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**Amit Bera and Pradip Namasudra**

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**Research Article**

# IMPACT OF SHIFTING CULTIVATION ON THE ENVIRONMENTAL CHANGES IN GUMTI RIVER BASIN, TRIPURA

***Amit Bera and Pradip Namasudra**

Department of Geography and Disaster Management, Tripura University, Suryamaninagar, Tripura, India

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**ABSTRACT**

Shifting cultivation or "slash and burn agriculture" is an ancient form of subsistence type agriculture still practiced in Tripura as well as in the Gumti river basin. Within the basin area it mainly practiced at the hilly track of Atharamura, Longtarai and Baramura hill ranges. In this traditional type of cultivation system forest area is cleared by slash and burn process. Every year vast forest area of are destructed as a result of the practice of shifting cultivation. In recent decades due to excessive population pressure on land, the fallow length period of shifting cultivation cycles become as short as 4 to 5 years in Tripura. As a result the secondary forest does not get enough time to regeneration properly. Some methodology has been adopted for understand the nature of environmental degradation process. The main objective of this study is to assess the impact of shifting cultivation on the environmental changes, which were mainly Deforestation, Biodiversity loss, Climate change, Soil degradation etc. The input morphometric maps have been prepared on the base of satellite data by using GIS and RS Platforms like Arc GIS 10.1 and Global mapper.



## INTRODUCTION

Shifting cultivation, regarded as a first step in transition from food gathering and hunting to food production, is nearly 9000 years old practice [1]. In Tripura, shifting cultivation (commonly known as *Jhum*) is still practiced nowadays as a form of subsistence agriculture by indigenous people of Tripura. It is practiced at the different hilly parts of Tripura and in the case of Gumti river basin it is mainly practiced at the hilly track of Atharamura, Longtarai and Baramura hill ranges. Out of a total of 55,049 *Jhumia* (shifting cultivator) households all over the state, 39.3% are entirely dependent on *Jhuming*, and the remaining 60.7% are partly dependent. The Tripuri (28%) and Reang (25.6%) tribes are the two major *Jhumia* communities [2]. For the preparation of shifting cultivation field, at first cultivators are clear the field by cutting down all plants. Then those cutted plants are left in that field for few days and when it get become fully sundried then fire is set for burning. The cultivators set fir when the wind direction is favorable. It helps to burn all the trees quickly. Cultivators use these Brunt ashes as a manure of the soil.

In the Gumti river basin, shifting cultivation has various impacts on environmental changes. It affects land, forest, biodiversity and local climate in the following ways; destruction of forest cover through slashes and burning process, land degradation through soil erosion, decreasing the floral and faunal species communities, polluting air at the burning time carbon emission etc.

### *Location of the Study Area*

The study was conducted at Gumti river basin in Tripura (Figure 1).

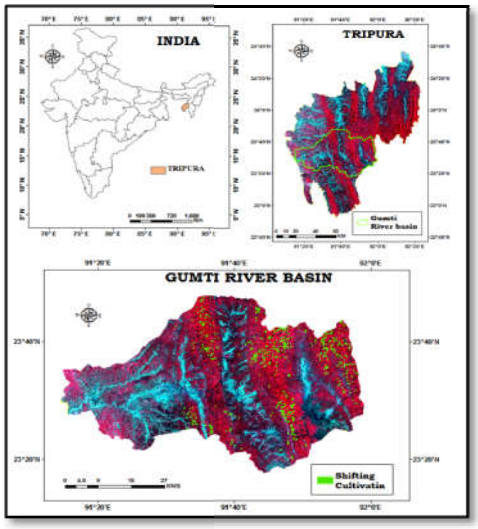


**Figure 1** Location Map of study area

**Corresponding author: **Amit Bera***
*Department of Geography and Disaster Management, Tripura University, Suryamaninagar, Tripura, India*

It is the largest basin among the rivers of Tripura. The maximum portion of Gumti river basin lies in the Gomati districts of Tripura. Latitudinal and longitudinal extent of the basin are between 23°17 46 N to 23°47 45 N and 91°14 43 E to 91°59 29 E, respectively. The catchment area of Gumti river basin is 2,492 km$^2$ within Tripura and 77 % area is under the hilly catchment portion and only 23% area is fall under the plains.

## METHODOLOGY

In pre-field stage of the present research work, some literature concerned with the topic has been collected and critically reviewed. Location of shifting cultivation has been initially identified from the Google earth image and thereafter it was verified with the help of Hand held GPS reading. Environment related impact was critically observed during field study and some secondary data are also use for analyzing the environmental effects of shifting cultivation. Rainfall data was collected from the Udaipur weather station of Tripura. Soils samples were collected from the three different locations of shifting cultivation plot under Gumti river basin and the soil pH was measured with the help of pH meter. In post field stage, topic related different data are analyzed through statistical tools and technique and represented by suitable diagrams. Morphometric maps have been prepared by using GIS Platforms like Arc GIS 10.1, Global mapper and Google Earth.

### *Physical background of the study area*

Tripura is predominantly a small hilly state. Geographically the Gumti basin is lies in the lower middle part of Tripura. Mainly two broad physiographic divisions; hills and plains (undulating and flooded) are major topographical characteristics of Gumti river basin. The main physical characteristics of this basin area are rich floral and faunal diversity, tropical monsoonal type climate and tropical evergreen deciduous forest. From the Physiography map (Figure 2) it has been observed that the patches of inter-hill valley, undulating plains, alluvial plains are mainly found at the western portion of the basin and high relief topography is mainly found at the eastern part of the basin.

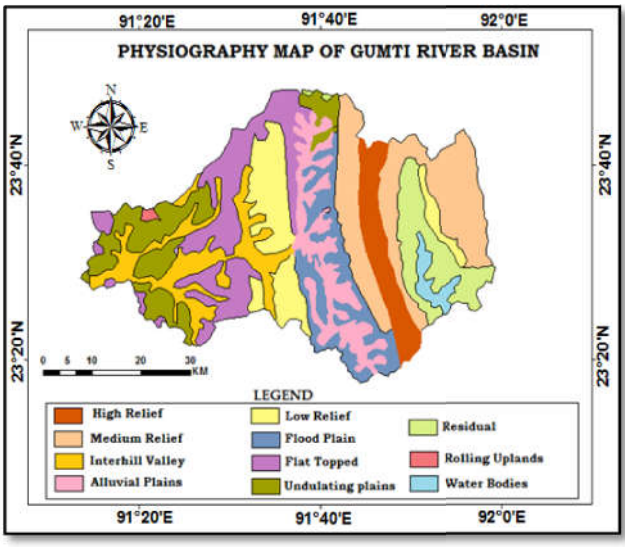


**Figure 2** Physiography Map of Gumti river basin

## RESULTS AND DISCUSSIONS

### *Deforestation*

Shifting cultivation is a one type of forest agrarian system which has been widely practiced (Figure 3) by tribal community of Tripura. Shifting cultivation has been identified as one of the primary cause of deforestation (Figure 4) and it causes substantial loss of primary forests and it occurs mainly in two ways. Firstly, shifting cultivators clearing forests by cutting plants for cultivation and secondly, during land clearance uncontrolled burning destroys the forest by forest fires. The rotation cycle of shifting cultivation in a particular area vary between 12 to 16 years but recently due to excessive population pressure the length of Fallow cycles become as short as 4 to 5 years in Tripura. It is not enough time for regeneration of secondary forest properly. The forest cover under Gumti river basin has drastically decreased over the last few years. The fragmentation of natural habitat presents a potential threat to the survival of wildlife faunal species.

**Figure 4** Cleared forest land for shifting cultivation

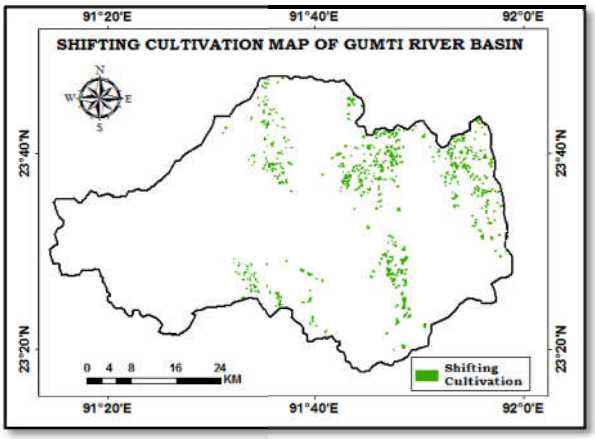


**Figure 3** Shifting Cultivation map of Gumti river basin

### *Impact on Biodiversity*

Tripura has diverse ecosystems ranging from forests and grasslands to freshwater wetlands. More than 1700 different species of higher plant exist in the forest of Tripura, among them maximum variety have medicinal importance [3]. Loss of natural forest ecosystems always results in loss of biodiversity and often in a range of Environmental impacts [4]. Short fallow rotation of shifting cultivation have arrested succession rate of

seral community of secondary forest. Total number of species and Varity of species richness are also become low than the primary parent forest. These changes in habitat also affect on faunal diversity in shifting cultivation prone area of Gumti river basin.

Endemic species, particularly, have been reported to have not fully recovered even after a period of 50-60 years [5]. Weedy species were not succeeded by pioneer woody species, and over time the soil seed bank was replaced with seeds of weedy shrubs [6]. The Baramura, Atharamura and Longtarai hill ranges under Gumti river basin are considered as rich biodiversity hot spot region but in recent decades it has been endangered due to massive uncontrolled destruction of forest for shifting cultivation fields.

Soil fauna plays a vital role as a maintaining agent of soil ecosystem as well as soil biodiversity but during burning time of shifting cultivation plot, Soil fauna may drastically destroyed in the cultivation land. In a few cases some macro-fauna and meso-fauna like burrowing worms and insects such as ants may only survive because they live comparatively deeper portion of soil layer than the micro fauna.

### *Impact on soil*

### *Soil erosion*

Soils are the vital natural resource, on whose proper use depend the life supporting system and socio-economic development [7]. The stability and erosivity of soil is depending on different types of factor like, parent materials, topography, climatic condition, human activities etc, which vary from place to place. In Gumti river basin basically in the portion of hill ranges the soil becomes bare due to forest cover removal for shifting cultivation and during monsoonal time huge amount of soil erosion take place by rain wash or sheet wash action.

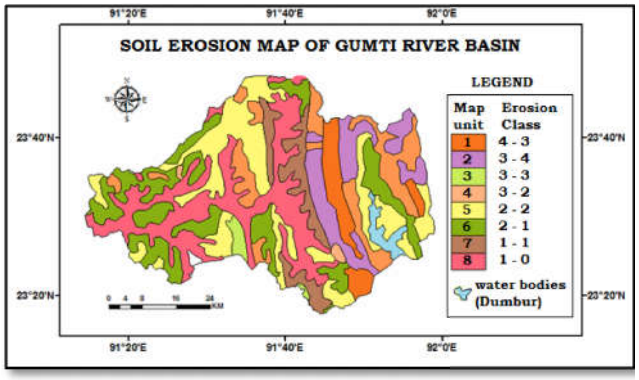


**Figure 5** Soil erosion map of Gumti river basin

The soil erosion class of Gumti basin has been shown in the map (Figure 5) and from this soil erosion map it has been clear that the rate of soil erosion comparatively high in the hilly part than the flood plain and undulating plain part of Gumti river basin. Shifting cultivation is the important factor of such type of soil erosion at Gumti river basin. It also destroys the ecological and environmental balance of soil layer because one inch soil formation in nature takes about 600-800 years but several inches of top soil layer are washed out each year due to Shifting cultivation, and heavy soil erosion from hilly part of Gumti river basin is another important factor for accumulation of siltation material on Gumti river bed.

### *Impact on soil fertility*

The net changes in soil available for nutrient pool from pre-cropped stage through slashing, burning and subsequent cropping result in substantial lowering of carbon, nitrogen and magnesium [2]. After burning of cultivation field the large amount of ash was added with the soil which is rich in minerals, destroys enormous quantities bacteria and other microorganism. It affects the soil organic matter of top soil layer and also responsible for deterioration of soil fertility level.

### *Soil Ph*

As a measure of soil acidity or alkalinity, soil pH constitutes one of the most important chemical soil parameters [8]. Results illustrated in Figure- 6, showed that the soil pH values in the present three sites were varied within a narrow range from 4.9 (Before Slash, sites-3) to 5.68 (Just After slash and burn, sites-1). After burning period of shifting cultivation plot, soil pH value immediately increases due to effect of the ash. Due to changes of soil pH the cations exchange capacity of soil also be changed. After few months it decreases gradually with respect of time due to leaching process. Changing nature of pH level affects the life cycle of cultivated crop as well as the growth rate of plants. Especially more sensitive species are affected by slight changes of pH levels in soil.

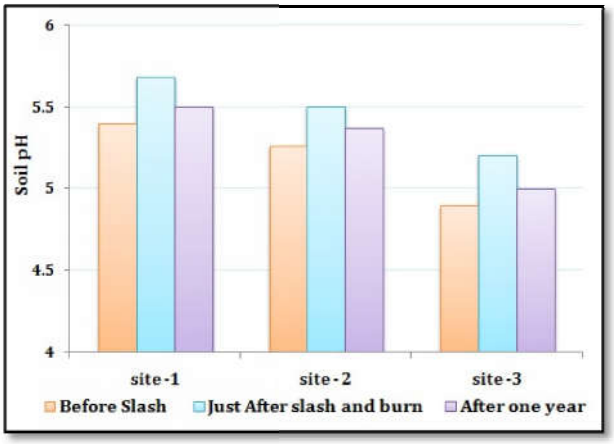


**Figure 6** Spatial variation of Soil pH

### *Impact on Climate change*

Shifting cultivation is widely believed as a practice promoting deforestation and carbon emission. Cumulative losses from shifting cultivation in the tropics can affect the local to regional to global balance of carbon and nutrient cycles [9,10]. Loss of forest cover and burning of shifting cultivation land affects on the micro climatic phenomenon like-uneven distribution rainfall, reduction of humidity etc. Evapo-transpiration is undertaken as one of the important sources for water vapors for cloud formation. Volume of evapo-transpiration reduces due to removal of forest covers with forest canopy and it affects on cloud formation as well as the rain cycle. Rainfall chart (Figure 7) of Gumti river basin showed that the average annual rainfall of the last ten years is quite fluctuating in nature but the overall trend of rainfall is on comparatively decreasing rate.

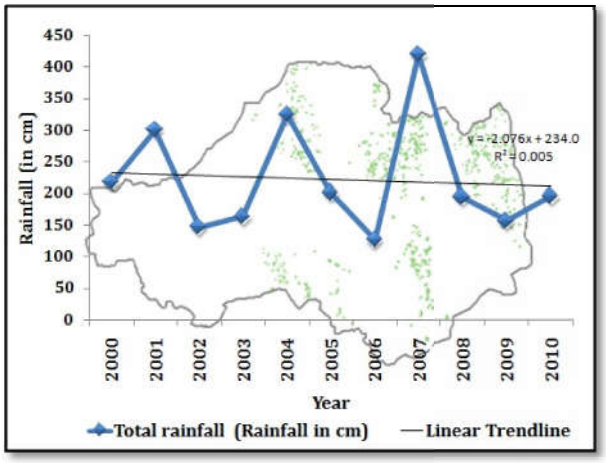


**Figure 7** Rainfall chart of Gumti river basin

## CONCLUSION

The practice of shifting cultivation on hilly topography has some negative impact on environmental factor like destruction of forest, threat of biodiversity, degradation soil quality etc. In recent decades due to shorten fallow periods of cultivation land the intensity of environmental impact become more vulnerable. It has been found that the Government has promised to cultivators to provide better schemes rather than the practice of slash and burn type cultivation but in maximum cases the schemes was not properly reached among the cultivators which results they still practice this subsistence agriculture. It can be concluded that the adoption of alternate land use practices like agro-forestry and the lengthening of fallow cycles for longer duration may reduce the environmental impacts of shifting cultivation.

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