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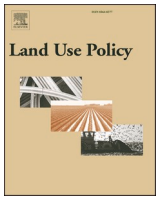

Social-ecological and institutional factors affecting forest and landscape restoration in the Chittagong Hill Tracts of Bangladesh

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ABSTRACT

Bangladesh government has recently pledged to restore 0.75 million ha of degraded forestland as part of its commitment to the Bonn Challenge, however little is known about the potential challenges and opportunities involved in achieving that goal. Using secondary literature complemented by expert consultation and a field survey, we examined the outcomes and limitations of previous restoration programmes and identified key social, ecological and institutional aspects crucial for a successful forest restoration programme in the Chittagong Hill Tracts (CHT) of Bangladesh. The CHT region accounts for over a third of state-owned forests, and it supports a large part of the country's forest-dwelling ethnic populations, although most of the forestland is severely degraded. Our analysis revealed that past programmes had utilised participatory tree planting, horticulture and rubber-based agroforestry to restore degraded forestland and improve community livelihood in the CHT. However, past restoration programmes merely emphasised improving tree cover without considering the ecological functionality, biodiversity and carbon co-benefits of restored forests. The duration of these programmes was also relatively short, and there was no clear plan for engaging local communities in the restoration activities beyond the programme period. Among other things, the local ethnic community's land rights issue remained unresolved and the participant's land ownership influenced their willingness to participate effectively in any restoration programme. Households with secured land rights had a more positive attitude towards participating in forestland restoration than those with unsecured land rights. Suitable acts and policies that would allow people to legally continue to use tree-based land in the regions (i.e. forest and land tenure rights) are also lacking. Future forest and landscape restoration (FLR) programmes may thus need to focus on improving the biodiversity and ecological functionality of those restored forests, resolving local people's forest and land tenure rights and involving them in site-specific restoration interventions. The engagement of local and regional-level multi-stakeholders in such an FLR programme is also essential for realising the restoration's multiple social and ecological benefits.

1. Introduction

Globally, forest and landscape restoration (FLR) is gaining increasing attention from governments and policymakers for its unique potential to restore essential ecosystem services and improve human well-being (Bastin et al., 2019; Chazdon et al., 2020a). Ideally, FLR is a means of regaining, improving and maintaining vital ecological functions, leading to a resilient and sustainable landscape in the long run (Chazdon et al., 2020b; Ota et al., 2021). The restoration of forests and landscapes aims to improve the ecological functionality, biodiversity and carbon

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co-benefits of forests while supporting the livelihoods of forest-dependent people (Holl, 2017; Ota et al., 2020; Chazdon et al., 2020a). Thus, FLR is integral to several other global conventions, such as the Aichi Biodiversity Target 15 of the United Nations (UN) Convention on Biological Diversity and the UN Sustainable Development Goals (SDGs) (Chazdon et al., 2020a). It can also help achieve several SDGs, particularly SDG15, which aims to protect, restore and promote the sustainable management of forest landscapes, combatting desertification and land degradation, and halting biodiversity loss (IUCN, 2020; Bhattarai et al., 2021).

The latest UN Decade on Ecosystem Restoration 2021–2030 has highlighted the need for increased global cooperation to restore degraded and destroyed ecosystems, including forests (Abhilash, 2021). The Bonn Challenge aims to restore 350 million ha of the world's degraded and deforested lands by 2030 (Laestadius et al., 2015; Bonn Challenge, 2021). The Asia Bonn Challenge event, held in May 2017, brought together several Asian countries to identify ways to collaborate on FLR in supporting the Bonn Challenge. In solidarity with the Bonn Challenge, Bangladesh committed to restoring 0.75 million ha of degraded forestland (Lewis et al., 2019). This commitment is notable given that the country has been facing a continuous challenge in maintaining forest resources, and only about 10 % of the country's land is forested today (Mukul et al., 2014). However, moving from commitment to real-world implementation of forest restoration is an uphill task, especially in developing countries like Bangladesh, where forests and people are intricately linked. While forest practitioners usually follow the policy directives, local communities' willingness to participate in restoration depends on various socio-economic factors, including land ownership and economic benefits. Restoring forestland through a people-centered approach may thus involve balancing the diverse needs of multiple stakeholders, determining the government's institutional capacity for restoration (Erbaugh et al., 2020), and, most importantly, identifying the socio-economic determinants of the local community's willingness to participate in the restoration. Such a multifaceted complexity calls for a holistic approach to forest restoration, including balancing social, ecological, economic and institutional conditions (Biswas et al., 2009; Le et al., 2014; Brancalion and Holl, 2020).

To date, most research on forest and landscape restoration in Bangladesh or its application has focused on a single or a couple of social, ecological, or institutional aspects, thereby providing only partial insights into the broader and more complex restoration challenges (Biswas et al., 2009). This is a significant hindrance to the implementation of FLR, given that it aims to improve the linkages between nature and people (Ota et al., 2020; Chazdon et al., 2020a; Fischer et al., 2021; Brancalion and Chazdon, 2017). One possible way to overcome this knowledge-gap challenge is to collate existing knowledge or synthesise lessons from past programmes and draw generalities regarding the outcomes and limitations of those past restoration approaches. However, every region in Bangladesh is characterised by somewhat unique patterns of forest-people linkages and, thus, exhibits unique patterns, processes and magnitudes of forest degradation (Biswas and Choudhury, 2007). Unsurprisingly, the priority and approach to forest and landscape restoration vary among regions within the country.

Currently, the Chittagong Hill Tracts (CHT) is one of the Bangladesh government's top-priority areas for forest and landscape restoration because it represents nearly 12 % of the country's total landmass and contains more than one-third of the total forestland [Bangladesh Forest Department (BFD), 2016a, 2016b 2017]. The area is part of the greater Hindu–Kush Himalayan region and the Indo–Burma Biodiversity Hotspot, which contains high endemic biodiversity (Nishat et al., 2002; Mukul et al., 2018). The CHT is also home to a large concentration of the country's ethnic populations, most of them dwelling in, and relying on, the forest for a livelihood. Unfortunately, the CHT's forestland and biodiversity have been severely degraded over the last few decades (Rasul, 2007), in part due to swidden farming on the forestland, illegal forest clearance and encroachment, the conversion of natural forests to timber or industrial plantations, and agriculture (Millat-e-Mustafa, 2002; Thapa and Rasul, 2006; Reddy et al., 2016; Ahammad and Stacey, 2016; Ahammad et al., 2019a; b). Although Bangladesh has implemented several restoration programmes in the CHT over the last few decades in an attempt to halt and reverse the ongoing forest degradation, any effort to learn from those past programmes has been surprisingly lacking. In addition, little is known about the socio-economic attributes influencing the local communities' willingness to participate in or continue forest restoration activities in the CHT.

Given the context provided above, we aimed to examine the outcomes of past restoration programmes and their limitations, and to understand the critical socio-economic determinants of a successful FLR implementation in the CHT. In particular, we focused on three questions: (i) what approaches, outcomes and limitations were involved in the previous restoration practices in the CHT region?; (ii) do the local communities' socio-economic attributes influence their restoration decisions?; and (iii) how supportive are the existing institutional arrangements towards FLR intervention in the region? In addressing these questions, we provide a comprehensive insight into the challenges and opportunities germane to the region's FLR .

2. Materials and methods

2.1. The study area

2.1.1. Geographical settings

The CHT is located in southeastern Bangladesh, spreading over 13,183 km^2 (Fig. 1). It includes three administrative districts—Bandarban, Khagrachari and Rangamati (MoCHTA, 2022). India surrounds the CHT to the north and east, Myanmar to the southeast, the Chattogram district of Bangladesh to the west, and Cox's Bazar to the southwest (MoCHTA, 2022). The regional climate is tropical to subtropical, with a mean monthly maximum temperature between 25° and 34 °C (Ahammad, 2019c). The annual average rainfall ranges between 2032 and 3910 mm, 80 % occurring from May to September (Rasul and Thapa, 2006). The region's topography consists of hills (450–1060 m high), valleys and cliffs (Hasan et al., 2020). About two-thirds area of CHT is characterized by steep to moderate slopes, ranging between 10° and 70°, and the remaining area is gently sloping (Emran et al., 2018) (Fig. 1). The soil in the region varies from sandy loam to coarse sand and is acidic with low base-exchange and water-holding capacities (Hossain et al., 2008).

2.1.2. Forests and people

The CHT accounts for nearly 40 % of the country's total evergreen to semi-evergreen forests. The total forest area of the region is 1,105,353 ha which shares over 80 % of the land area in the CHT (BFD, 2016a). Although about 64 % (710,603 ha) of the forestland is Unclassed State Forests (USF) (Table 1). The USFs are hilly lands, most of which are bare, lack tree cover, and are mainly used for swidden farming by ethnic communities. The district administration manages about 98 % of the USF lands as opposed to the Bangladesh Forest Department (the country's designated authority for forest management), which manages only about 2 % of USF. However, about 36 % of the total forest area of CHT is reserved forests with medium and dense forests. The reserved forests are the country's most restricted forests where local people or anyone possesses no right in or over the land unless permitted explicitly by Forest Department; most importantly, once a forest or any land is declared a reserved forest, no new clearings for harvesting, cultivation such as swidden farming, or any other purpose is allowed. Beyond the state-owned forests, the CHT's community-owned forests (commonly known as the *Village Common Forest* or VCF) account for about 12,530 ha (Chowdhury et al., 2018). Conservation and management of VCFs are a traditional practice of the local ethnic communities inhabiting the CHTs (Roy, 2002).

Dominant tree species across CHT includes: Champa *(Michelia*

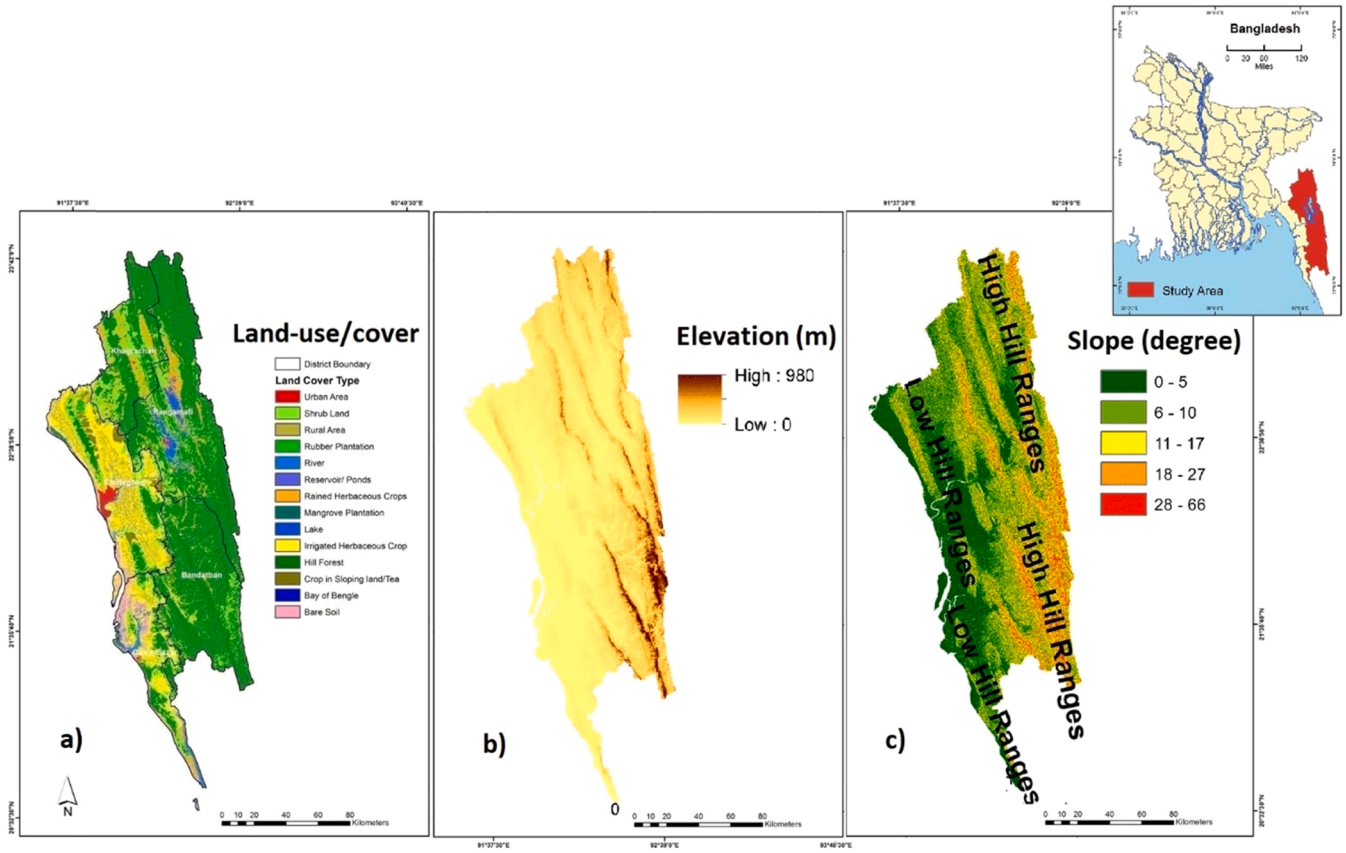

Fig. 1. Map showing locations of the CHT in Bangladesh: (a) current land-use/cover; (b) elevation; and (c) slope.

Table 1
Forest areas under different management systems in three districts of the CHT (BFD, 2016a).

District	Forest Department managed		District government controlled USF (ha)	Total forest land (ha)
	Reserved forests (ha)	USF (ha)		
Bandarban	107,095	15,646	200,151	322,892
Rangamati	248,855	–	309,267	558,122
Khagrachari	38,800	1702	183,837	224,339
Total forest	394,750	17,348	693,255	1,105,353
% of total forest area	35.71 %	1.57 %	62.72 %	100 %

champaca), Chapalish *(Artocarpus chama),* Chickrassi *(Chickrassia velutina)*, Civit (*Swintonia floribunda*), Garjan *(Dipterocarpus* spp.*)*, Telsur (*Hopea odorata*), Dhakijam *(Syzygium firmum)*, Lohakat *(Xylia xylocarpa)*, Boilam *(Anisopera scaphula)*, Toon *(Toona ciliata)*, and Bandarhola *(Duabanga grandiflora*) (Khan et al., 2007). Plantation species include Teak *(Tectona grandis)*, Gamar *(Gmelina arborea),* Chapalish *(Artocarpus chama)*, Jarul *(Lagerstroemia speciosa)*, Koroi *(Albizia spp.)*, Kadam *(Neolamarckia cadamba)*, Chickrashi *(Chichrassia velutina*) *and* Telsur *(Hopea odorata)*. Notable forest-dwelling mammals in CHT's forests include Asian Elephant *(Elephas maximus)*, Wild Pig *(Sus scrofa)*, Barking deer *(Muntiacus muntjak)*, Sambhar *(Cervus unicolor)* and Indian Leopard *(Panthera pardus)* (Khan, 2008).

Historically, the CHT was inhabited by diverse local ethnic groups, (i) Chakma (43.4 % of total ethnic populations), (ii) Marma (25.8 %), (iii) Tripura (13.6 %), (iv) Tanchangya (9.1 %), (v) Bawm (1.5 %), (vi) Murong/Mro (4.5 %), (vii) Khumi (0.2 %), (viii) Chhak (0.5 %), (ix) Pankhoya (0.7 %), (x) Khuki (0.3 %), (xi) Khayang (0.4 %), and (xii) Lusai (0.2 %) (UNDP, 2009). While ethnic peoples were living in the CHT comfortably, constructing a hydroelectric dam (*Kaptai dam*) over *Karnaphuli* river for power generation in the 1960s brought a major tragedy to the ethnic populations. It flooded about 22,000 ha of land and submerged about 40 % of CHT's most arable land (Poffenberger, 2000). As a result, nearly 100,000 ethnic peoples were displaced from their ancestral homes and lands. Those displaced people moved to neighbouring areas near forestlands or inside forests for subsistence land use (swidden agriculture) (Thapa and Rasul, 2006). Around a similar time, many non-ethnic people to the region (mainly Bengali speaking population) from neighboring regions of the country also started migrating to the CHT. So, three groups of people, namely (i) ethnic people living in their ancestral home, (ii) displaced ethnic people due to the construction of the *Kaptai dam*, and (iii) the newly migrated people, presently live in the CHT. Although it varies among ethnic groups and administrative districts, about 46.3 % of ethnic populations has no formal education, and about 63 % of local ethnic populations rely on agriculture including swidden framing for their living. By contrast, only 6.7 % of non-ethnic populations rely on swidden farming. Beyond swidden farming, ethnic and non-ethnic populations legally or illegally utilize forest resources for their livelihood needs (Ahammad and Stacey, 2016), thereby stressing the CHT's forests.

2.1.3. Forest management and degradation

The CHT region's forest management and degradation have a complex history (Box 1). Early management focused on maximizing timber production and thus prioritized converting natural forests to plantation forests (Rasul, 2004). At the same time, the expansion of reserve forests (i.e. restricting people's access to forests unless permitted by the designated authority) continued until the mid of 20th century (Rasul, 2007). However, large-scale deforestation and thus depletion of tree cover continued, in part due to swidden farming, illegal logging and

Box 1
Forest policy and management history in the CHT.

Historically the colonial government influenced the management of the forest resources in the CHT, particularly throughout the second half of the 19th century. From the 1870 s onward, the government prioritized revenue collection by harvesting forest resources (Rasul, 2004). To expedite the harvesting, the government introduced planting Teak (*Tectona grandis*) in the region for the first time, opened lands for plantation forestry and more reserved areas under state control and restricted swidden agricultural land use.

The plantation approach required converting land into the forest, restricting swidden farming and forming a new CHT forest division for a management plan (Hossain, 1998). The Forest Act adopted in 1927 also provided legislative support to maintain this legacy of the state's control management of forest reserves over any other land use (Millat-e-Mustafa, 2002). Although no precise estimates are available, within the three decades of the early 19th century, nearly 350,000 ha of land were declared for reserve forest regardless of the land rights of the local ethnic population on their traditional lands (Roy, 2002).

The first national forest policy that came into effect in 1970 (adopted in East Pakistan before the independence of Bangladesh in late 1971) emphasized on the forest protection and development of the USF with plantations to minimize soil erosion in the region (Ahammad and Stacey, 2016). However, the supply of wood and non-timber forest products (NTFPs) to meet regional and national demand was at the core of the policy, with barely considered the active participation of the local ethnic population in forest protection and management through their secured land rights (Rasul, 2007). The national forest policies and management have undervalued the roles of forests in supporting multiple social, cultural, economic and environmental benefits, particularly those involving local ethnic populations and their part in the restoration and conservation of forest resources (Ahammad, 2019c).

forest encroachment, conversion of relatively intact mature forests to plantation forests, unsustainable resource collection, hunting, and commercial horticulture (Salam et al., 1999; Nishat and Biswas, 2005; Iftekhar and Hoque, 2005; Biswas et al., 2012; Ahammad et al., 2019b) (Fig. 2). Although swidden farming is typically considered the most important cause of forest degradation (Rahman et al., 2012), patterns, processes, and the relative importance of factors underlying forest degradation in the CHT are evolving. For instance, recent improvements in road networks and the migration of people from other parts of the country to CHT have also contributed substantially to forest clearance and encroachment (Iftekhar and Hoque, 2005; Uddin et al., 2019). Additional socio-political complexity arises from the lack of recognition of ethnic land rights and the mixing of three groups of people (ethnic people, displaced ethnic people and non-ethnic people) with diverse cultures, languages, and livelihood patterns. In such a complex and conflicting socio-political situation, illegal logging, forest encroachment and unsustainable resource collection increased substantially, causing

Fig. 2. Key drivers of deforestation and forest degradation in the CHT.

significant losses of regional forest cover and biodiversity (Iftekhar and Hoque, 2005; Mukul et al., 2018).

The Bangladesh government responded to such forest degradation by imposing a moratorium on all forms of logging in state-owned forests in 1989 (Biswas and Choudhury, 2007) and by restricting people's access to forests, including swidden farming, by declaring the forestland as reserved forest (Rasul, 2007). Yet, forest loss continues—for instance, between 2000 and 2015, the extent of forest cover has reduced by 8 % in the CHT (GoB, 2020). The CHT's forest cover is now characterized mainly by secondary forests or monocultures of Teak and Gamar plantations, with sporadic distributions of natural bamboo (Hossain et al., 2008). Most of the hill forests or USFs in the region possess little tree cover to form forest patches and remain open, hosting shrubs, scattered trees, and bamboo (Khan et al., 2012; Uddin et al., 2019). The spatial extent of the reserve forest has increased but is still below 40 % (Mukul et al., 2017). However, regional protected areas, such as national parks and wildlife sanctuaries, have increased considerably and now cover about 12 % of the total reserved forests (BFD, 2022). Several studies have reported a decline in the enthusiasm of local ethnic populations towards state-owned forest conservation and the maintenance of VCFs due to restricted access and insecure ownership, potentially threatening the ecosystem benefits and related well-being (Ahammad et al., 2019a; b).

Such a bleak situation in both state- and community-owned forests calls for the immediate restoration of forests and the landscape. Given the complex and evolving pattern of forest and people linkage and forest degradation, a detailed evaluation of existing forestland restoration approaches, their social-ecological outcomes, and challenges and opportunities is crucial for successfully implementing any FLR programme in the future.

2.2. Data collection and analytical approach

To understand the CHT's situation regarding forestland restoration, we collected data from three sources: (i) literature reviews, (ii) expert consultations, and (iii) household surveys.

We first gathered background information from available literatures to understand the outcomes and limitations of previous restoration practices in the CHT region (question 1). Our literature review included relevant peer-reviewed literature and grey literature such as government and non-governmental organization (NGO) reports, national policies, and strategic documents relevant to previous restoration progammes, forests and land use in the CHT.

Following an initial screening of literature, we listed several programmes/projects that had been implemented and are relevant to explaining the region's restoration initiatives for in-depth review. The selected programmes include the followings: Afforestation in USF land, Reserve Forests and Rehabilitation of Jhumia Families (1979–2000), Joutha Khamar (1976–1983), Upland Settlement Programme (1985–2006), and Plantation Programme (mainly roadside and homestead) (2000–current) (Asian Development Bank [ADB], 1979; Khan and Khisa, 2000; Ahammad, 2005; Nath and Inoue, 2008, 2009, 2010). Most of these restoration programmes were implemented from 1970-current. Besides, we also reviewed the legislation (the Forest Act, 1927, the Biological Conservation Act, 2017; Land Use Policy, 2001) and policies (National Forest Policy, 2016; National Biodiversity Strategy and Action Plan, 2016; Country Investment Plan for Environment, Forestry and Climate Change, 2016, Forestry Master Plan, 2016) relevant to forest and land management in Bangladesh.

Many project documents were relatively short and did not offer much information about the restoration programmes' essential contexts. We overcome this challenge by conducting expert consultations to collect information on the CHT's historical context of forestland restoration initiatives. We consulted ten experts represented by the academic (N = 2), CHT researcher (N = 1), government staff (N = 2), NGO staff (N = 3), and local ethnic leaders (N = 2). All of our selected experts (N = 10) had at least ten years of work experience; most importantly, they were directly or indirectly involved in programmes implemented in the context of forestland restoration and/or land use in the CHT. During the consultation, we first asked each expert their opinions on the CHT's past restoration programmes. By leading with this question, we aimed to obtain their opinions on the social, economic and ecological impacts of the past FLR-related programs in the CHT. We also asked about current challenges and sought suggestions to improve the FLR experience in the region. In doing so, we obtained information on the role of the institutions and the policies required for successful FLR implementation in the region (question 3). We refer to institutions as formal (i.e. the written constitution, laws, policies and regulations enforced by official authorities) and traditional (customs or traditions that shape thought and behavior) terms that highlight the social, political and economic relationships (North, 1990). Finally, we lumped the data gathered from these two sources and discussed the outcomes and limitations of past initiatives, existing opportunities and challenges for restoration, and the role of institutions and policies (questions 1 and 3). Because the number of experts consulted was too small (N = 10) to do any formal and quantitative analysis, we presented both document review and expert consultation data in descriptive or tabular form.

To understand how the critical socio-economic factors, such as demography (family size), land ownership and farmland size, might influence people's willingness to participate in restoration programmes (question 2), our lead author conducted a household-level (N = 304 households) field survey in 2015–2016. Although the survey was conducted about six years ago, there were no major policy changes concerning CHT's land ownership issue and thus potentially no significant change in farmland size pattern over the past six years; therefore, the survey data should still be useful for the study. For the survey, the CHT region was stratified into three zones based on access to the forest, distance to market and roads and dominant land-use practices such as swidden farming, forest and tree-based ecosystems, low-lying agricultural land, and fruit orchards (Sunderland et al., 2017). The three zones show the differences in land ownership from open access (without secure title of lands), private and community (secure and customary title) to private ownership (secure land title). Four villages from each zone (N = 3) were then purposively selected for the survey, totaling 12 villages in the study. Next, 304 households from the selected 12 villages were randomly chosen for the survey. The selected households are located in Belaichari, Bandarban Sadar and Rowangchari sub-districts of Bandarban and Rangamati administrative districts within the CHT. Finally, detailed household-level data was gathered on demographics (mainly family size), farmland size and land ownership (private land, private plus community-owned land, open access), and the household owner's willingness to participate in forest restoration. Because many ethnic communities are unfamiliar with the term 'restoration,' respondents were asked whether they would be willing to improve their degraded land or participate in tree planting on degraded land.

We ran a generalized linear model to determine the social and economic characteristics (e.g. farm size, land ownership, and household size as independent variables) of the local ethnic people that influenced their willingness to participate in forest restoration. We used the Stats package of R programming for the model and Car package to run ANOVA (using a chi-squared test) for the most significant socio-economic determinants influencing the restoration decision. Ethical approval for this research was obtained through the Charles Darwin University Human Ethics committee (H15005), and all participants also gave informed consent for this study.

3. Results and discussion

3.1. Past FLR programmes in the CHT

Literature reviews and expert consultation revealed that previous restoration programmes conducted in the CHT had focused on improving tree cover and, at the same time, enhancing the socio-economic conditions of the local communities. Those communities primarily included landless ethnic people and displaced swidden farmers (the construction of a dam for a hydroelectric power project in one of the hill districts had flooded vast areas of the CHT, displacing many swidden farmers from their homes). Most programmes had employed one or more approaches, from timber plantation, to rubber-based agroforestry, homestead forestry, and horticulture for forest restoration and livelihood improvement. Those programmes were mainly government-led, although some NGO-led restoration programs had been implemented more recently.

The government-led restoration programmes focused on degraded forest or USF land (i.e., forestland with no significant tree cover), whereas the NGO-led programmes targeted private or community-owned land. In government-led restoration, the authority typically allocated ~0.81 − 2.02 ha of degraded land to each ethnic household for forestry (Table 2). The land receivers also received technical training, financial assistance through wages, and free seedlings for establishing plantations. By contrast, in the NGO-led restoration programmme, the implementing authorities mainly emphasised increasing and conserving the area of community-owned forests and promoting horticulture for improved livelihoods. Before restoration, most state-owned degraded forestlands were used for swidden farming or were cleared through timber harvesting or illegal felling. By contrast, deteriorating tree stocks characterised most private or community-owned forests before restoration.

3.1.1. Outcomes

Although there is no complete and precise estimate of the spatial extent of the restored land, spatial extents is absent, partially available data (Table 2) indicate that at least 41,631 ha of degraded forestland were brought under some sort of tree cover, most of which had been, legally or illegally, clear-felled in the past. Notably, past restoration programmes contributed to increased tree cover for about 30,000 ha of plantations. Horticulture combined with planted trees increased to almost one-third of the land use in the region. Although no estimates were available concerning the total area of plantations on private land, planted trees occupied half of a family's total land (on average, 1 ha). Beyond increasing tree cover, the regulation on swidden farming during restoration intervention resulted in its decline, leaving more land available for plantation. The NGO-led restoration programmes also increased the area of VCFs. Taken together, we can confirm that previous restoration programmes effectively increased CHT's tree cover.

Table 2
Summary of the major restoration programmes in the CHT region.

Key initiatives relevant to restoration	Major strategies	Outcomes	Limitations
Joutha Khamar (collective farming schemes) (1976–1983)	■ Establishment of horticulture ■ 0.81-2.02 ha of land in each family to raise their homestead and fruit orchard	■ More than 3000 landless and local ethnic families rehabilitated	■ Low level institutional and financial capacity for replanting supports, processing facilities for rubber and monitoring plantation
Afforestation in USF land, reserve forests and rehabilitation of Jhumia families (1979–2000)	■ Plantation on the degraded lands within forest reserves and USF land ■ Rehabilitation of swidden farmers ■ Regulating the logging activities of smallholder (mainly rehabilitated swidden farmers) timber extraction ■ Enforcement and control of swidden farming expansion and rehabilitation through tree plantation	■ More than 30,000 ha of the plantation established ■ 3245 swidden farmers rehabilitated	■ Weak community engagement in planting activities ■ Insecure off-farm employment or alternative livelihood strategies during the plantation establishment period ■ Lacking community awareness and cultural ignorance of the accrued economic benefits of plantation
Upland rehabilitation programme (1985–2006)	■ Agroforestry with horticulture and rubber plantation ■ 0.81-2.02 ha of land were provided to each family to develop their homestead, fruit orchard and rubber plantation	■ More than 3000 landless and local ethnic families rehabilitated ■ 1619 ha fruit orchard and 3239 ha of rubber plantation established ■ Decline intensity of swidden farming and soil erosion ■ Training assistance contributed to income-generating skills through paid planting activities, including rubber tapping ■ Land ownership opportunity	■ Absence of transparency and equity in the selection of the landless families ■ Insecure ownership of land, including the plantation with timber and fruit trees ■ The low willingness of swidden farmers to stay on the newly relocated place ■ The long growth period of planted trees until harvesting ■ Ineffective harvesting practices and planning concerning smallholder-planted trees
Pulpwood plantation on USF land (1995–2000)	Plantations with the fast-growing species e.g. Gamar (*Gmelina arborea*), Kadam (*Anthocepalus chinensis*) and Chatian (*Alstonia scholaris*) to supply the raw material to Kaptai Pulp and Paper Mill	■ About 6073 ha of land were undertaken for plantations ■ 700 ethnic families, including swidden farmers were rehabilitated	■ Lack of agricultural land or employment opportunities ■ Decrease in annual food production areas and livestock grazing areas for communities
Forestry sector projects (1998–2003)	■ Plantation on the degraded lands	■ 1200 ethnic families, including swidden farmers, were rehabilitated	■ Lack of agricultural land or employment opportunities
NGO-led Restoration and conservation of community forest (2009–2016)	■ Establishing community forest management in small forest patches of high biodiversity and with watershed services value ■ Enhancing agroforestry with tree or fruit species ■ Developing periodical harvesting rules for fuelwood and construction materials, mainly bamboo ■ Regulating the felling and fire activities required for swidden farming inside conserved patches and along the watershed	• Critical ecological zones in watershed sources in over 700 ha of community forests restored • Fire/burning activities in community forests reduced • Use of fuelwood, bamboo, medicinal plants and construction materials regulated • Illicit felling of trees and bamboo, including bamboo shoots, and wildlife harvesting reduced • Waterflow increased after the watershed protected • Alternative livelihoods provided, mainly economic returns from bamboo and fruit • Biodiversity and water flows protected • Traditional knowledge and management of lands preserved	■ Limited time frame and financial support for restoration ■ The succession of customary ownership of community forests ■ Boundary delineation for customary ownership of forests ■ No policy recognition of the social and cultural importance of community forests ■ Absence of policy or legislation to allow community/customary ownership access to lands used for farming and forest reserves

From the local community's perspective, at least 11,145 ethnic families' livelihoods were improved by past restoration programmes (Table 2). The main sources of direct financial benefits to the participants included: income from horticulture and rubber-based agroforestry, short-term wages from seedling raising, income from selling stumps/rootstock, wages from rubber tapping and plantation maintenance, and income from non-timber forest products. Beyond this direct financial benefit, many families that participated in the restoration programmes got complimentary access to facilities, such as a safe drinking-water supply, education, access to the main road, and marketing help with their cash crops. Some swidden farmers participating in the restoration programmes received tenure rights on planted tree-cover land, potentially enhancing their social security. The NGO-led restoration programmes, by contrast, typically utilised livelihood improvement packages via grant money or micro-credit, thereby improving the financial insecurity of the participating communities. All in all, the previous restoration programmes were generally effective in temporarily improving the livelihood situation of the participating communities.

3.1.2. Limitations

While the previous government-led restoration programmes can be viewed as successful from the perspective of temporarily increasing tree cover, the ecological restoration associated with FLR goes beyond tree cover, focusing instead on improved ecological functionality, biodiversity and the carbon co-benefits of forests. However, not a single restoration programme in the CHT has thus far considered these aspects or formulated any restoration-oriented management plan to enhance any of the multiple benefits of restored land. Monoculture of Teak has resulted in lower undergrowth, poor natural regeneration, and a less conducive habitat for forest-dependent biodiversity (Islam et al., 2007). Soil erosion has long been a significant problem in planted forests, impacting natural watershed functions (Hossain, 2003). Plantation-based restoration approaches generally also undervalue the traditional wild food sources and the associated ecosystem services that local communities value (Ahammad et al., 2019b). In a nutshell, if not treated as a significant failure, whether previous government-led restoration programmes improved the overall environmental sustainability of the CHT beyond tree cover remains highly questionable. The NGO-led restoration programmes, by contrast, have contributed substantially to improving biodiversity conservation and protecting the watershed on private and community-owned land. Such an approach has also recently gained support from national and international donors. However, the NGO-led programmes were limited in scope because they did not possess any legal right to restore the state-owned forest land.

On the other hand, although the previous government-led restoration programmes did involve the local ethnic people (mostly swidden farmers) in land preparation and plantation raising, those communities were not fully engaged in plantation management. As a result, local ethnic people rarely owned the restoration programme or got the most financial benefit from the plantation, thus impacting their socio-economic improvement potential. In addition, harvesting forest plantations has increased the flow of forest products, but most of those were destined for the industry rather than benefiting the well-being of local communities. Although horticulture and rubber-based agroforestry have provided cash benefits, the proportion of participants receiving those benefits has been relatively small. Expert consultation also revealed weak community engagement, insecure land ownership on the plantations, limited alternative income options during the initial plantation establishment, a lack of transparency in the beneficiary selections and planning process, and poor infrastructural facilities thwarted the restoration progress. In fact, there was limited evidence of successive plantation establishment by the landless and swidden farmers in the region (Nath and Inoue, 2008).

Table 3
Descriptive information of the surveyed households.

Household characteristics	Mean (SD)/%
Age of the household head (years)	47 (14.49)
Household size (numbers of family members)	5 (1.54)
Years of education completed by the household head	
Less than 5 years	70 %
5–10 years	28 %
Above 10 years	2 %
Numbers of livelihood options	
One source	22 %
Two sources	55 %
Three sources	22 %
Four sources	1 %
Food sufficiency in the household (last 12 months)	54 %
Farm size (ha)	1.24 (1.98)
Household owned livestock	84 %
Homestead areas with trees	52 %

SD: Standard Deviation.

Table 4
Model estimates for household socio-economic characteristics' association with their restoration decision. Open access is the reference category for the land ownership context of the respondents.

	Exp (coefficients)	Std. Error	z value	Pr (>|z|)
Intercept	0.49	0.51	-1.40	*0.161*
Farm size	0.87	0.08	1.72	*0.084*
Private ownership	8.95	0.37	5.98	*0.000*
Private-Community ownership	4.47	0.38	3.94	*0.000*
Household size	0.80	0.09	-2.35	*0.018*

3.2. Socio-economic influence on household FLR decision

Analysis of the field-survey data suggested that land ownership type (private, private-community, open access rights) and household size (number of family members) significantly affected the restoration decision by local ethnic communities (Table 4). The willingness of the householders to retain trees or improve the degraded land near their household greatly depended on land ownership types [$\chi^2_{(2)} = 47.81$, $P < 0.01$] and household size [$\chi^2_{(1)} = 5.85$, $P = 0.05$]. In particular, consistent with Ahammad et al. (2021a), we found that households with fully (private) or partially (community and private) secured land rights had a more positive attitude towards being involved in FLR than those having unsecured and open access land rights ($P < 0.000$). This is because people with partially or fully secure land ownership can get the economic benefits from forest and tree sources directly (Ahammad et al., 2021a; 2021c). On the other hand, although about half the surveyed households had three to five family members (Table 3), those households with smaller family sizes were more willing to restore trees on their land than those with larger family sizes ($P < 0.01$). The plausible underlying reasons are the decreased family size, the scarcity of land for swidden farming, and labour constraints that motivated people to demand more economically rewarding land use, including plantations and fruit orchards. Interestingly, over half of the surveyed households possessed less than 1 ha of farmland, and farmland size did not influence their restoration decision ($P = 0.08$). Not all of the farms had secured land tenure. Overall, our results underscore the need to properly consider people's access to land use rights in future restoration efforts (Fig. 3).

3.3. Institutional challenges for successful FLR implementation in the CHT

Multiple formal and informal/traditional institutions are responsible for forest and land management in the CHT (Fig. 4). Our expert consultation revealed that forest and land ownership at the national and local levels remains a major institutional challenge for FLR in the CHT.

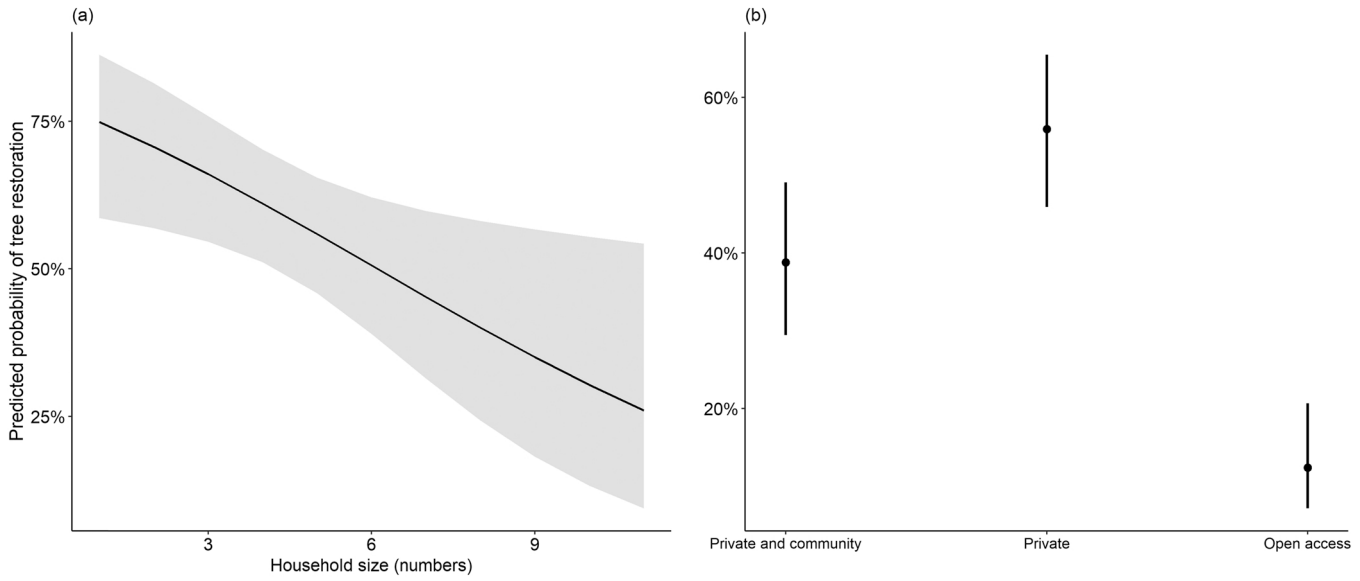

Fig. 3. The predicted probabilities of household respondent's decision for restoration with planted tree land use depending on their household size (a) and the existing forest and land tenure conditions (b) in the CHT, Bangladesh.

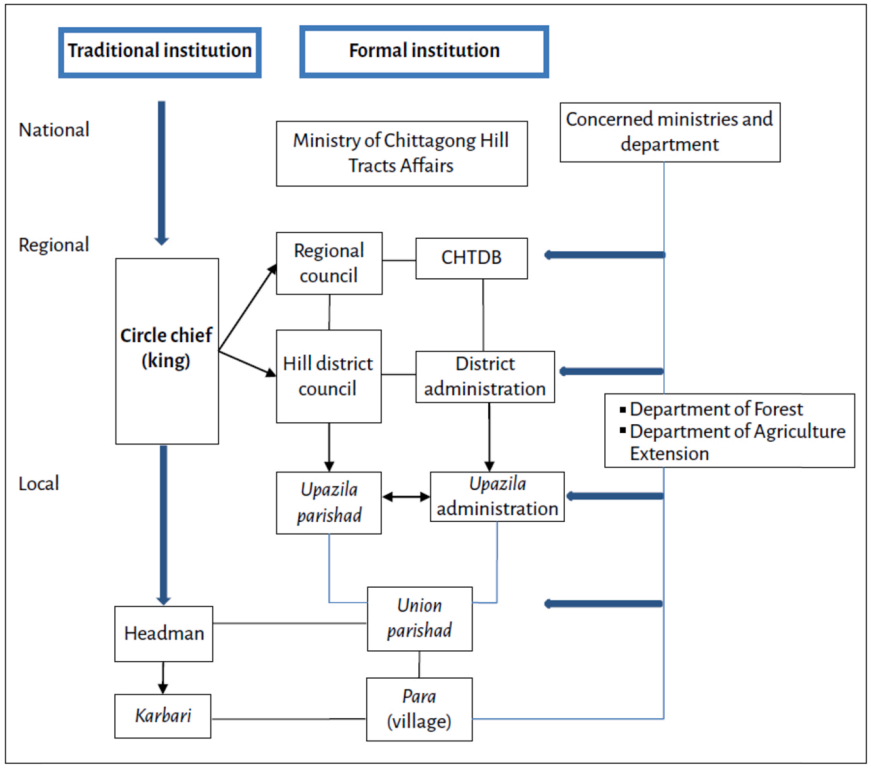

Fig. 4. Institutional arrangement related to forest and land management in the CHT.
Source: Adapted from Ahammad and Stacey (2016).

Although the local government agencies (district administration) manage a large part of the USF land, the traditional institutions, headed by three ethnic kings, have called for their usufruct rights on the land previously used by ethnic people (Rasul et al., 2004; Ahammad and Stacey, 2016). Here, we discuss how state-level institutions, acts and policies associated with forest and land ownership have shaped FLR, and the roles of regional and local organisations and customary institutions in this. For each of the challenges presented in this section, we discuss the role of institutions- their acts and policies- in succeeding with FLR.

The first and foremost issue regarding restoration in the CHT is the adoption of a legislative mechanism that can protect the tenure rights of local ethnic communities on farmland in and around forests and ensure their participation in the restoration programme (Roy, 2002; Ahammad et al., 2021a, 2021b). Unfortunately, there are still no specific rules or national policy addressing this issue. The Forest Act of 1927 is the country's only and direct basis for forest-management-related legislation, regulating local communities' access to reserve forests and any claimants to land used for swidden farming in the CHT (Roy, 2002).

However, this act has specific limitations to declaring the land for forest regardless of community and farming lands. For instance, Section 10 of the Act explains the limited, often demarcated and restricted, use of lands within and along the forest boundary. Jurisdictions over customary land and government reserve forests (as well as the designated USF land) thus overlap among institutions (e.g. district administration versus forest department versus traditional institutions). Although the issue has been under discussion for quite some time, there has been no progress in the legislative provisions necessary to resolve this complexity in managing common property (i.e. forests and swidden-farm areas). Application of the Forest Act of 1927 has already restricted and abolished several claims to forestland, including community conserved areas (VCFs). So, there is a clear limitation in government policy, and in terms of on-the-ground reality, towards being able to support local community engagement in the restoration process.

Disproportionate land ownership across different geographic areas and ethnic groups in the CHT is another institutional issue for FLR (Ahammad et al., 2021a; 2019c). Relevant policy- the National Land Use Policy of 2001- did not recognise the land ownership issue specific to the CHT. Although a pilot-scale land-settlement process was introduced for the region in the 2000s (Rasul, 2015), this initiative quickly came to a halt due to the migration and application of land ownership by non-ethnic people (Rasul and Thapa, 2006). Currently, the people living in and around state-owned reserves have yet to secure any rights to agricultural land or the use of forest resources (Ahammad and Stacey, 2016). Insecure land ownership thus remains a specific driver of forest loss across the region, especially in an open-access context, and it ultimately impedes the prospect of collaboration with the local people in future restoration processes.

4. Conclusion and recommendations

Drawing on the experiences of past restoration programmes we aimed to gain an understanding of the social, ecological and institutional challenges and opportunities regarding FLR in the CHT. Our synthesis suggests that previous restoration programmes were generally monoculture-plantation-centric (e.g.Teak or Gamar). Those programmes effectively increased tree cover but were not concerned with ecological functionality, biodiversity or environmental sustainability. This finding is not surprising, given that past national forest policies and management efforts have mostly emphasised production forestry over the role of forests in supporting multiple socio-cultural, economic and environmental benefits. Although the Bangladesh government recently overcame this policy deficiency by shifting from production to protection and conservation and participatory forestry, translating the shifting policy to field-level forest restoration has yet to be adequately implemented. Therefore, in matching the forest policy of Bangladesh with the principles of FLR, future FLR programmes in the CHT need to pay explicit attention to ecological functionality, biodiversity and environmental sustainability-that is, going beyond tree cover improvement in degraded forestland.

From a socio-economic perspective, the livelihoods of some participating local ethnic communities have improved through previous restoration programmes, although those improvements have been transient and heterogeneous across participants. Perhaps, the reason is that the scope for cash income from horticulture or rubber tapping is too limited, and that the participants were not involved in long-term plantation management. A lack of transparency in decision-making, especially beneficiary selection, and the time lag involved in a plantation reaching economic maturity both seem to have contributed significantly to the declining interest and enthusiasm among ethnic communities for participating in future restoration programmes. Our empirical data pinpointed an additional, and perhaps the most crucial factor, that insecurity surrounding land ownership and land tenure rights impedes people's willingness to participate in forest restoration initiatives. Complex land ownership and land tenure rights may also explain why local ethnic communities were not engaged in long-term plantation management in order to utilise the full potential of community livelihood improvement in past restoration programmes. Future FLR programmes for the CHT should thus address the issue of community land ownership before initiating any such programme.

Beyond the issue of land ownership for the local community, the jurisdiction over CHT's land is also an institutional issue because it overlaps with traditional (i.e. ethnic- *king*- centered) versus government institutions. Within the government institutions, however, jurisdictions also overlap among several ministries, such as the Ministry of Chittagong Hill Tracts Affairs, the Ministry of Land, the Ministry of Public Administration, the Ministry of Forest, Environment and Climate Change, and the Ministry of Agriculture. Such overlapping and ambiguity in the jurisdiction issue hinders the achievement of policy objectives. For instance, the Bangladesh forest policy of 2016 stressed the importance of restoring suitable USF land via plantations. However, 98 % of the USF land is under the jurisdiction of district administration, not under the forest department. The current Forest Policy of 2016 also highlights the importance of *king-centred* customary rules around forested areas for community conserved forests (i.e. VCFs), although the forest department does not possess jurisdiction over that land. Inter-institutional, inter-ministerial, and inter-departmental cooperation is thus necessary for addressing departmental jurisdiction and the CHT's community land tenure and ownership issue. Although critical for the sustainability of FLR in the CHT, the scope for addressing these complex issues is limited within the context of any particular restoration programme. Extensive policy dialogues about the above-stated issues are thus needed prior to FLR intervention in the CHT.

Meanwhile, to halt and reverse the ongoing forest degradation and uplift the livelihoods of the forest dwellers, the CHT needs urgent restoration intervention, especially FLR. For that, we suggest the following specific recommendations for a successful FLR programme:

- Firstly, a detailed biophysical and social mapping of the areas with restoration potential and with different levels of land ownership and tenure conditions is needed for a site- and land-tenure-specific FLR plan. Such a plan would also need to define the roles of the diverse stakeholders, including institutions, and their land use choices.
- Secondly, most USF has the potential for restoration through site-specific and suitable mixed-species plantation or agroforestry development. Such an approach would not only help improve biodiversity and ecosystem function, but would also offer a short-term economic return and thus improve the livelihood of local communities.
- Thirdly, the local forest department might consider offering technical and financial incentives to the villagers to pursuade them to restore the community-owned forests (i.e. VCFs) and involve them in annual plantation programmes in the state-owned forest lands.
- Fourthly, although only NGOs have thus far focused on the conservation and restoration of VCFs, the government could step in and offer legal and financial support to restore the degraded VCFs and ensure the sustainability of the already restored VCFs. In such a context, collaborative management with the government, NGOs and local ethnic leaders would benefit local people by maintaining the sustainable harvesting of non-timber forest products and practicing agroforestry, thereby reducing the pressures on state-owned forests.
- Fifthly, future forest restoration and community engagement plans need to be transparent and accountable to multi-level stakeholders, including local communities, relevant state agencies at the national, regional and local levels, customary institutions, NGOs and civil society.
- Finally, since the FLR approach emphasises ecosystem functioning and the delivery of services, future FLR interventions in the CHT should involve an ecosystem services-based approach for restoration in both state- and community- owned forestlands. Notably, without proper consideration of ecological functioning and the delivery of

services or a transparent approach to address land ownership and benefit-sharing issues, effective FLR or people's participation in FLR, would be challenging to achieve in the CHT, or in any other region having similar social and ecological complexities.

Data Availability

Data will be made available on request.

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