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# An analysis of processes and practices prevalent at the lower Chambal Valley

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## ABSTRACT
This paper discusses, though briefly, the formation of badlands along the notorious Chambal valley and its journey till now, in the light of recent studies. The paper founded on the mainly two theories of badlands formation at the valley, one is, probably, due to strengthening of southwest monsoon in the late Pleistocene-Holocene; second is due to neo-tectonic activities. Recent studies have put forward a lot of information about the processes and practices going on in the Chambal valley. It is important to analyze and disseminate them and put forth a sysnthesis which might open up new possibilities in finding ways to tame the badlands in favour of local farmers who are much troubled due to the inhospitable terrain they find themselves in.

**Keywords**: Badlands; Chambal; Reclamation; change detection; geomorphic evolution

## INTRODUCTION
Fluvial erosion has been estimated to be the biggest agent of land degradation. In today's world where population of world has been increasing tremendously, man's efforts are towards increasing the land productivity to secure a hunger free world. Since, land degradation reduces the fertility of the land; measures must be taken to reduce its furtherance. India being the home of 1/6 of world's population needs the food security for its growing population. In pursuance of this policy, badlands remained an untamed resource despite many govt. efforts (such as aerial seedling, govt. policy thrusts etc. see: Ranga *et al*., (2016)). Focus of badlands studies in the valley has always remained on the conservation and reclamation (a overview of such literature has been published elsewhere: Haigh, (1984) as it can help to alleviate poverty of the local population through modernization of agriculture. Another contention is the origin of badlands which actually be helpful in reclamation efforts, many of the earlier conservation works suggested a number of reasons including surface runoff mismanagement, deforestation, overgrazing and due to intensity and concentration of rainfall during monsoon on the deep alluvial deposits (Haigh, 1984). However, a theory which linked the Chambal badlands with Himalayan orogeny has gained more popularity (Ahmad, 1968; Sharma, 1968, 1979). In the later years, Agarwal et al., (2002) found evidences of neo-tectonic activities in the Chambal valley. Furthermore, Mishra and Vishwakarma, (1999) has also concluded in the favour of neo-tectonic activities in the valley. An approach has also been implicated i.e. intensification of monsoon in late Pleistocene-Holocene (Gibling *et al*., 2005; Joshi, 2014; Ranga *et al.*, 2016).

Apart from the origin of the badlands, despite its originality and attractiveness, reclamability of badlands is a more pressing issue at present. Ranga *et al.*, (2015) has presented an interesting analysis where an geomorphic evolution of badlands at the lower Chambal valley was proposed (originally a modification to the model proposed by Sharma, (1979). This model was also linked to leveling/reclamation of badlands. Recently, a number of works has also been presented on the reclamation practices and efforts (Pani, 2016; Ranga *et al*., 2016). This paper analyses and presents a brief summary of the works done in the lower Chambal valley in a consistent and comprehensible way. This work, however, should not be considered a literature review which should be a more elaborate one.

## STUDY AREA

The study area (Fig.1) is the area infested with badlands along the lower reaches of the Chambal river, more conveniently termed as lower Chambal valley (see: Sharma, (1979) for classification of the Chambal valley). The Chambal River has a length of 960 km with a total basin area of ca. 143,219 km2 (Jain et al., 2007). The average annual rainfall is ca. 800mm and majority of the rainfall occur during the monsoon season (June-September) (Ranga *et al*., 2015). Climate is semi-arid type with three distinct seasons, winters (November-February), summers (March-June) and monsoon (June-September).

## RESULTS AND DISCUSSION
This study is carried out, primarily, as a synthesis of the recent published studies on the lower Chambal valley. Therefore, an extensive material and methodology section was unnecessary, and thus it was

skipped. Starting from the origin of badlands, this study has founded on two major school of thoughts which imply formation of badlands. As it has also been argued by Sharma, (1979), the author also has similar viewpoint that such a wide, severe and deep badlands as present in the Chambal valley cannot be attributed to mal-land use practices. There has to be a strong force must be responsible for such spectacular landforms, author accepts and supports the argument thus relying on the two theories mentioned above. Most of the studies during the early phase of studies on badlands were aimed at conservation and reclamability of the badlands and serious efforts were made to classify them on the basis of their reclamability (see: Haigh, (1984)). As a part of these efforts, aerial seedling was carried out but was utterly failed which prompted Govt. of India inviting an expert to evaluate the reasons of its failure (Adams, 1987). An exceptional work on the Chambal badlands was carried out by (Sharma, 1979) ranging from physiography to its agricultural aspect, however this study put forth studies of later than 1990 as a comprehensive compilation of older studies has been done by Haigh, (1984).

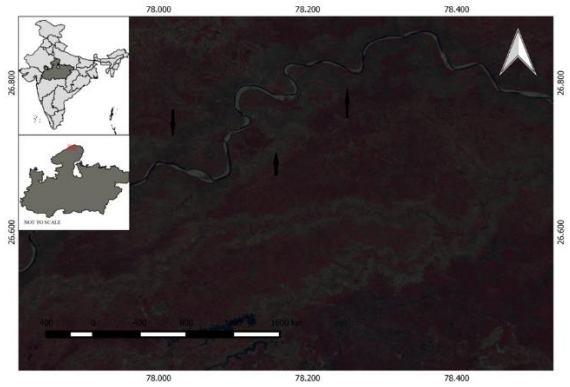


Figure 1 Location map showing an False Color Composite (FCC) satellite image of a part of lower Chambal valley (Arrows showing badland areas)

Figure 2 Recurrence of gullies in recently reclaimed badland

In the recent studies, contribution of a research group (Agnihotri and Yadav, 1995, 1995; Yadav and Bhushan, 2002) cannot be ignored. Yadav and Bhushan, (1994) developed the concept of prefabricated drop spillway which is reportedly cheaper than conventional brick bunds and more effective to prevent reverting fields to gullies. Later, they (Yadav and Bhushan, 2002) supported the watershed management approach for gully erosion reclamation and advocated that the projects should have participatory group actions of people directly involved with badlands. Such programs has also been carried out as elaborated in Balooni, (2003) such as social forestry programs were launched during 1980s and pioneered by three states namely Madhya Pradesh, Rajasthan and Uttar Pradesh in the badland areas. Balooni (2003) has also gave the inflated costs of afforestation in ravines for this zone for the year 2000-2001 from the prices reported by Govt. of India (1984) and Chaturvedi, (1985).

In more recent studies, the lower reaches of the Chambal River has been identified to have been a multi-channeled planform in contrast to today's single channel planform. The multi-channel planform has now been reduced to palaeo-channels which can be effectively used for cultivation inside the badlands, wherever they could be found. As far as the reclamation is concerned, local farmers employ two methods: 1) Levelling of badlands using bulldozer and 2) sedimentation behind the small check dams (Ranga et al., 2016). As reclamation is the most important practice, people engage in the Chambal valley, it becomes important to evaluate their success vis-à-vis cost of reclamation. As described in Pani (2016) and Ranga et al., (2016), reclamation practices may not give desired results and can be a continuous process due to recurrence of gullies in the newly reclaimed lands (Fig.2). Furthermore, if the cost of reclamation cannot be ascertained, it will be difficult to understand the financial and mental burden on the marginal farmers, who are most vulnerable. Since gully formation is a threshold phenomenon, it becomes important to inquire into the conditions which trigger the formation of new gullies and thus encroachment of badlands in the agriculture area. There has been a good body of literature on threshold limits of gully formation in the European countries (Desmet et al., 1999; Poesen et al., 2003; Vandekerckhove et al., 2000, 1998) but none could be found for the Chambal valley. It becomes tantamount to carry out such a study to make reclamation efforts successful.

First stage, in carrying out successful reclamation of badlands, should be undertaking of

serious research efforts in understanding the nature and causes of formation of new gullies and in a second stage, dissemination and engagement with the farmers will be important.

## CONCLUSIONS

In the light of the new works on the Chambal valley it has been understood its origin cannot be attributed to simple mal-land use practices. In explaining its origin, both the above mentioned theories could be used, not exclusive but may be augmentative or one another. In today's scenario, farmers are engaged in leveling badlands to make the land suitable for cultivation but their efforts are not completely fruitful. A greater understanding is required and for that a dedicated research is required to first fully understand the nature of processes in the Chambal valley and secondly developing methods to tame the wildness of badland thus make them suitable for cultivation. Directions of the future work can be on estimating slope thresholds, though a lot of literature is available on this in the European countries but none can be found for the Chambal badlands.

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