Economic gain apropos socio-ecological pain: expansion of plantation crops in biocultural jhumscape of North East India

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North East India is a biodiversity-rich zone and a part of both the Himalaya and Indo-Burma biodiversity hotspots. It is a large-scale multipurpose landscape consisting of a mosaic of crops, livestock and forest. The landscape also ensures almost all the ecosystem services that contribute to the well-being of more than 100 diverse ethnic groups (indigenous people) in the region. However, in recent years, rapid transition in the form of promotion and expansion of oil palm and rubber plantations as mooted and supported by the state has posed threats to the ecosystem and biodiversity especially the biocultural landscapes. Supported by empirical evidence (primary and secondary data), this study argues that as we increase the intensity of production or harvest of such crops, the environmental cost becomes unprecedented and immense to be offset by economic gain. The use of renewable biological resources as the foundation for a bioeconomy must be regulated in terms of environmental impact rather than short-term financial dividends. Therefore, we need to develop optimization models for the biocultural landscape(s) that determine land use based on what is both economically and environmentally optimal.

Keywords: Bioeconomy, food security, jhum, multipurpose landscape, plantations crops.

NORTH East India (NEI), comprising the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, is part of the Indo-Burma biodiversity hotspot. It has 17.2 million ha of land under forests, thus accounting for over 25% of India's total forest area[1] and contributing to about 45% of the country's total flora[2]. The bio-geographic region of NEI connects the Indian, Indo-Malayan and Indo-Chinese bio-geographic zones that support a diverse range of the country's flora and fauna[3]. For agri-horticultural crops, this region contains the most diverse genetic reservoir attributable to climatic, edaphic and altitudinal variations resulting in a vast range of biological ecosystems. Rice production is the main source of food and employment for the people of this region, as agriculture and related activities employ majority of the population[2]. In upland and lowland water-fed locations, agricultural production practices cover around 72% of the total farmed area. Over 100 indigenous tribes in NEI represent hill farmers have been practising shifting cultivation (jhum) for millennia in these ecologies[4]. Many indigenous hill farmers are still raising their own landrace or cultivar, inherited from their forefathers and suited to their local microclimate and adaptation. These individuals also demonstrate the cultural significance of the local landraces[5]. The concept of 'biocultural diversity' adds to a better understanding of the cultural landscape and the relationship between nature and culture[6]. It encompasses the diversity of life in all of its linked (and possibly co-evolved) manifestations[7], as well as biological diversity at all levels and cultural diversity ranging from individual ideas to the entire social milieu[8,9]. Two key principles underpin the concept of biocultural diversity. First, throughout human history, nature has emanated and manoeuvred cultures in ways that have shaped our worldviews[10,11]. Secondly, human–environment interaction has resulted in the formation of distinct sets of cultural knowledge and practices for guaranteeing the survival and expression of locally revered biodiversity elements[12]. This implies that protection and conservation of biocultural diversity need not entail a static vision of culture and landscape, but it indicates that bio-culturally diverse locations can self-determine their future without undue foreign cultural impositions.

The livelihoods of indigenous communities and human well-being (HWB) are heavily dependent on direct and indirect ecosystem support services (ESs), according to global acknowledgements like the millennium assessment[13]. This 'nature for people' paradigm has been increasingly adopted by governments and non-profit organizations to frame, plan and distribute resources for the welfare of people[14,15]. The Inter-governmental Science-Policy Platform on Biodiversity and ESs has recognized ES approaches as an integral part of sustainable development and HWB[16]. Despite the importance of ES to HWB, planned development

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values the tangible ESs, weakening and discounting the cultural services[17]. In fact, the well-being of tribal people is mostly regulated by ESs[13,18], and the indigenous ecological knowledge is also credited for their social and cultural values[19,20]. For example, indigenous forest management is guided by social justice and equity, which strengthen water availability, livelihood security, biodiversity conservation and healthcare of the people[21]. Forest resources and products have long been a source of livelihood, supplying food, medicine, construction materials and other requirements to local residents who live in and around the forests. In addition, cultivation in the states of NEI is dominated by shifting agriculture that creates a mosaic of crops and forests (at various stages of regeneration) which is well suited for biodiversity than monoculture plantations. This traditional agroforestry system is well adapted to such environmental conditions and the indigenous knowledge of local communities has complimented them for maintaining the ecological balance[20]. However, the conspicuous shift from biocultural landscape towards the monoculture of plantation agriculture, mainly oil palm (*Elaeis guineensis*) and natural rubber (*Hevea brasiliensis*), poses a great environmental concern[22]. The present study, therefore, aims to examine the potential threats to the ensuing expansion of plantation crops in the biocultural landscape of NEI.

Methodology

NEI holds over 80% of India's total jhum (shifting cultivation area, SCA), which supports the livelihood of about four million households. The jhumscape includes the current jhum plot, jhum fallow and forest fringe. Thus, the present study uses primary data of six states in NEI covering 52 villages mainly dependent on jhum with randomly selected 481 households representing the districts of Upper Subansiri, Arunachal Pradesh; Churachandpur, Manipur; West Garo Hills, Meghalaya; Siaha, Mizoram; Mon, Nagaland and Dhalai, Tripura. The study examines the usage of timber and non-timber forest products (NTFPs) by selected households and their preferred diversification options other than jhum. In order to capture preferred diversification choice, we have used a five-point Likert scale (not preferred – 1 to most preferred – 5). Ten items of preference were identified based on an extensive review of the literature and a pilot survey of non-sample respondents from 87 households wherein plantation agriculture was an item of preference. In addition, secondary data on the present and potential area under plantation crops, namely oil palm and natural rubber procured from official records, were analysed.

Results and discussion

The results of the present study are discussed under the sub-heads of planted and potential area for oil palm and natural rubber plantation in NEI, socio-economic and ecological changes in the jhumscape, 'the hidden harvest' of jhumscape, and respondents' diversification preference.

Table 1 indicates that the government agencies have identified around 12,666 km^2 area in the forest-rich biodiversity niche of these NEI states for oil palm and natural rubber monoculture, whereas around 2050 km^2 is already covered by both the plantation crops. Further, in Arunachal Pradesh, which has about 79% forest cover and is the most biodiversity-rich state, around 3338 km^2 has been identified for both the plantation crops. Under rainfed conditions in NEI, the ICAR-Indian Institute of Oil Palm Research (IIOPR)[23] has recommended growing oil palm even on wastelands (4322.99 km^2) like grasslands (2495.17 km^2), land with shrub/scrub (662.13 km^2) and areas under shifting cultivation (1165.69 km^2). However, several challenges have been identified to sustain oil palm cultivation in Mizoram – the state has maximum area (315 km^2) under oil palm plantation among the NE states[23].

Socio-economic and ecological changes in the jhumscape

Empirical evidence is mounting on the consequences of landscape change, which pronounces more on food security and biodiversity loss if monoculture of plantation agriculture is adopted[22,24–27]. Such transitions, though, had a visible positive economic gain, for example, for several rubber-growers, the majority of whom are still practising shifting cultivation (less lucrative agriculture). The growth of natural rubber in Tripura has improved the living standard of innumerable landless shifting cultivators. As rubber production in NEI has a monoculture tendency, it may compromise the ecological integrity of the region's diversified land-use systems[28]. A recent global review on the impact of rubber plantations on ecosystem functions concluded that rubber cultivation had increased farmers' economic situation has influenced otherwise on ecosystem services of the environment[24]. The New Land Use Policy of Mizoram replacing traditional jhum with settled agriculture and oil palm expansion has sparked social discontent, with residents claiming that the proposed policies are damaging intervention to their environmentally sustainable and traditional land-use management methods. Similarly, conservation scientists in Arunachal Pradesh have warned against expanding oil palm plantations in the state[29,30]. Unsustainable oil palm expansion with short-term economic goals shall have biodiversity and social implications[25]. For example, the role of women in settled oil palm farming will be 'submissive' as their dynamic role in shifting cultivation. This will force men to work more against lesser pay and women to extract artisanal palm oil at home[31], thus affecting the land tenure system. 'Land grabs' and the transfer of land ownership to a small group of powerful people, expanding socio-economic disparities have occurred in

Table 1. Planted and potential areas for oil palm and natural rubber plantation in North East India

State	Oil palm		Natural rubber		
	Planted area (km^2)[a]	Potential area (km^2)[a]	Planted area (km^2)[b]	Potential area (km^2)[b]	Forest cover of total geographical area (%)[c]
Assam	16.99	3754.28	40.65	250	36.09
Arunachal Pradesh	15.95	1338.11	517.95	2000	79.33
Manipur	0	666.52	39.55	100	74.34
Meghalaya	0	1226.37	147.75	500	76.00
Mizoram	315.97	667.92	33.50	500	84.53
Nagaland	26.40	512.97	142.35	150	73.90
Tripura	0.31	0	750.70	1000	73.34
Total	375.62	8166.17	1674.45	4500	71.08

[a]Ref. 23; [b]Ref. 49; [c]Ref. 1.

similar socio-cultural situations in the past, too[32,33]. The main argument is that India's biodiversity-rich ecosystems of NEI do not need to be altered in order to significantly increase indigenous oil palm production[34].

The hidden harvest of jhumscape

India's Wastelands Atlas shows only the burned and cleared areas, excluding several cultivation years, and classifying shifting cultivation (SC) as a wasteland against its viable land use. Indeed, such a mosaic landscape provides a diversity of goods to the jhumias, which is 'environmental income' having three key functions for supporting rural livelihood[35], viz. (i) supporting current consumption, (ii) providing safety nets in the face of shocks and gap-filling of seasonal deficiencies, and (iii) providing a method of accumulating assets and a way out of poverty. Figure 1 depicts the hidden harvest and its use among sampled households from jhumscape in NEI.

Although jhumscape, particularly jhum fallow, is categorized as 'wasteland' in official land use classification. Figure 1 depicts the use of timber and NTFPs among the sampled households. After slashing the patch of vegetation biomass on a community-owned forest, the left over wooden logs are utilized for furniture and house construction. As an important source of energy, rest of the biomass is used as firewood and charcoal utilized for cooking, heating of water, room heating, lighting and livestock rearing, etc. Forest resources are projected to be used by 60–94% of the indigenous population in Arunachal Pradesh, Nagaland, Manipur and Tripura for diverse purposes[36], corroborating the results of the present study. About half of India's households use firewood as their primary and secondary cooking fuel (12%), totalling 150 million households[37]. Besides, such a landscape provides a variety of wild foods with medicinal value. Across the sampled villages, over 60% of households reported the use of NTFPs, reaching up to 75% in the case of Saiha, Mizoram and Upper Subansiri in Arunachal Pradesh. Murtem and Chaudhry[38] identified the usage of 269 medicinal plant species from 77 families in the Upper Subansiri district of Arunachal Pradesh[38]. Konyak *et al.*[39] documented 43 plant species belonging to 26 families used by the tribals of Mon district, Nagaland. The Garo tribe in West Garo Hills, Meghalaya, used wild vegetables (13 species), wild fruits and medicinal plants (11 species)[40]. Some NTFPs have high socio-cultural values for the people of NEI and are also used in various magico-religious treatments/practices. Thus, NTFPs, if properly channelized through the government sector, may provide direct economic benefits through trade and help conserve biodiversity[41]. For example, broom grass (*Thysanolaena maxima*), an important minor forest produce of Meghalaya, if directly taken by commission agents will ensure maximum share to the producers[42]. Further, climate-induced hazards with non-climatic stress (like loss of resource extraction, market shifts, etc.) often result in insecurity and accelerate vulnerability in the agricultural system[43]. Thus, NTFPs provide safety against adverse effects of climate change[44,45].

Table 2 reveals that vegetable cultivation, fruit orchard and spices production are the top three choices for agricultural diversification in SCA. Agricultural diversification towards high-value crops can boost farm income, particularly in countries like India[46]. Albeit, the livelihoods of small farmers can be significantly improved by horticulture-led growth if supported by adequate infrastructure and institutions, thus lowering transaction costs[47]. However, in NEI, high agricultural inputs and lack of awareness of efficient adaptation solutions are the major challenges[48].

Conclusion – the way forward

The Food and Agricultural Organization, Rome, Italy, has projected that up to 16.08 million hectares of marginal rice lands in India are suited for oil palm growth[34]. One strategy to handle such a trade-off is to locate suitable niches for oil palm area expansion which may result in its production (about 108.92 Mt) at the expense of 18.94 Mt of rice, even with optimal use of inputs. As most NEI is unfavourable for oil palm from a purely agricultural standpoint, it will

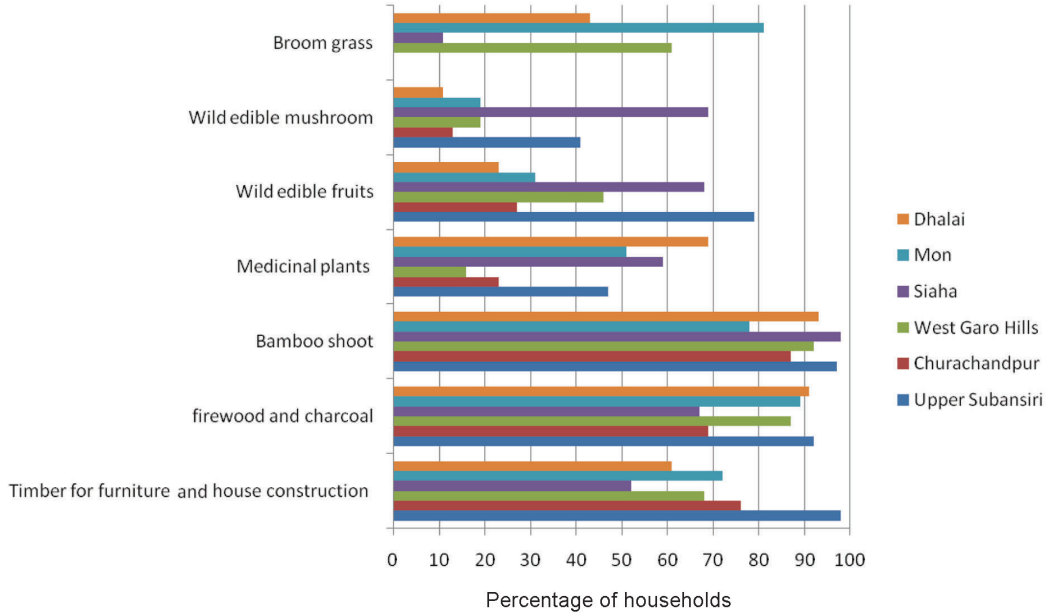

Figure 1. Usage of timber and non-timber forest products by the sample households.

Table 2. Bottom-up perspective – respondents' diversification preference

Diversification preference	Mean	SD	Rank
Vegetable cultivation	4.09 ± 0.23	0.94	I
Fruits orchard	4.04 ± 0.23	0.91	II
Spices production	4.04 ± 0.23	0.92	II
Fruit and vegetable processing	4.01 ± 0.25	0.99	III
Integrated farming	3.96 ± 0.24	0.97	IV

n = 481.

threaten numerous globally vulnerable species while providing dubious agricultural benefits[34].

Considering diversification preferences of the jhumias and their socio-economic condition, convergence of ongoing national missions is imminent. For example, the Mission for Integrated Development of Horticulture in Northeast and Himalayan States covers promotion of cultivation of fruits, vegetables, root and tuber crops, and many more, and involves a high share (90%) of the budget earmarked for this region by the Government of India. This scheme intends to conserve the cultivated diversity by promoting locally suitable species. In addition, the NE Mission for Organic Value Chain Development is being executed in all the NEI states. Both the schemes may complement the National Mission for Sustaining the Himalayan Ecosystem and the National Mission on Strategic Knowledge for Climate Change, besides promoting high-value crops for increasing the farm incomes of jhumias in NEI. Thus, the knowledge generated from the present study may guide the development planners to evolve the appropriate balance of indigenous diversified cultivation vis-à-vis modern monoculture.

Conflict of interest: None.

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