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Changing Landscapes in a Changing Climate: An Opportunity for Invasive Plants to Create a New Proxy for Recent Landslide Events

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Abstract:

The objective of this short communication is to review the impact resulting from climate change modifications in the landscape on the growth of invasive plant species within the Western Ghats region, with a specific emphasis on the state of Kerala in India. The study highlights the correlation between intense precipitation events and the frequency of landslides, which in turn facilitates ideal conditions for the growth of invasive plant species. The Western Ghats, which are of utmost importance for biodiversity, are being confronted with substantial challenges.

our study region, characterized by the presence of abundant laterite soils, encounters regular occurrences of landslides, particularly in rubber plantations that cultivate *Mucuna bracteata* and *Pueraria phaseoloides*. The plants possessing nitrogen-fixing capabilities make a significant contribution to soil conservation and facilitate the growth of rubber. In places effected by landslides, invasive plants exhibit a notable proliferation, so showcasing their ability to swiftly alter the patterns of vegetation in areas that are susceptible to such disturbances. The study additionally investigates the ramifications of intense precipitation events, such as cloud bursts, on drainage systems near the rubber plantations, hence presenting a potential hazard to indigenous flora and fauna. In summary, this study underscores the increased vulnerability presented by invasive plant species in relation to increasingly extreme weather phenomena, resulting in disruptions to ecosystems within the Western Ghats region.

Key words: *Western Ghats, Mucuna bracteata, Pueraria phaseoloides, cloud bursts, rubber plantation*

Introduction: This short communication discusses the changing landscapes due to changing climate create an opportunity for invading plant species to proliferate which is dangerous to local plants. The increasing extreme rainfall events causing several landslides which interns changes the landscape and hence the purposefully introduced invading plants find the opportunity. As a result, ecological changes happen in the most eco sensitive zones of western ghats. the Kerala state situated in between coastlines of Arabian ocean and Western Ghats. The physiography of Kerala state has been divided into lowland coastal plane, the central midlands, and the Eastern high lands. The eastern lowlands are near to the seashore happen under threat due to increasing sea level rise because of Global Climate change. The central the mid lands, where most of the population of Kerala exists, we can find intensive cultivation practices and the higher lands have climate very much suitable for production of rubber, tea, coffee, and spices cultivation. Due to population explosion since 1980, the population has been pushed to most eco sensitive zones of Western Ghats. Much of the forest land has been converted to rubber plantation for the livelihood. Most of the nation's rubber production (75%) and holdings (67%) are produced in Kerala (Pradeep & Jacob 2021, 56)

The primary soil type found in Kerala is laterite, which is a product of high temperatures and intense rainfall. These soils typically have low levels of organic matter, nutrients, and limited capacity for nitrogen fixation. In our research area, landslides frequently occur in rubber

plantation sites, which are often covered with the plants *Mucuna bracteata* and *Pueraria phaseoloides*. These plants are indigenous to tropical regions and were purposely introduced to Kerala state to prevent soil erosion in rubber plantations, retain soil moisture, and improve the soil's organic matter content. This practice can enhance rubber growth and yield because these plants possess superior nitrogen-fixing abilities. In warmer weather, *Mucuna bracteata* does not dry. Due to the high concentration of phenolic chemicals, it is unpleasant to cattle, protecting crops from them as well as other wild animals. Additionally, it resists drought and presents fewer fire risks when the weather is dry.

Methodology: Our main objective is to investigation of landslides in western ghats of Kerala. We conducted a field trip for investigation of Geotechnical factors which can leads to the landslides in Kanjirapally taluk, Kottayam District, which was severely affected by 2021, October 16. The river Manimala got flooded due to the cloud burst event, which was occurred within a short period of time, but its consequences are miserable. This particular event is called Mesoscale CloudBurst (MsCB) which are increasing in numbers in Kerala from recent times. (Vijaykumar et al. 2021). Due to a combination of a progressive decline in monsoon circulation and precipitation as well as a substantial rise in extreme rainfall events over the past few decades, the monsoon's variability has become greater. ((Sing et al. 2014; Dash et al. 2009; Dash et al. 2011; Ghosh et al. 2016; Vinnarasi & Dhanya 2016; Mohan & Rajeevan 2017; Wang & Ding 2006; Turner & Annamalai 2012; Mishra et al. 2012; Roxy et al. 2015; Kulkarni 2012; Goswami et al. 2006; Rajeevan et al. 2008). Nearly 17 people have died due to the landslides events because of this single cloud burst event in the Vagamon hilly area, one of the most prominent tourists attracting place of western Ghats. The most affected locations are Yendayar, Plapally of Kootickal panchayat. The village Kottickkal is one of 13 villages of Kanjirapally taluk is highly populated on the banks of Manimala River. Nearly 50 landslides happen in the vicinity of Kanjirapally taluk in a single day. On the investigation of landslides, we discovered that the most of landslides were happened in the rubber plantation sites. Later we discovered that this invading plant species appearing everywhere wherever a landslide happens. It is appearing even on the roadside cleared lands which are supposed to be used for commercial purposes.

Upon observation, it has been noted that certain plant species exhibit rapid growth and territorial occupation following landslides, thus demonstrating invasive traits. Specifically, two plant species have been observed to thrive on the steep slopes of Western Ghats hills following a landslide event, causing a discernible difference in vegetation patterns between affected and adjacent areas. Introduction of new species can have significant impacts on ecosystem structure and function, particularly when invasive characteristics are displayed. Invasive species have the potential to cause sudden and severe effects on ecosystems, contributing to the loss of biodiversity, deterioration of ecosystems, and reduction of global ecosystem services. (Pyšek and Richardson 2010). Furthermore, invasive species represent a noteworthy component of global climate change.

Excessive rainfall events, such as cloud bursts and during the monsoon seasons, result in the natural drainage system being saturated with humus-rich soils from *Mucuna bracteata* growing areas, leading to a dark brown to black appearance. In addition, the riverbanks adjacent to rubber plantations that utilize these two species as ground crops experience flooding with clay, mud, and silt. These invasive species pose a significant threat to the native species, endangering their survival. (Sajeev T.V. et al. 2012). The speed at which they can cover the entirety of the forest sanctuary area implies that ecological changes may rapidly occur in the sensitive zones of the Western Ghats.



Image1. growth of *Mucuna bracteata* on the slopes of recent landslide scarp surface.

In the image1 the distance between the crown position and the tow is approximately 100 meters. The demarcation of the landslide perimeter is represented by the highlighted section as shown in Image. The paleo landslide surfaces are characterized by discernible vegetation patterns. Walking through these plant species within the sloping terrain presents a formidable challenge, given the presence of venomous serpents, such as vipers and pythons, which are known to inhabit the vicinity. These areas are becoming breeding ground for mosquito population to proliferate. Earlier researchers have found the mosquitoes breed in rainwater-filled cups used for collecting rubber latex, causing the species diversity (Sumodan P. K. 2012). The growth of this plant on the paleo landslides surfaces further enhances the species diversity of mosquitoes.

Similar kind of invading plant called *Chromolaena odorata* was introduced in India in 1840s time and it is one of the world's most dangerous tropical invasive weeds is known to decreases native plant species in the Western Ghats of India (Mangla et al. 2008). This plant produces a particular chemical which can attracts fungus *Fusarium semitectum*. This fungus will not allow the local plants to grow.

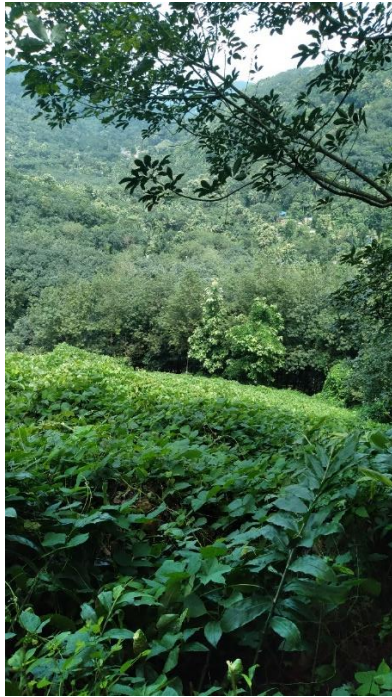


Image2. growth of *Mucuna bracteata* on landslide scrap surface

Conclusion: These short notes were our observations based on the field investigation of landslides in western ghats. The occurrence of these invading plant over a sloping face indicates the recent landslide event. Hence it is serving as a new proxy for the recent landslide event. But the concerning fact is as the severity of extreme weather events increases, the frequency of the landslides, mudslides increase. Hence these creates fresh surface for these plants to proliferate, thus creating treats to the local eco system.

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