OPINION

Cropland greening and forest browning in India – an alarm to strengthen conservation measures

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Cropland greening and forest browning are potential threats to biological diversity in India. It is therefore imperative to revisit the existing conservation measures for effective management of biodiversity, enhancement of carbon stocks and sustainable management of forests.

India is the one of the mega-biodiversity as well as the most populous country in the world. It is therefore highly challenging to meet the society's growing needs for food while simultaneously reducing greenhouse gas (GHG) emissions from agricultural production and preventing the conversion of remaining forests to agricultural land in the country. According to a recent estimate, there is 1.87 billion hectare of croplands in the world (~12.6% of the global terrestrial area). India ranks first, with 179.8 million hectare croplands (9.6% of the global net cropland area; croplands.org). Despite the lower rates of deforestation (0.07%–0.05%) in recent times[1], significant loss of forests (89 to 63 m ha) has occurred during 1880–2010 (ref. 2). Conversely, cropland area has increased from 92 to 140.1 m ha during 1880–2010, and majority of the cropland expansion has resulted from conversion of forests[2]. Recently, Chen *et al.*[3] reported that India accounts for 6.8% of the global net increase in leaf area, next to China (25%). Though it is encouraging, greening in India is mostly from croplands (82%) with minor contribution from forests (4.4%), whereas in China, forests (42%) are the major contributors towards greening[3]. It has also been reported that there are significant negative changes in seasonal greenness of major forest types in India[4]. This observed increase in trend of cropland greening and forest browning (or reduced ecological status) is a threat to biological diversity in India and warrants effective conservation measures.

Cropland expansion threatens biodiversity by driving habitat loss and impacts carbon storage through loss of biomass and soil carbon[5]. However, in countries like India where substantial expansion of agriculture is expected, it is unlikely that increase in crop production will come from current agricultural land. Furthermore, increasing frequency of extreme natural calamities caused by global climate change will have unprecedented effects on biota and threaten the resilience and recovery potential of natural ecosystems. Keeping global warming below 1.5°C is a universal agenda to avoid dangerous climate change consequences[6]. To achieve this, increasing the natural forests is proposed as the cheapest and technically easiest option by many global efforts like REDD+, Bonn challenge, etc. India is an active partner of global climate change mitigation efforts, and has strong legislative measures and high protected area (PA) network to safeguard the forests. Unfortunately, many of these PAs are poorly designed or enforced due to inadequate manpower, lack of facilities and absence of formal management plans[7,8]. Also most of the PAs lack both clear aims and long-term biological data to evaluate the management effectiveness[9]. Chakraborty *et al.*[4] reported significant negative changes of seasonal greenness over large PAs in India. Furthermore, in terms of restoration, to return all degraded lands to natural forests, often planting of commercial trees has been practised[6]. Despite supporting local economies, plantations are much poorer at storing carbon than natural forests, and release stored carbon dioxide back upon harvesting and clearing. In order to achieve the targets of REDD+ and the Bonn Challenge, and to ensure the sustainability of ecological services offered by the forests, it is imperative to preserve the ecological health of the existing forests.

In recent times the focus of natural resource conservation has witnessed a shift from species to ecosystem, and has often focused on ecosystem-based management (EBM) approaches. EBM is driven by recognition of the failure of conventional management practices[10], and aims at achieving conservation, sustainable use and fair allocation of benefits from natural resources[11]. The lack of sufficient data is still a major impeding factor for the success of forest conservation. Also, EBM requires more precise information of various components of a given ecosystem to be managed. To transform current conservation measures into effective EBM-based measures, a multidisciplinary approach will be needed. National legislations need to form multi- and interdisciplinary teams to critically revisit the available information and make efforts to fill knowledge gaps for better policy-making. Recently, Ravindranath *et al.*[12] also highlighted the ambiguity in the estimation of forest area and deforestation in India and insist the need for a new approach to monitoring and reporting of forest area in India to meet the challenges of forest conservation, research and reporting. On the whole, in-depth site-specific understanding of dynamics and functions, strict legislative measures and long-term monitoring are pivotal to ensure the sustainability of India's forest resources.

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