KEEPING ECOLOGICAL DISTURBANCE ON THE LAND

Recreating Swidden Effects in Bhutan

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Introduction

For many centuries, swidden agriculture was the basis of complex, linked socio-ecological systems throughout much of the world (Cairns, 2007; Xu et al., 2009; Padoch and Pinedo-Vasquez, 2010). In South and Southeast Asia, hundreds of ethno-linguistically and culturally unique societies developed and managed tree- or shrub-fallow farming systems that reflected context-specific environmental (e.g. climate, soils, slope and vegetation) and social conditions (e.g. cultural beliefs, governance institutions and socio-economic resources). For centuries these practices provided communities and households with food, fibre, building materials, medicines and other valuable products and, in the process, created and maintained floristically diverse and structurally complex vegetation mosaics across landscapes (Fox et al., 2009; Mertz et al., 2009a; Xu et al., 2009; Siebert and Belsky, 2014). However, in recent decades, swidden systems and the diverse societies that created and maintained them have disappeared or been radically transformed (Kerkhoff and Sharma, 2006; Fox et al., 2009; Mertz et al., 2009a; Xu et al., 2009). The bio-cultural losses associated with modernization and the integration of formerly isolated peoples into nation-states and a globalized economy are well documented, as are changes in traditional agricultural knowledge and practices (e.g. replacement of diverse, nutritionally rich subsistence food systems with more risky cash crops and monocultures that are dependent

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on chemical inputs) (Kerkhoff and Sharma, 2006; Xu et al., 2009; Maffi and Woodley, 2010; Pilgrim and Pretty, 2010; Wangchuk and Siebert, 2013). What is less understood are other implications associated with the cessation of swidden systems, especially their socio-ecological legacies.

In a recent paper we examined the socio-ecological aspects of historical swidden practices in Bhutan and argued that they functioned as intermediate ecological disturbances that contributed to the creation and maintenance of biodiversity (i.e. the composition, abundance, structure and distribution of flora and fauna) (Siebert and Belsky, 2014). In this chapter we suggest that some integral (i.e. what we call 'historical') swidden systems offer principles that may be built upon or adapted to promote biodiversity conservation and to provide goods, income and employment for rural households in the future. Our argument is not that swidden can or should be recreated in Bhutan or anywhere else; that is impossible due to dramatic changes in agrarian conditions, political economy and culture. Rather, we suggest that understanding the socio-ecological attributes and disturbance effects associated with swidden (and other historical land uses) can and should inform the conservation and development policies and programmes of the present day.

Swidden, cultural landscapes and biodiversity

Swidden, or shifting cultivation, was for centuries widely practised in Bhutan and much of the tropical and temperate world (Cairns, 2007; Fox et al., 2009; Padoch and Pinedo-Vasquez, 2010; Dove, 2015; Dukpa et al., this volume). The extent of human modification has led to the use of the term 'cultural landscapes' to denote land forms that are the cumulative result or 'co-production' of human activities and environmental conditions (Balée, 2013). Despite aggressive attempts to suppress swidden by colonial regimes, post-independence governments and protectionist conservation approaches, in the early 2000s about 10 million hectares remained under some form of forest farming in the eastern Himalayas, at the hands of between 50 and 200 million swidden farmers (Kerkhoff and Sharma, 2006; Mertz et al., 2009b; Ziegler et al., 2009). The extent of swidden in Bhutan prior to the country's political and economic integration with the outside world in the

Disturbance	*Disturbance type and effects*	mid-

20th century is unknown, but in 1988 swidden fields or fallows were believed to cover about 200,000ha, or 5.2% of the country's land area (Roder et al., 1992).

The effect of swidden and other historical land uses on flora, fauna and biodiversity in general can be evaluated by conceptualizing anthropogenic activities as ecological disturbances and identifying their effects (Siebert and Belsky, 2014). Ecological disturbances can be characterized on the basis of specific attributes, the most important of which are their type, spatial features, temporal characteristics, specificity, intensity and resulting synergisms (Mori, 2011). While disturbance effects vary with soil, topography, climate and other factors, three disturbance parameters are particularly important in forest ecosystems: (1) the return interval (i.e. the time between disturbances); (2) the severity (i.e. amount of vegetation killed and the type and amount of space available for new plant growth); and (3) the landscape-level spatial patterns that are created (Seymour and Hunter, 1999).

Disturbance effects associated with traditional Bhutanese swidden farming and two important and widespread natural disturbances (i.e. individual tree mortality and landslides) are summarized in Table 1. This comparison suggests that ecological disturbances due to swidden farming held an intermediate position between natural tree-falls and landslides in terms of size, intensity and duration. Another important effect of swidden was the maintenance of complex vegetation mosaics or patchiness, with significantly more early seral vegetation (i.e., grasses, forbs and other plant species that establish following disturbance) and open habitats. The species composition and structure of the flora in swidden fallows was different to that which developed following natural treefalls and landslides. Swidden landscapes also included areas that were not cultivated or managed due to steep slopes, poor soils, difficult access, religious beliefs and local customs that maintained habitats for forest-dependent flora and fauna (Siebert and Belsky, 2014). At the landscape level, the overall effect was to increase plant species richness and structural heterogeneity, and maintain open and disturbed habitats of value to ungulates and carnivores, such as tigers, leopards and wild dogs (Wikramanayake et al., 2011; Post and Panday, 2013; Siebert and Belsky, 2014).

	Tree-falls	*Swidden (tseri)*	*Landslides*
Size	small partial – less than 0.25 ha	Intermediate 1 to more than 3ha	Large tens to hundreds of hectares
Intensity	low plants crushed, pits and mounds	intermediate biomass cut and burned, cultivated, not ploughed	extreme vegetation and soil removed to subsoil or bedrock
Duration	short rapid regrowth	Intermediate 1 to 2 yrs of cultivation	long variable: yrs to decades
Frequency	?	2 to more than 10-yr fallows	?
Landscape pattern	variable, widespread	managed mosaic of different species and seral stages	variable – slopes and deposition areas
Ecological effects	maintains +/- dense closed forests	Greater percentage of early seral spp. With unused closed forests	widespread rock and bare ground
Succession	rapid, native spp.	secondary fallow spp.	primary, slow

TABLE 1: Disturbance effects associated with swidden, treefalls and landslides in Bhutan

Swidden has largely ceased in Bhutan and the rest of Asia. This has been due to government policies based on modern development and conservation politics that purposefully disregarded or failed to understand the productivity, priorities, sustainability and mutually reinforcing social and ecological services provided by historical livelihoods and land uses. Instead, they pursued sedentary and export agriculture, forest exploitation and western protectionist conservation (Dove, 1983; Dove, 2015; Phuntsho et al., this volume). New market opportunities, cultural changes, rural to urban migration and other dimensions of agrarian transformation have also propelled farmers to replace swidden with different agricultural practices and livelihood activities (Mertz et al., 2009a; Xu et al., 2009; Wangchuk and Siebert, 2013). Consequently, swidden-related, intermediate-scale disturbances no longer provide the ecological and livelihood functions they did in the past. Throughout Bhutan and other areas of the eastern Himalayas, swidden landscapes have transformed into either dense, closed-canopy forests or intensive annual and perennial cash-crop monocultures (Mertz et al., 2009a; Xu et al., 2009; Siebert et al., 2015). As a result, the flora, fauna and rural economy are changing with uncertain, but potentially profound implications for bio-cultural diversity and household livelihoods. We suggest that understanding historical swidden practices and their effects should inform rural livelihood development and biodiversity conservation efforts.

Opportunities for recreating swidden effects in Bhutan

Recreating the intermediate-level ecological disturbances associated with historical swidden practices in contemporary Bhutan will be challenging. It will require: (1) identifying the range of effects associated with historical swidden practices particularly the size and intensity of the ecological disturbances they create and the resulting landscape patterns; (2) revising the forest policies and regulations of the Royal Government of Bhutan so that the ecological importance of swidden-related disturbances is appreciated and experimentation with novel forest-management practices that replicate swidden disturbance effects is encouraged; and (3) supporting livelihoods and land uses that generate products and income while meeting ecological objectives. We suggest that

experimental activities and land uses be context-specific and collaborative, involving resource users, local managers and others to understand available options and to pursue land uses and livelihoods that make sense in the light of local social, economic and environmental conditions and concerns.

We suggest two practices that may maintain some of the ecological-disturbance effects associated with historical swidden farming in Bhutan: timber harvesting by group selection or clear felling and the cultivation of tree crops in open orchards. It is important to emphasize that both practices should occur at intermediate scales and be managed in a patchy or mosaic-landscape pattern to maintain historical landscape-scale disturbance effects. Group selection or clear felling of small stands of blue pine (*Pinus wallichiana*) in cool temperate areas and oak (e.g. *Quercus griffithii*) and other hardwood species in warm temperate zones for timber and firewood could mimic some historical swidden-disturbance effects while generating products for household use or sale. Blue pine, oak and other economically valuable species have grown in former swiddens throughout Bhutan and are widely used for timber and firewood. Blue pine is an aggressive, shade intolerant pioneer species that rapidly colonizes swidden fields and other open areas in mid-altitude zones throughout the southern Himalayas (Cochrane, 2009). Thousands of hectares of dense, even-aged, blue pine stands now cover much of the Bumthang district alone (Siebert et al., 2015), on what are now Royal Government of Bhutan forest lands, following their nationalization (Dukpa et al., 2007). Yoder et al. (this volume) estimate that harvesting all pines with a diameter at breast height greater than 16cm on a 30-year rotation could generate between US$18,412 and $23,422 per ha in this region. This is an attractive financial return compared to available alternatives, particularly since it requires little labour or capital investment (Dukpa et al., 2007) and would also produce firewood for domestic consumption and sale.

To recreate disturbances to mimic the historical effects of swidden, harvesting could be conducted in small blocks (1 to 3ha), followed by low-intensity burning of slash (i.e. tops, small branches and leaves). Repeated across the landscape, this would create mosaics of open and regenerating pine stands of different ages and sizes, along with unutilized, closed-canopy forests. Seed trees could be retained to facilitate regeneration and to improve the growth, vigour and form of subsequent trees. Parcel sizes, landscape patterns and other disturbance attributes could reflect previous site-specific swidden

practices, which vary from one region to another. These practices could potentially be implemented in government reserve forests, including community forests, and on private land, with harvesting activities regulated by the government (Phuntsho et al., this volume). Harvesting could be conducted by private contractors who pay the government, community forest-management groups or private landowners on the basis of stumpage values.

This same approach could be explored in temperate broadleaf forests dominated by oak, chestnut and other economically valuable species. Unlike blue pine, some hardwood species, such as oak, coppice vigorously, which eliminates the need to replant or to retain seed trees. Potential market opportunities and returns from clear felling of hardwood stands in Bhutan are unknown, but would provide timber for furniture and veneer as well as high quality firewood.

Some historical disturbance effects might also be recreated by cultivating tree crops in relatively open stands. One example is a current project being undertaken by the private Mountain Hazelnut Venture, the Royal Government of Bhutan and private landowners, in which hazelnuts are being grown as a cash crop on private, former swidden lands and degraded slopes between 1600m and 3000m above sea level, particularly in eastern Bhutan and in the Punakha and Bumthang districts, where swidden was once widespread (Mountain Hazelnut Venture, 2014). The company provides assistance with seedlings and planting, and later with processing and marketing. As of 2014, 4,400 private landowners had planted two million hazelnut seedlings, with a goal of 20,000 landowners cultivating 10 million trees on 20,000 acres (10.080ha) (Mountain Hazelnut Venture, 2014).

Orchards are more open than primary or secondary forests and support understory growth of grasses and forbs that could be used by wild ungulates. However, orchards will not provide other swidden effects, such as regenerating secondary forests. Importantly, the long-term economic viability, benefits to landowners and sustainability of hazelnut cultivation will depend on the terms of production and exchange under which they are grown and marketed, crop yields, market demand and prices, returns to labour, pest losses and other factors, all of which are presently unknown.

Policy and regulatory changes

The biodiversity effects and economic returns associated with clear felling trees in small parcels for firewood, and tree-crop cultivation, warrant examination under a range of socio-economic and environmental conditions. Field trials should evaluate and monitor variable harvesting and management effects on plant regeneration, residual vegetation, soils, wildlife, economic costs and benefits, labour requirements, marketing and other factors. Including older farmers with experiential knowledge of traditional swidden practices and their ecological effects could help to identify possible management approaches and evaluation criteria. These strategies may require the modification of existing government forestry and agricultural policies and regulations to: (1) fund trials under a range of climatic, soil and vegetation conditions (e.g. cool temperate blue pine and warm temperate oak stands); (2) modify current timber harvesting practices, which emphasize single trees and selective systems, and evaluate group selection or clear felling in small patches; (3) allow increased timber harvesting over a greater proportion of landscapes, particularly around villages where timber and firewood can be readily transported to market, where forest fires pose increasing risks and where swidden was formerly practised; (4) evaluate market demands, returns to labour and opportunities for locally profitable, value-added processing for domestic and export markets; and (5) revise attitudes towards swidden farmers to consider them potential resource collaborators.

Another challenge to recreating swidden-like disturbances in Bhutan is the need for government officials, elected representatives, environment and development organizations and the general public to recognize that some traditional swidden systems contributed to the creation and maintenance of bio-cultural diversity. Swidden agriculture and the people who managed it have been denigrated for decades in Bhutan as being both primitive and destructive (Dukpa et al., this volume). Since the early 1980s, the government has subsidized the conversion of swiddens to permanent wet and dry fields and cash crop plantations (Phuntsho et al., this volume). In Bhutan, increased forest cover and density are widely assumed to be desirable. Indeed, the constitution provides that at least 60% of the country must remain under natural forest cover, and more than half of the country is in some form of national park or protected area (MoA, 2009; Kuensel, 2013). Despite this, the promotion of market-based enterprises in rural areas has become a development objective in Bhutan (PDP, 2013), but their pursuit in the forestry sector is fraught with challenges. For example, the government recently

suspended the designation of new community forests because of concerns over inadequate monitoring and excessive tree harvesting by some community forestry management groups (Dema, 2014).

Attitudes towards traditional swidden systems and expanding forest cover may be changing in Bhutan and elsewhere. The International Centre for Integrated Mountain Development (ICIMOD) has concluded that some swidden systems were not only productive and sustainable, but also preferable to the agricultural practices that have replaced them in the eastern Himalayas (Kerkhoff and Sharma, 2006). Moreover, the governments of Bangladesh, Bhutan, China, India, Myanmar and Nepal have acknowledged that 'shifting cultivation must be recognized as an agricultural and adaptive forest-management practice that is based on scientific and sound ecological principles' (cited in Kerkhoff and Sharma, 2006). This view mirrors those of long-term swidden researchers throughout Asia (Cairns, 2007, 2015; Xu et al., 2009). In addition, swidden maintained open areas and limited the accumulation of biomass over large areas for centuries. Royal Government of Bhutan forestry officials have recently concluded that forest fires are increasing in frequency, size and intensity and have become a serious problem due, in part, to the increasing cover and density of the country's forests (MoAF, 2013).

Conclusion

In Bhutan and much of the eastern Himalayas, historical swidden-based societies created, managed and maintained open habitats and early seral vegetation, along with large expanses of mature, closed forests in complex landscape mosaics. For centuries, these landscapes sustained local food production and cultures, along with diverse flora and fauna (Kerkhoff and Sharma, 2006; Xu et al., 2009; Siebert and Belsky, 2014). In recent decades, the swidden-associated, intermediate-level ecological disturbances of the past have ceased in Bhutan and elsewhere. Government policies, emerging market opportunities and other agrarian changes have led to the establishment of annual and perennial crop monocultures and dense, closed canopy forests across formerly heterogeneous landscape mosaics in Bhutan and other upland areas of Southeast Asia. Flora and fauna that prefer open habitats, such as ungulates and rare and endangered

carnivores, may be adversely affected by these land-use changes. The ecological sustainability and livelihood security of households and communities who are dependent upon cash crops are questionable and increasingly vulnerable to economic, social and environmental (e.g. climate) change. Increasing forest cover and density are also resulting in different disturbances, such as larger and more destructive fires, which affect people and their environments.

The conservation of biodiversity and human well-being, particularly the capacity of socio-ecological systems to adapt to dynamic and unpredictable social, economic and climatic change, require the identification and development of new functional links between sustainable livelihoods, culture and biodiversity (Xu et al., 2009). Small scale clear-felling of forest stands for the production of timber and firewood, followed by burning of slash, could generate income and products for rural households while recreating the intermediate-scale ecological disturbances formerly provided by swidden farming, thereby supporting national development and biodiversity-conservation objectives. Recognizing and building upon historic social-ecological legacies and traditional knowledge could and should inform future conservation and development paths.

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