Investigation of Physical Environment of a GullyNetwork of Sahson Village of Etawah, Lower Chambal Valley.

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Abstract

High erosion of fluvial deposits of both sides of Chambal is allowing the formation of gullies and ravives in its basin. Lower Chambal Valley is known for its deep gullies and large expansion of ravines. The extension of gully network creates several unique features that deeply affects the physical and socio-economic environment of its catchment. Information has been collected through a detailed physical field survey. Traces of soil erosion process and pattern of landuse/land cover has been analysed in this paper.

Key Words: Gully Catchment, Lower Chambal Valley, Physical Environment, Soil Erosion

Introduction

Land degradation problem with respect to gully erosion and the ravines is a serious issue in the tropical raverine environment. Soil erosion by water is a major form of land degradation. It is abruptly hitting the physical environment and also degrading the socio-economic environment of the region. Soil erosion is one of the major causes of depletion in soil quality and productivity. Yield outcome is the base of farm profit. The income of the vulnerable farmers is directly affected by the soil erosion through its impact on yields. Thus the socio-economic condition of the farmers is adversely affected by the land erosion. Words of Prof. Toynbee capture this meaning as

"Ravines are symptoms of decay of civilization"

Literature Review

Erosion of fluvial landscapes not only affects the physical environment but also the socio-economic scenario of the people of that land. Therefore it is important to look at the literature available on the topic in order to understand the physical environment of gully catchments with its various dimensions.

Pani P. and S.N.Mahapatra (2011) discussed the expansion of ravenous land in India specially in Chambal valley with its causes and consequences. The role of geospatial technology in such study also discussed here. They told that ravine formation lead the heavy erosion of soil from crop lands has affected the productivity of land. They further told that soil erosion hazard could be converted into disaster by anthropogenic interference in the process. **Dr. Padmini Pani and S.N.Mahapatra(2001)** have estimated the rate of ravines expansion in Lower Chambal Valley, by using multi temporal remote sensing data and GIS. In this article they estimated that the affected area during the 15 years time period (1984-1998) has been increased from 35.37 % to 38.94- % of the study area. This is a remarkable study of delineation and monitoring of the gullied and ravenous land in the sub- humid climate region of India.

In "Mapping gully erosion patterns in foothills of lower Shiwaliks" by **S S Kukal and Bhoop Singh (2010).**discussed the causes of failure in gully management in lower Shiwalik area of Punjab. He told that the possible reasons for the failure of these gully control structures could be a complete lack of information about the gully network and most of the structures were installed in the highest ordered

W.P.Ezaza(1988) studied the factors influencing land degradation in mountains site of Tanzania. In his task "Geoecological factors influencing over-exploitation and land degradation in the Usambara. Mountains of north-eastern Tanzania" he told that external and internal forces influenced by geoecological factors have generated internal demographic pressure. The results are increasing pressure on marginal hill forests, firewood, and animal fodder, and decreasing soil fertility and as a consequences, a low level of economic activity and a low standard of living

M.P.Mosley (1972) worked on the evolution of a discontinuous gully system in the semiarid west and southwest United States in his article titled as "**Evolution of a discontinuous gully system**". He explained that the gully system has developed under the influence of geomorphic agents which operate infrequently, during heavy rain or strong winds in the studying area.

Michael E Meadows and **Timm M. Hoffman (2003)** discussed the potential impact of future climate change on the nature extend of land degradation in South Africa. In their work "land degradation and climate change in south Africa" they reveal that land degradation is underpinned by poverty and its structural roots in the colonial and apartheid political planning. Future climate change represents a key challenge to the developing economies of South Africa.

Sharma (1979) has covered study related to the physiographic of the lower Chambal valley and its agricultural development. Author has formulated a theory of ravines genesis on the bases of various geomorphologic and hydrological evidences which opens up a new line of thought in fluvial geomorphology. He has also established relationship between geomorphology and agricultural development in Chambal valley.

Kumar, H. (2012) discussed the problem of human wildlife conflict in Chambal badland. He told that due to expansion of land degradation and juliflora, wild animals are forced to move toward crop land. It is increasing the man-wildlife conflicts in the region. As a result of that peasants are avoiding to grow particular crops like gram, pigeon pea etc.

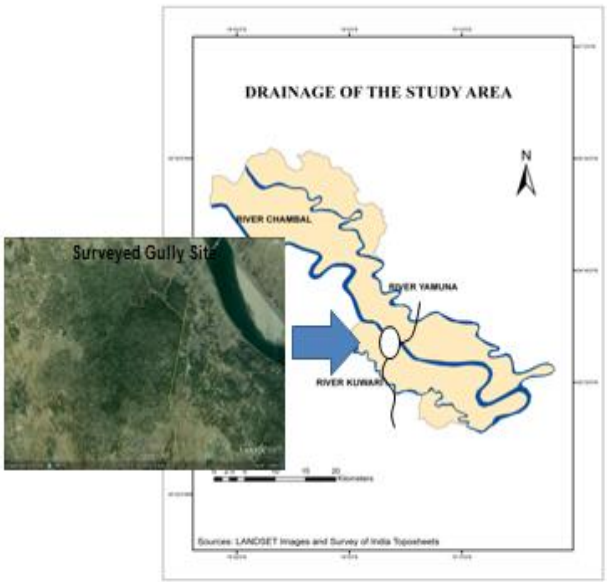
L.P.Lusambo,G.C. and J. Katani (2007) worked on socio-economic condition of the people and land degradation in their work ''Socio-economic analysis of land –use factors causing degradation and deforestation of Miombo woodlands in Tanzania''. They find out that agriculture and charcoal making activities are statistically significant causes of degradation of land there. People of the region are making good money from charcoal making activities there. But just for some economic gain, they are destroying their environment.

Kumar H. and Padmini Pani (2013) investigated the impact of soil erosion in gully affected region of lower Chambal valley. They found that headword erosion of gullies is rapidly encroaching the crop land and declining the productivity of land there.

Study Area

The surveyed gully is located in Chakarnagar block of district Etawah, Uttar Pradesh. This gully is expanded at the right bank of Chambal River. The mouth of gully is joining the Chambal near Sahson village. The geographic location of this place (mouth of gully) is $26^{0}\,32'34.9''$ N and $79^{0}\,05'15.7''$ E. The catchment of surveyed gully is spread over 5 square kilometers. Village Sahson, Hanumantpur, and Chandhaspur are affected by the land encroachment of this gully (Fig 1).

Fig 1



Objective and Methodology

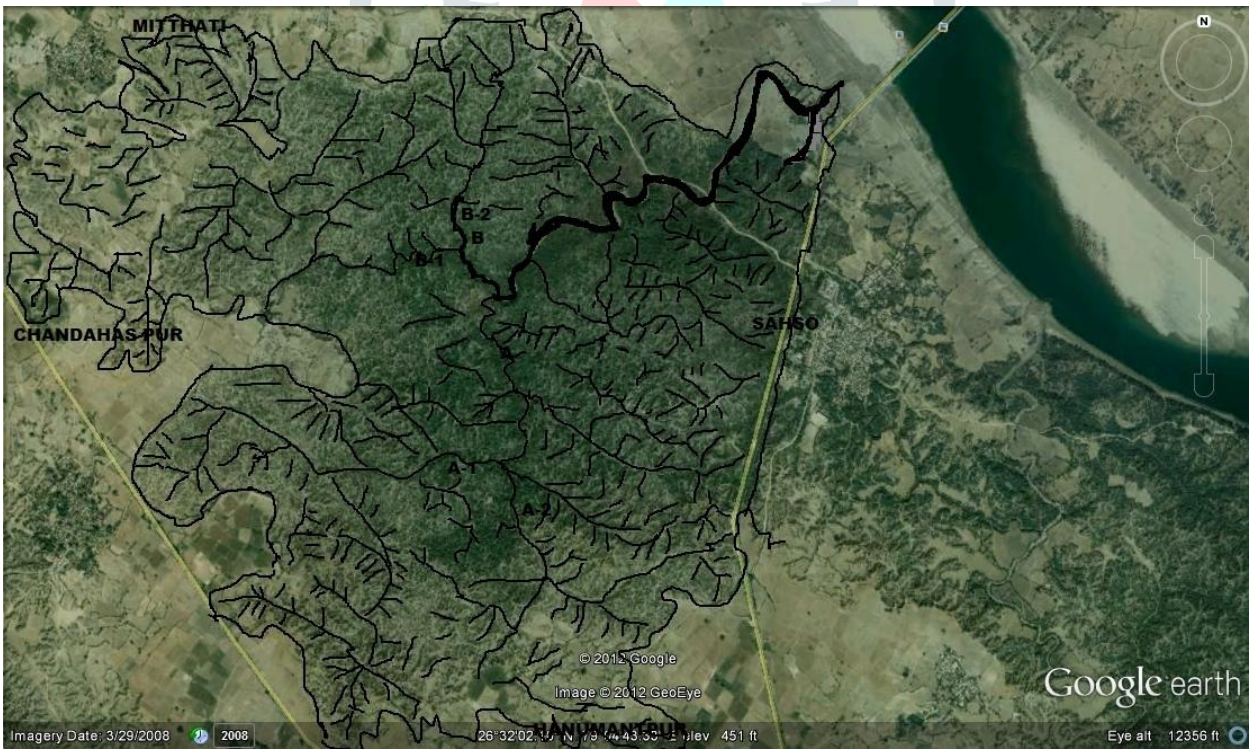
Major task of this paper is to investigate the physical environment of a gully catchment. Primary filed survey has been done. Information collected from measurement of gully features has been interpreted and analyzed in a logical way.

Discussion

Pattern and Features of Gully

Gully is locally known as Khar. The surveyed gully is spread in a large area having many braches on upper reaches. At the distance of 1.70 kilometers away from mouth to upper reach, it is devided in two major branches. The right side brach (branch A) is reaching to Hanumantpura,. The length of this brach is around 1.94 kilometers. At the distance of 1.24 kilometers away from mouth of this sub branch, it again devided in two branches. Several small branches has been developed from both sides of these braches and actively eroding a huge area.

Fig 2.0



Source: Google Earth.

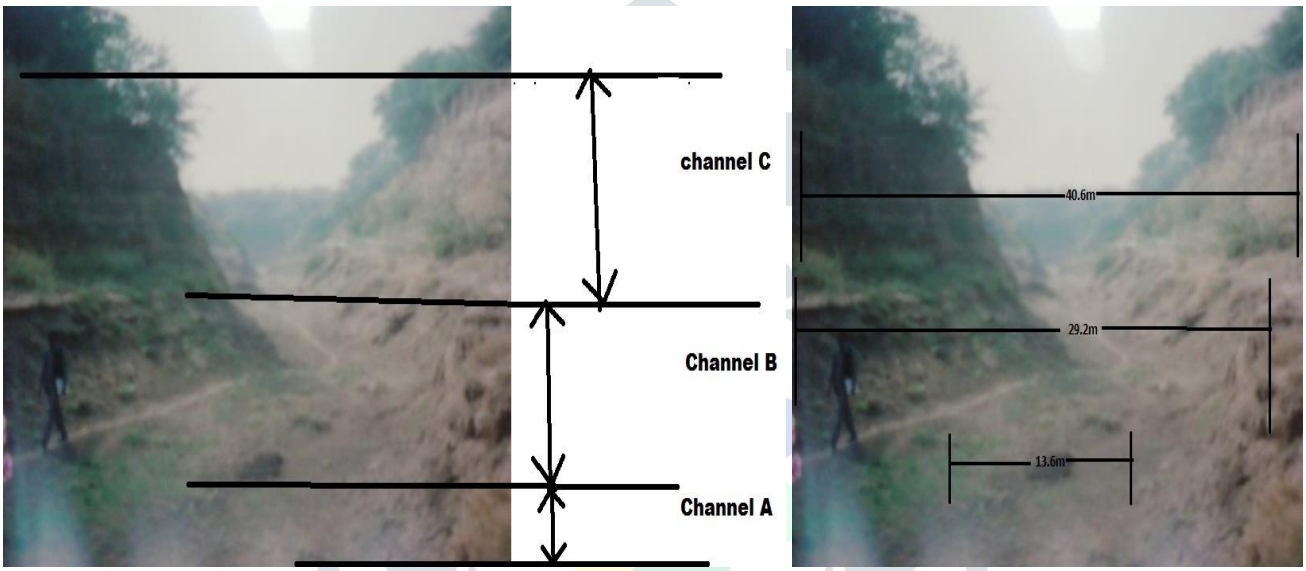
Another main branch (branch B) of Khar is also devided in two parts at the distance of 0.26 kilometer from its junction with main gully. These two sub-braches are spread in a big area and affecting the mithati, chandhaspur villages of the region.There are many branches in upper reaches. These all are combined in a single Khar and finally meeting with Chambal. Although some sub-branches are

developed in parallel pattern, particularly in area of branch A, The pattern of gullies is very much dendric here.

Alluvial Traces

Due to heavy discharge of water and sediments, the mouth of this gully is very wide and its channel is narrowing toward upper part of the catchment. At the mouth of this gully, three distinct stages of development of this channel can be seen. The lower channel (channel A) is very narrow one (13 meters). See figure 3.0 and 4.0.

Fig 3.0 **Fig 4.0**



Source: Taken by author during his field visit in 2013.

A wider channel's footprint can also be seen here. That is clearly visible by an alluvial terrace. The width of this channel is 29 meters (channel B). Just above this terrace the width of channel becomes 40 meters (Channel C). Such feature could be outcome of following conditions.

The Erodibility of soil material of various layers is different here. With change in rainfall amount, channel discharge amount reaches to different heights. In case of heavy rainfall, heavy discharge of water will push the literal wall erosion and maximum erosion will be occurred at top layers of high erodobility. The presence of kankar layer at lower strata restricts erosion of soil material. At the distance of 0.75 kilometers to 1.70 kilometers from its mouth, a thick layer of unconsolidated canker has been observed in the bottom of the gully channel. Such kankar layers are exposed at many places here(Fig 5.0).

Fig 5.0

Another possible factor could be the development of parallel gully/gullies from upper reach to lower end. Its confluence with Chambal makes them independent from previous gully. A part of gully discharge of previous gully catchment will start to flow down through this channel. It suddenly declines the discharge of main gully, resultant in such traces in its channel. Such small gullies are also found in nearby area.

Clay Deposits-

Huge fine silt and clay content are spread near the mouth of the gully. It is spread over a big area. Due to high amount of clay and less moisture content (in dry season), cracks has been developed in this soil. The average width of these crakes is 2 inches. These crakes developed up to the depth of 10 to 12 inches. (Fig 6.0 and 7.0).

Fig 6.0 Fig 7.0


Source: Taken by author during his field visit in 2013

Land Use Pattern

Area of this gully network is several kind of land use here. There is forest cover, agricultural land, settlements and a huge area is left as barren land. Near the mouth of surveyed gully, undulating land is under cultivation practices. Due to undulating shape, land is not suitable for intense agriculture. It is under use of cultivation of mustered and gram. Crop plants are grown in patches and a big area of these fields can be seen with bare soil cover. Soil is clayish in nature and soil clods can be seen in each part of these fields. An average diameter of these clods is 2-4 inches (Fig 8.0).

Fig 8.0 Fig 9.0


Source: Taken by author during his field visit in 2013

On other hand there is few properly leveled agriculture fields are developed toward the upper reaches at the distance of 1 kilometer from the mouth. These fields are properly covered with fans by using locally available bush material. Working people are found there while it was totally deserted near the mouth of this khar. Usually wheat is sown in this area. The gully (Khar) is around 3meters deep in this part of the region (Graph 9.0).There isalmost continues forest cover at the right side of this khar. Most of the trees are *vilayati babul* (prosopis juliflora),Khair (Acacia indica), Capparis deciduas, Capparis sepiaria, Balanites aegyptiaca etc. Due to post monsoon period, small bushes and grasses has been developed here.

Conclusion

Overall we can say that the expansion of gully is in a wide area. A huge size of agricultural land came under encroachment of this gully. A large part of this area is completely converted in to badland and still it's continuously expanding toward its upper end. The presence of this gully has also developed a separate drainage channel here. It has also developed various kind of land use pattern in the region. The heavily eroded land is converted into undulating surface and become very challenging for cultivation practices.

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