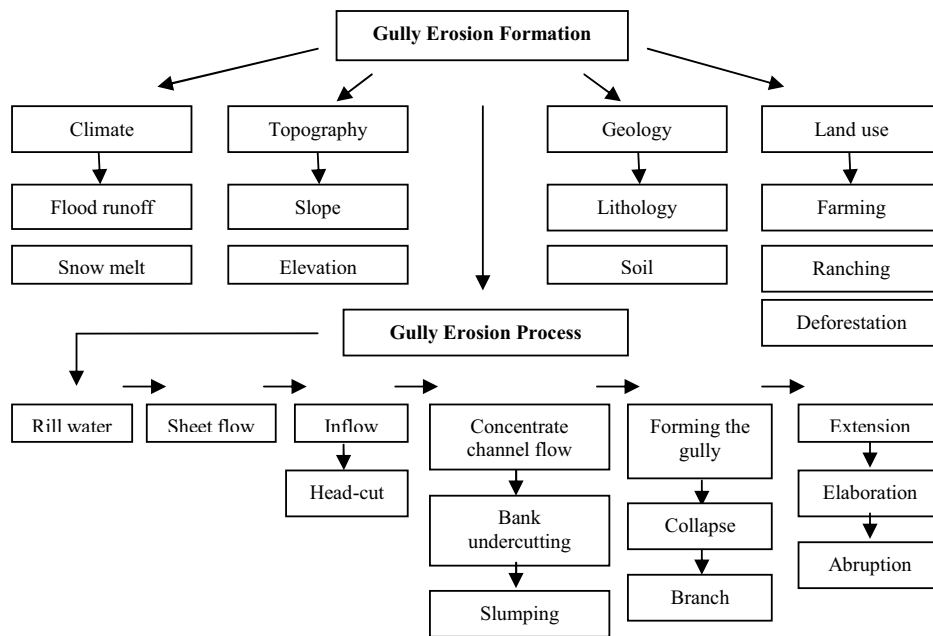


Fig. 1. Gully erosion formation and process

2. Material and Method

Toroud basin is located at 35, 47, 45 north latitude and 52, 53, 35 east longitude in Semnan state and northeast of Tehran in Iran. The surface area is approximately 874.5 hectares. And according to the maps prepared by GPS in 2008, the surface of gully erosion in this basin is about 97.25 hectares.

By considering the challenges faced within Toroud region and regarding to mentioned objectives, this research tries to evaluate effective elements on the formation and expansion of gully erosion by performing applied and scientific studies. To accomplish these goals, this research needs providing great assistance for appropriate planning to control of gully expansion. Among various parameters, geologic, climatic, topographic, and land use factors are conspicuous.

Hence to obtain requires data need to visit the field and interview with the people living in this area and also a special interview with the experts in gully erosion in watershed management office in Tehran, Karaj and Firouzkouh. Also the field surveying and applying GPS to prepare digital maps, and also coordinating the topography and geology maps to prepare different layers of required maps and tables by GIS, also climatic histogram by Excel related to the region and performing precise studies.

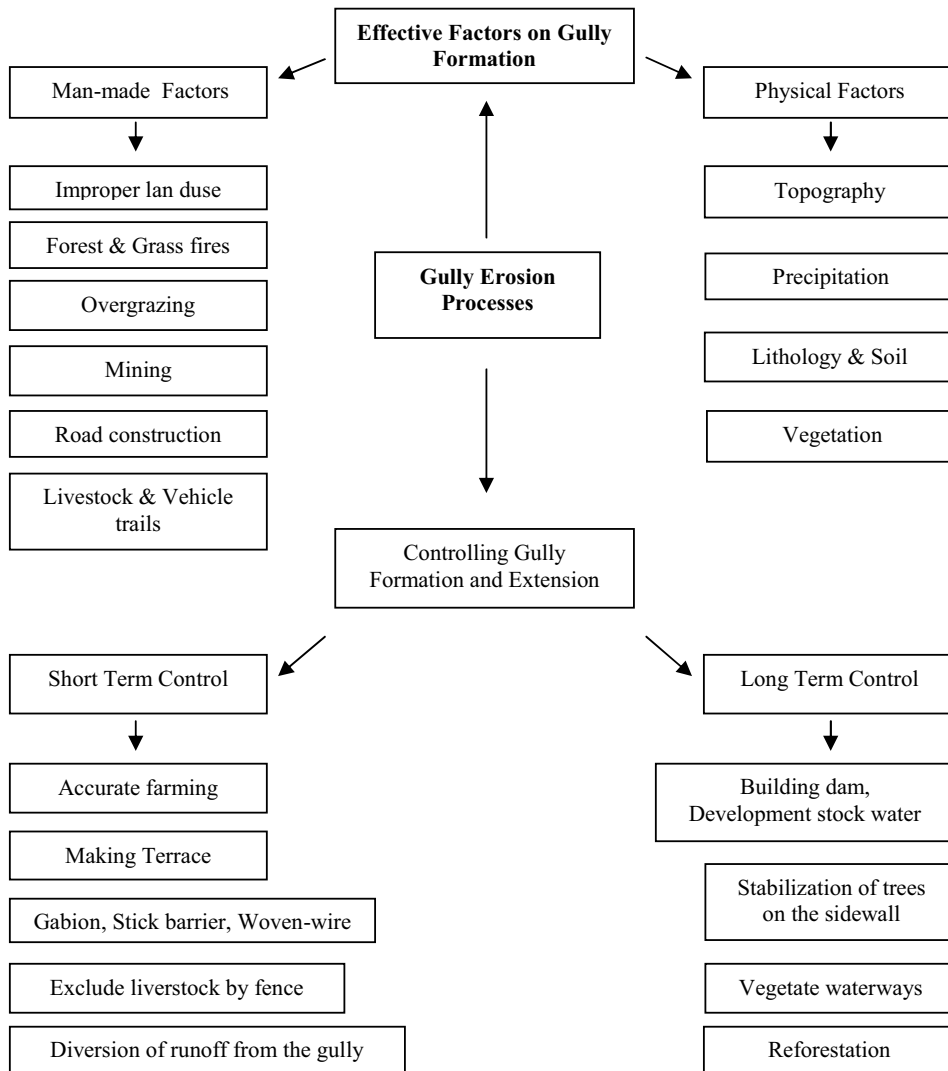


Fig. 2. Factors effecting gully formation and its controlling

3. Results and Discussion

Results from this research on gully erosion shows that there are many factors to occur and expand gully erosion in many places in the world as following diagram. According to the factors in different place it is required to help and teach the people to use the land properly and apply special treatment which can prevent the extension of gully erosion. By this research there are some factors that they affect and control gully formation as below diagram (Fig. 2).

This research on gully erosion in Toroud basin shows that gully erosion is a process controlled by a diversity of connected factors like lithology, climate, topography and land use.

The river in this area is Toroud river and most branches of this river are seasonal and some parts feed by some spring. There are about 10 springs and 4 flumes that are using for the houses, farming and livestock.

The people use some ways to preserve and save the water and use it in farming and for their livestock. As it shows in below pictures, they make a big hole in the ground and collect the rain and groundwater in this hole. Also they cover some water way with plastic to prevent the water from absorption into the ground and convey it to their farming land (Fig. 3 and 4).

Also in some sites of this basin to prevent gully extension they planted some trees near the gully, in the sidewall or inside of the gully bed to stabilize of the soil. Also they constructed stone gabion after the head cut of the gully, but still gully is extending (Fig. 5). The people in this area seek to prevent gully erosion expansion, but it needs proper planning by considering the effective elements on the occurrence and expansion of gully erosion.



Fig. 3. Plastic cover to keep and convey the water



Fig. 4. Making hole to collect water



Fig. 5. Stone gabion after head cut.

Table 1. Geology of Toroud basin and gully extension

Class of slope	Extent of class (hectare)	Extent of class %	Gully extent (hectare)	Gully extent %
0-5	1151.41	13.17	58.75	60.41
5-10	959.33	10.98	1	1.03
10-20	1304.22	14.92	11.75	12.08
>20	5325.54	60.93	25.50	26.22

Topographic map of the area shows that the most expansion of the gully occurs on the 2000–2500 meters above sea level. And no gully erosion formed on the upper than 3000 meters above sea level.

Also according to measure slope, most of the gully formation is occurring in lower slopes, (0-5) that is 60.41 percent of whole gully erosion in this area (Table 1, and Fig. 6).

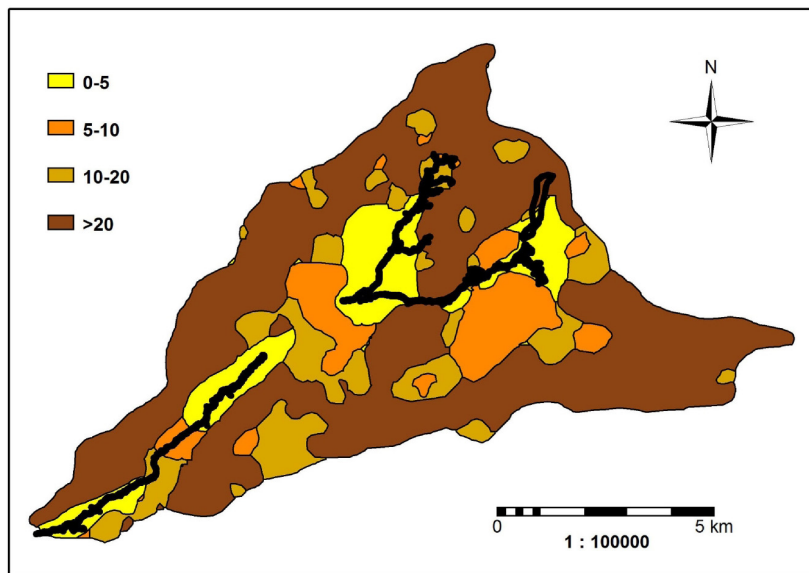


Fig. 6. Slope map and gully erosion in Toroud basin

The land use map of this area shows the most expansion of gully formed in pastureland that is equal 69.67 % of gully erosion in Toroud basin and no gully formation in shrubbery and less than all in the orchard. Table 2, and Fig. 7.

Table 2. Land use and gully extension

Class of land use	Extent of class (hectare)	Extent of class %	Gully extent (hectare)	Gully extent %
Pastureland	7757.50	88.75	67.75	69.67
Agriculture	474.00	5.42	27	27.76
Shrubbery	330.25	3.78	-	-
Village	28.50	0.33	1.50	1.54
Orchard	150.50	1.72	1	1.03

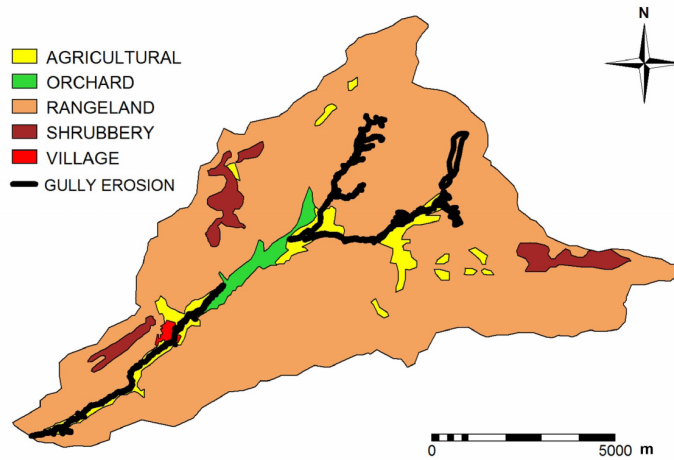


Fig. 7. Land use map and gully erosion in Toroud basin

Also geology of Toroud basin shows that this basin contains Eocene sediments include: Marl, Limestone and Tuff (41.56 percent of gully erosion). And Neogene sediments like: Sandstone, Shale and Conglomerate (26.48 percent of gully erosion). Also Young Holocene that is include: Alluvial fan sediments (15.94 percent of gully erosion).

Monthly rain is one of the factors affecting gully formation and expansion. According to climate data in this area the rainiest month is April and less rainfall in August, which in some months there is no or trace rainfall. Flash flood has a big role that run on the land and washes the soil surface and extends gully erosion especially in branches. Below diagram shows the mean monthly rainfall and temperature of this area during the 35 years (1968-2003). By below diagram during January to March the amount of rainfall is higher than temperature that is wet season and March to December as the temperature is higher than rainfall is dry season (Fig. 8).

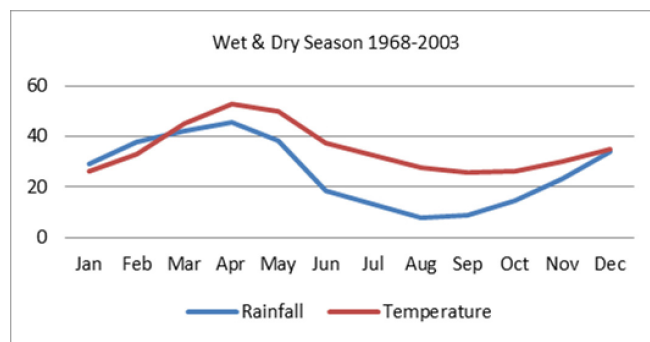


Fig. 8. Wet and dry season by mean monthly rainfall and temperature

4. Conclusion

The research on the lithology and soil type in Toroud basin is shown that most erodible sediments in this region. By considering the research on gully erosion in Toroud basin the problem is neither indication of lessening the individual pressure on the land nor planned gully control efforts and land sustainability is at stake. It is required to perform all possible actions and use the land properly which lead to bring an end to the development and expansion of gullies.

Gully erosion in Toroud basin has created many problems and negative effects and it is the cause of hardship in passing through the land in whole this region. So it needs recognition various reasons effect on occurring gully formation and its management in the long term especially by increasing peoples' knowledge and also government operation.

References

- Bull, WB. (1997). Discontinuous ephemeral streams. *Geomorphology* 19: 227–276. Casali J, Lopez JJ, Giraldez JV. 2003. A process-based model for channel degradation: application to ephemeral gully erosion. *Catena* 50: 435–447.
- Elliot, J.G.; Gellis, A.C.; Aby, S.B. (1999). Evolution of arroyos: incised channels in the Southwestern United States. In *Incised River Channels*, Darby SE, Simon A (eds). John Wiley: Chichester; 153–185
- Francis, C.J. (2010). How to control a gully. Part of Yearbook of Agriculture Series. Soil Part 2 - Tillage.
- Jianrong, F.; Bingwei, T.; Dong, Y. (2008). *Journal of natural science*, Wuhan University Vol.13 No.3, 343-349.
- Karlstrom, T.N.V. (1988). Alluvial chronology and hydrologic change of Black Mesa and nearby regions. In *The Anasazi in a Changing Environment*, Gummerman GJ (ed.). Cambridge University Press: New York; 45–91.
- Mennoubi, S.; Felfoul, Ali; M. Mohamed, R.; Boussema Mohamed, H.; Snane. (2007). Assessment of the influence of the lithology and rainfall events on gully erosion in Oued Maiez Watershed in Central Al Tunisia. Tunisia. 2nd Inter-Regional Conference on Environment-Water 99. *Geophysical Research Abstracts*, Vol. 9, 01710. SRef-ID: 1607-7962/gra/EGU2007-A-01710
- Moge, A.; Holden, N. (2006). Farmers' perceptions of soil erosion and soil fertility loss in Southern Ethiopia.
- Morgan, R.P.C. (1995). *Soil Erosion and Conservation*. 2nd edition, Longman, London.
- Patton, P.C.; Schumm, S.A. (1975). Gully erosion, Northwestern Colorado: a threshold phenomenon. *Geology* 3: 83–90.
- Pederson, Joel L.; Petersen, Paul A.; Jennifer, L. (2003). Dierker Gullying and erosion control at archaeological sites in Grand Canyon, Arizona.