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Forest Resource Management in the Context of Climate Change Adaptation and Mitigation in Bhutan

Bhagat Suberi¹, Krishna R. Tiwari², Dhan B. Gurung³, Roshan Bajracharya⁴, Bishal K. Sitaula⁵

Abstract

Deforestation has continued to be a major global problem as large areas of forests are lost every year. On an average 13 million hectares of forest is being lost annually which emits approximately 6 million tonnes of carbon dioxide into the atmosphere. Such emissions contribute to global warming and climate change which may undermine nations' effort to biodiversity conservation and timber production. This article presents an analytical review of forest resource management in Bhutan, highlighting relevant policy issues and mitigation and adaptation measures taken to reduce the impact of climate change. Considering 70.46% of Bhutan's geographical area under forest cover and 51.44% under protected area system, forest resources management has been a priority for the Royal Government of Bhutan. Forest plays an important role in mitigation and adaptation of climate change. Forests also provide many socio-economic functions and ecosystem services to support livelihoods and ecosystem processes. However, change in climate variables raises critical question for forest management in Bhutan. Climate change is a new component in Bhutan's forest management policy, which will become one of the main components in shaping its development preferences in future. Incorporating sustainable strategies in forest management and payment for ecosystem services can contribute significantly to forest conservation and reduces vulnerability to climate change.

Keywords: Adaptation, climate change, forest management, mitigation, policies

Introduction

Global climate change suggests that it will have a significant impacts on forest ecosystems and their associated ecosystem services with serious consequences on livelihoods of communities, particularly in the Himalayas (IPCC, 2001; Agrawal and Perrin, 2008; ICIMOD, 2010; Van de Sand, 2012). The Millennium Ecosystem Assessment (2005) identifies climate change as one of the underlying drivers of forest degradation which is likely to affect the livelihood of rural poor. The rural poor rely on forest resources for their subsistence livelihoods and

^{1,3}College of Natural Resources, Lobesa, Bhutan
 ²Institute of Forestry, Tribhuvan University, Pokhara, Nepal
 ⁴Kathmandu University, Dhulekhel, Nepal
 ⁵Norwegian University of Life Sciences, Norway
 ¹Corresponding author: bsuberi.cnr@rub.edu.bt
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have limited capacity to adapt to change, which makes them more vulnerable to climate variability changes (ICIMOD, 2010).

Various studies suggest that warming in the Himalayas has been much greater than the global average of 0.74° C over the last 100 years (IPCC, 2007). For example, warming in Nepal was 0.6° C per decade between 1977 and 2000, which is progressively higher at higher elevation (Shrestha *et al.*, 1999; New *et al.*, 2002). In Bhutan, data from 2000–2009 show that there is an increase of temperature, and climate model predicts an increase in mean annual temperature by 0.8° C to 1° C by 2039 and 2° C to 2.4° C by 2069. This indicates that the warming is an observable phenomenon, which will have impact on the forest structure (Davis and Li, 2013).

Climate change induced calamities trigger deforestation and forest degradation. Flash floods and soil erosion causes landslides and loss of forest cover fragmenting forest habitats with consequences on ecosystem services e.g., biodiversity and water quality. Alternatively, a significant portion of the forest conversion is often exploited by users who make resource use decisions under insecure tenure regimes. While the government and NGOs have been trying to implement appropriate policies to reverse the trend of resource degradation, rural communities continue to extract resources for their livelihood sustenance. It is unclear on what efforts are being made to integrate communities' needs with policy and institutional processes in forest management (Berkes, 2008; Ojha *et al.*, 2013).

Bhutan is known for maintaining its extensive forest cover of 70.46% of the total land surface area (RGOB, 2010). Forests are important component of the Bhutanese farming system as farmers obtain a variety of products and services from forests such as leaf litter for animal bedding, which is used for production of organic manure. Forests provide timber and fuel wood as well as non-timber forest products (NTFPs) such as mushrooms and edible ferns to supplement diets and provide a source of cash income (ibid.). Therefore, Bhutan cannot fail to manage its rich forest resources despite mounting uncertainty from climate induced stresses.

Therefore, the objectives of this paper are to carry out an analytical review of forest resource management practices implemented in the context of climate change, review relevant policy issues, and explore climate change mitigation/ adaptation measures adopted in relation to forest management practices in Bhutan.

Methodology

This manuscript is based on review and analysis of existing literature like the Forestry Infor-

mation Database (FIB), Renewable Natural Resources (RNR) statistics published by the Ministry of Agriculture and Forests (MOAF, 2015), policies and acts of the Department of Forest and Park Services of Bhutan, national reports, published and unpublished articles, reports of various organisations, and internet based relevant information.

Forest Management and Related Policies in Bhutan

Bhutan's forest policies and practices have ensured that the forest heritage is preserved and managed for the future. About 70.46% of the country is under forest dominated by broadleaf and mixed conifer forests. The broadleaf forest constitutes 62.43% and the mixed conifer forest constitutes 62.43% of total forest cover. Fir forest constitutes 6.77% while Chir pine and Blue pine forests comprise of 3.98% and 2.96% respectively. The Broadleaf with conifer forest constitutes the least with 1.16% of the total forest cover. Figure 1 shows the forest coverage in percent (LCMP, 2010).

Until 1950, there was no formal law and policy to govern the forest management system. Local institutions that regulated access, use and management of forest resources existed in Bhutan before the intervention of the state in forest management (Wangchuk, 2001 and Allison, 2002, as cited in Dorji, 2006). The country consisted of self reliant and self subsistent communities, possessing well defined community based rules and institutions to facilitate the use of common pool resources which had customary forest management institutions (Dorji and Webb, 2003).









as domains of local deities and hold special values in Bhutanese beliefs. Local people protect such forest areas as sacred grooves and maintain them good condition. Likewise, lake is believed to be formed by powerful local deity and cannot be disturbed as it is a home to the deity. Any disturbance to such protected forests and lakes would bring bad events such as incessant rainfall or prolonged drought.

For the government, forest is an important source of revenue and an environmental heritage (Dorji and Webb, 2003). To implement conservation programmes, a forestry unit was created in 1952 under the Ministry of Trade and Industry. It was later upgraded to a Department in 1961. With the beginning of the government's Five Year Development Plan in 1961, the planning process for national-level forest management in Bhutan also began. Initially, the Forest Department focused on commercial logging with one of its Divisions as Forest Logging Corporation.

The Forest Act of 1969 (RGOB, 1969) nationalised all of Bhutan's forests, declaring even trees on private land to be 'Government reserved forests', and nullifying traditional rights and customary laws. The National Forest Policy of 1974 set a goal of maintaining 60% forest coverage for all time to come, which is currently embedded in the Constitution of Bhutan. Forest management practices focused on revenue generation from timber extraction of natural forests to meet the local and national demand, and export the surplus timber. Clearfelling method was used in timber harvesting with little or no regards to climate-resilient practices until 1970s. The basis for scientific management of forests and provisions for restoration of degraded land emerged in 1974 with the drafting of National Forest Policy in 1974 (RGOB, 1974). Then, the government began to recognise that rural communities depend on local forests to meet their basic needs. The Land Act of 1979 (RGOB, 1979) allowed the use of forest resources on private land for domestic and non-commercial purposes. In this Act there was a Royal Decree that placed the groundwork for 'social forestry', an attempt to engage the community in forest protection and restoration. One of the participatory activities established under this initiative is the community forestry.

In 1995, the Forest and Nature Conservation

Act strengthened the scientific management of forest resources, restored communities' traditional rights, and provided provision for private forestry and community forest, with community groups granted management and user rights in conjunction with an approved management plan. The Forest and Nature Conservation Rules, promulgated in 2000 and revised in 2003 and 2006, enabled a rapid expansion of community forestry, with 62,115 ha in 556 community forests, benefiting more than 23,808 households (SFD, 2010).

However, in neighboring countries like Bangladesh, Nepal, India, and Sri Lanka, forest had been heavily exploited almost with no vegetation during the era of British colonial regime (1757–1947) to generate revenue (Bandi, 2011). Only after the independence gained from the British rule, forest acts and policy were formulated to safeguard the natural resources. However, conservation of forest and management were nationalised granting limited rights to the local communities to use and manage resources which further deteriorated the resources available. This was mainly because of lack of qualified forest personals and more importantly so due to centralised forest conservation and management system by government (Inoue and Shivakoti, 2015).

Forestry in Bhutan is regulated by the government since the nationalisation of forests in 1969 (Moktan, 2010). Production forests are managed through forest management units (FMUs) to ensure a sustainable supply of timber but also to protect biodiversity and ecosystem services (ibid.). Recently, exploitation of forest resources has been discouraged by imposing a ban on timber export in the form of sawn logs and following an official notification to encourage wood imports (Jadin et al., 2015). Despite many positive outcomes, there are several mounting challenges, limitations and short comings, particularly in implementation on conservation rules. Notable challenges include Human-wildlife conflict, over grazing, excessive harvesting, and forest fire which have impact on local livelihood and climate change (MOA, 2009).

Forest Management Regimes

The forest management regimes in Bhutan are broadly divided into two; 1) State management 2) Community forest management (Suberi and Sittipong, 2010). The Department of Forests and Park Services (DOFPS), to ease its management and administration has six major functional divisions.

I) The Nature Conservation Division (NCD), which was established in 2004, looks after conservation programmes in the country for protected areas. Bhutan has significant portion of the country as protected areas (51.44%) including (8.60%) biological corridors. This places Bhutan at the top of the list of countries with the highest proportion of area under protected status in the world. Bhutan has 10 formally declared protected areas covering 19,676.57 km², which is more than a quarter of the country. Table 1 below shows the number of protected areas of Bhutan.

 Table 1: Protected area establishment

Sakten Wildlife Sanctuary

Phibsoo Wildlife Sanctuary*

Jomotshangkha Wildlife Sanctuary*

Jigme Khesar Strict Nature Reserve*

duction forest resources under scientific sustainable management". Scientific management of forests is done through identification and establishment of Forest Management Units (FMUs) and managing them under a prescription of written management plans. Forest management practices involve from clear-felling to group selection felling systems for commercial purposes in FMUs and single tree selection system for rural use in consideration to environmental concern that took place during 1990s. All activities related to forest management units such as harvesting of timber, extraction, disposal, and plantation of areas harvested are being carried out by Natural Resources Development Corporation Limited (NRDCL) under the super-

740.6

334.73

268.93

609.51

Name	Year	Area (sq. km)
Wangchuck Centennial Park	2008	4,914
Jigme Dorji National Park	1974	4,319
Royal Manas National Park	1966	1,057
Jigme Singye Wangchuck National Park	1995	1723
Phrumshingla National Park	1998	905.05
Bumdelling Wildlife Sanctuary	1994	1,520.61

vision of FRMD. To meet annual timber demand and manage the forests on a sustain-NRDCL able basis, also carries out thinning activities in collaboration with DOFPS. Timber is marketed as per Marketing and Pricing Policy of the Royal Government at the prices fixed by the Natural Resources Pricing Committee.

* The year of establishment is uncertain (Source: MOAF, 2010)

II) Forest Resources Management Division (FRMD) is mandated to sustainably manage the forests of Bhutan. This Division fulfills the basic goal of the forest policy of "meeting long term needs of the people for wood and other forest products by placing all the country's pro-

Table 2 shows an increase in the supply of annual timber quantity required. The increase is mainly due to growing infrastructure development activities being executed in the country. Moreover, with the increasing rural-urban migration there is a need for more housing demand

Table 2: Timber supplied by Natural Resources Development Corporation Limited

	C	Concession	nal	(Commerc	ial		Total	
Year	Qty sup- plied (1,000 cft)	Royalty paid to DOFPS (Nu. M)	Total sale value (Nu. M)	Qty sup- plied (1,000 cft)	Royalty paid to DOFPS (Nu. M)	Total sale value (Nu. M)	Qty sup- plied (1,000 cft)	Royalty paid to DOFPS (Nu. M)	Total sale value (Nu. M)
2008	153	0.122	12.256	1,560	20.16	173.278	1,712	20.282	185.543
2009	180	0.144	14.265	1,889	15.112	208.331	2,069	15.257	222.596
2010	248	0.198	20.386	1,751	20.201	245.297	1,999	20.4	265.683
2011	214	0.171	17.21	1,758	19.711	200.102	1,972	19.882	217.312
2012	185	0.148	21.316	1,989	26.146	272.958	2,174	26.294	294.273
2013	292	0.234	33.244	1,748	21.799	250.25	2,040	22.033	283.494
Source: Forest Information Database (FID. 2015)									

2003

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D, 2015)

especially in the cities and towns to accommodate rising population. No actual timber need assessment is being carried out for such urban development. Such activities if continued may have severe effect on the forest management. Therefore, proper planning is necessary to curb timber harvesting beyond the annual allowable cut (AAC).

III) Forest Protection and Enforcement Division was one of the earliest functional divisions established under the Department of Forests. It was created in 1991 and was entrusted with the challenge of protecting the nation's vast forests. Besides sustainable utilisation of forest resources and ensuring an effective system of monitoring, regulating and adequate allocation of forest resources in collaboration with other

relevant agencies like Territorial Divisions, Parks, and NRDCL are implemented. This division is also entrusted with the overall responsibilities of dealing with offences like illegal activities, forest fire cases, and allotment of government land for other purposes. Table 6 shows the number of offence cases receded for the past two years (2012/13-2013/14) (FID, 2015). Analysis showed that the number of offences has increased from 893 in 2012-2013 to 935 in 2013-2014 (an increase of 4.5%). Offences concerning timber transaction decreased by 34.2%, while collection of firewood remained the same. Other offences ranged from 1.7% (felling of trees) to 68% (smuggling of animal products). Poaching (62.9%) stands next to smuggling of animal products (Table 3).

Types of offences	2012—13		2013	—14	% Cases (+ or -)	
Transaction of timber	212	23.7	158	16.9	-34.2	
Felling of trees	228	25.5	232	24.8	1.7	
Collection of firewood	32	3.6	32	3.4	0	
Fishing	123	13.8	138	14.8	10.9	
Poaching	13	1.5	35	3.7	62.9	
Collection of sand/stones	119	13.3	138	14.8	13.8	
Smuggling of animal products	6	0.7	19	2	68.4	
Others	160	17.9	183	19.6	12.6	
Total cases	893	100	935	100	4.5	

 Table 3: Forest offence types and status

Source: Forest Information Database (FID, 2015)

Despite several forest legislations in place in protecting the forest from further depletion, there are challenges which directly or indirectly have negative impact on forest management. Firstly; conversion of forest to other land uses, mainly through infrastructure development like the hydropower has attributed to fast conversion of forest land to other purposes to support the economic growth of Bhutan. Land use changes such as forest land conversion to activities like the road constructions, power transmission lines, and horticulture plantation have decreased forest cover. However, in view of climate change, receding glaciers, and changing rainfall patterns are projected to affect the production of hydropower energy in the long run (NEC, 2011).

Secondly; Human-wildlife conflict is a major problem in rural Bhutan. Each year significant quantity of crops and a number of livestock are lost to wild animals. According to WCD (2015), during the year 2010 to 2014, 493 livestock were killed by wild animals. Even the Royal Bengal tiger (*Panthera tigris tigris* Linnaeus), which is a large predator, is found at an altitude of more than 4000 masl, a sign of shrinking or fragmented habitats and possible impact of climate change. This view highlights the need for promoting an effective policy and building capacity of key stakeholders in managing natural resources management in the face changing climate.

Thirdly; over grazing leads to loss of plant species, reduction of land productivity, and soil erosion causing forest degradation. However, over a period of time, population of free grazing cattle might have reduced since people opt for less number of improved varieties which give more milk production (Figure 2).



Figure 2: Percentage of improved and local cattle (WCD, 2015)

Fourth reason is attributed to excessive timber harvesting, which is a significant threat to forest biodiversity. It is reported that the annual consumption of timber at 190,000 m³ in recent years exceeded the total annual allowable cut of about 149, 000 m³ from all Forest Management Units (Wangchuk, 2013). The excess demand was met on ad hoc basis, which raises questions regarding sustainable forest management planning combined with occurrence of illegal exploitation of timber. Fuel wood consumption is estimated at 1.2 million m³ with the bulk of this met from natural forests (ibid.).

Lastly, forest fires in Bhutan are regular and widespread phenomenon, mostly caused by humans. Faulty power transmission lines, molten metal pieces dropping over dry grasses, are also suspected to set forest on fire. Otherwise, forest fires are either set deliberately to invigorate pasture growth or occur due to public carelessness. Significant changes in forest cover are already occurring in Bhutan; forest fire are now more frequent and intense due to accumulated fuel load, density of trees, and fire suppression (Gyamtsho, 2013). In the last 5 years more than 79,374 (Table 4) acres of forest was destroyed by forest fires occurring 181 times across the country (FID, 2015).

If these issues are not seriously viewed, it will further trigger the degradation of forest in addition to rise in temperature that will have negative impact of climate change in the forest management. However, it has been observed that in forests that are managed by communities, the number of fire occurrences have reduced. Therefore, involvement of communities in management of natural resources has an effect on changing climate.

IV) Watershed Management Division (WMD) is responsible in managing watersheds throughout the country. Managing watersheds in a holistic manner engages multiple actors; from that of private farmers through various government ministries, departments, and agencies to corporate entities. Although Bhutan has not used the watershed approach to pursue its development goals, activities of the Department of Forest and Park Services such as the community forest, private forest, afforestation, reforestation, enrichment plantations, and maintenance of parks and strict nature reserves have contributed towards maintaining healthy watersheds in Bhutan. For instance, parks, other protected areas and biological corridors together constitute 19,676.57 km² or 51.44% of the country's geographical area. On the other hand, unsustainable activities such as overgrazing of natural grazing land; depletion of natural resources such as trees and bamboos resulting in landslides triggered from construction of roads and irrigation channels are having a negative influence on the numerous watersheds in the country. Therefore, it is rational that a watershed approach would be more appropriate for carrying out developmental activities of Bhutan.

V) Nature Recreation and Ecotourism Divi-

Year	Incidences	Area burnt (acres)			
2010-2011	44	11,200			
2011-2012	39	10,904			
2012-2013	34	12,175			
2013-2014	64	45,095			
Total	181	79,374			
Source: Forest Information Database (FID 2015)					

 Table 4: Incidences of forest fire and area burnt between 2010-2014

sion is responsible for all nature recreational and ecotourism activities both within and outside the protected areas. The essence of establishing nature recreational areas is not only to provide venues for recreation but can also be centre for disseminating environmental education at various levels. Therefore, in this era of global warming and climate change, recreational activities could be one of the effective means to provide nature education to the visitors.

VI) Social Forestry Division is responsible for implementing community forest activities. In accordance with the decentralisation policy, this division looks social forestry activities, forest fire management, protection of *Tsamdrog* (grazing land) and *Sokshing* (leaf litter collection), encroachment, and allocation of dry fire wood. It gradually focused its role in technical backstopping Dzongkhag Forestry Sector for effective implementation of the decentralised activities.

Community Forest

The concept of CF was introduced in Bhutan following a Royal Decree in 1979 under the social forestry programme (Chhetri *et al.*, 2009). Although CF emerged in the international arena in the 1970s, it picked up in Bhutan only in the 1990s when the importance of peoples' participation in protection and manage -ment of forests was finally recognised (Wangchuk, 2010). The FNCA (RGOB, 1995) and FNCR (2006) provide the legal basis for the estab-lishment of CFs in Bhutan. These rules prescribe steps for the initiation, planning, implementation and review of a CF, and formation of community Forest Management Groups (CFMGs).

Despite initial hurdles, CF establishment increased rapidly in Bhutan since its initiation in 1996. As of now, the DOFPS under the Ministry of Agriculture and Forests (MOAF's) has approved and handed over 600 CFs to 25,663 households in managing an area of 66,934 hectares (SFD, 2010).

About 4% of Government Reserved Forest land (about 238,000 ha) has the potential to become CF in future (Temphel and Beukeboom, 2006), which will benefit the rural communities as well as help in mitigating climate change. Poor farmers are highly dependent on forest resources for their subsistence livelihoods. CF provides poor farmers with better access to forest resources and a more sustainable supply of forest products through decentralised and sustainable forest management (Phuntsho *et al.*, 2011). CFs are managed on the principle of sustainable forest management practice with harvesting of excess timber beyond household consumption for income generation and extraction of all other products for subsistence needs. Such initiation of community forest helps in expansion of forest cover over degraded land, which helps in mitigation of climate change through carbon sequestration in the wood biomass as well as poor farmers' access to their daily needs of forestry resources.

The concept of community forest management in the Southeast Asia (e.g. Bangladesh, India, and Nepal) came as a last option to reverse deforestation process. This is primarily because of the state government's view on commercial production and earning revenue excluding the right and participation of the local people on common pool resource excess. The inability of excess to forest resources led to widespread exploitation of forest resources. Forests have rapidly degraded under population pressure and increasing demand for forest products (Gautam *et al.*, 2004; Biswa and Choudhuri, 2007; Gopalakrishna, 2010).

Climate Change, Adaptation, and Mitigation Measures

Over the next 100 years, climate change is expected to have significant impacts on forest ecosystems (David and Robert, 2003). Forests, when sustainably managed, can have a central role in climate change mitigation and adaptation. Strengthening sustainable forest management practices will be an effective framework for forest based climate change mitigation and adaptation (FAO, 2010).

Forest acts as a carbon sink, sequestrating almost 80% of the above-ground and 40% of below-ground biomass carbon storage (Kirschbaum, 1996 as cited in Baral *et al.*, 2010). They play an important role in reducing significant levels of CO_2 by sequestering atmospheric Carbon into the vegetative biomass and by increasing the soil organic carbon (SOC) content (Brown and Pearce, 1994 as cited in Baral *et al.*, 2010).

In Bhutan, 69% of the rural communities practice agricultural farming and depends on natural resources for their livelihood and responses to climate change at the community levels are yet to be identified and institutionalised. According to Boon and Ahenkan, (2012), limited access to resources, lack of diversification options for subsistence livelihoods and lack of health and education are some of the factors limiting the capacity of developing countries to climate change adaptation. While preservation and conservation of environment has important position in Bhutan, some of the observed threats that climate change cause to bio-diversity in Bhutan are: loss of medicinal plants, change in species composition, change in structure and functioning of alpine meadows leading to habitat alteration and disappearance of ecologically and economically important species (MOAF, 2012). Further, damage to wetlands and freshwater ecosystems such as lakes, marshes and rivers, may increase. Climate change can also increase the risk of forest fires in Bhutan, thus resulting in reduction and degradation of forest resources (ibid.). Bhutan has come up with series of policies for conservation of forest and its environment. These policies are reviewed time and again to meet the concerns of the people as well as the overall conservation measures to face the challenges of climate change.

Although Bhutan do not have sufficient historical climate data, observation from 2000-2009 show maximum and minimum temperature are increasing. Future climate models indicate that annual mean temperatures will increase by 0.8°C to 1°C by 2039 and by 2°C to 2.4°C by 2069 (RGOB, 2011). Similarly, Annual precipitation is expected to increase by 10% by 2039 and 20% by 2069 (ibid.). These indicate that the climate is expected to get warmer with increase in precipitation which may lead to alternation of forest structure.

Extreme weather is already increasing, as can be observed from frequent flash floods and landslides caused by heavy rains, and damages done on properties and crops by wind storms (RGOB, 2011). In this context, sustainable forest management should include strategies to mitigate the impact of climate change.

Climate change and its impacts are pertinent development issues in developing countries. In the context of climate change mitigation in Bhutan, during the year 2009, it was declared that it would remain carbon neutral and has made the most ambitious pledge at COP15 of cutting down emissions which was reconfirmed during COP21. Bhutan is carbon neutral already because of its vast forest cover which sequesters carbon emission. To achieve this, the Royal Government of Bhutan has embedded its commitment to maintain its forest cover at 60% at all times to come in its Constitution.

Moreover, in the wake of climate change,

during the year 2015, Bhutan planted 49,672 trees in just one hour (Kuensel, 2015). Later in 2016, to celebrate the birth of a prince, 108,000 seedlings were planted across the country. Such initiatives will certainly help enhance more carbon sequestration.

Opportunities for Forest Conservation

Bhutan has increased its forest cover substantially in the last few decades. There are four main strategies, which are expected to contribute to forest conservation significantly in future.

Sustainable forest management (SFM)

Sustainable forest management supports integration of conservation and economic development. With rapid population increase, expanding agriculture and unsustainable timber harvesting will lead to decline in biodiversity. However, the maintenance of Bhutan's rich biodiversity and its growing economy is dependent on effective implementation of ecologically sensitive approaches to forest management that ensure sustainability of the goods and services. Bhutan's forests are rich in non-wood forest products (NWFPs) that are regularly collected by local rural population both for food and for generating income. There is also a growing demand for ecological-nature based products (e.g. essential oils or resins). Income from these products could be used to support conservation efforts through integrated conservation and development programmes, which directly or indirectly help in adaptation and mitigation of climate change through increasing diversity of plants in forests.

Payment for environmental services (PES)

The concept of payment for environmental services (PES) has emerged as a mechanism in which watershed conservation is financed by those who benefit from the environmental services it provides. The principle of PES is to compensate those who provide environmental services for protecting natural resources and those who receive environmental services should pay for the provision. Thus, principle of PES is to share the benefits and costs of conservation on an equitable basis among different beneficiaries to sustain the ecosystem. In Bhutan, there is potential for PES application in hydropower, logging, tourism, and urban water supplies. For instance, communities managing community forest at Yakpugang in eastern Bhutan earned Nu. 52,000.00 and Nu. 142,880.00 in the year 2013 and 2014 respectively from the PES scheme (WMD, 2015). Given the large area of forest under CFs, such PES initiative can be replicated to other parts as well. This kind of initiative will encourage people to actively engage in management of available resources as well regenerate the degraded areas thereby helping to mitigate the impact of climate change.

Carbon trading

Currently, Bhutan has 70.46% of land under forest cover and more than 50% declared as a protected area system. This is mainly attributed to the enabling policies and legislation for conservation and sustainable forest management. Therefore, the implementation of REDD+ has a huge potential to complement the effort of the Bhutan Government. REED+ can be linked with the market mechanism which allows developed countries and other agencies to fund the planning and implementation of REDD+ activities in the country (WCD, 2015).

These activities have economic benefit for Bhutan both nationally and regionally. On a national level protection forest is critical for the sustainable development of hydropower, which is the greatest revenue earner for Bhutan, and protection of communities and agricultural land from flood risk. At regional level, maintenance of Bhutan's watersheds with forest cover, which discharge flows into the Brahmaputra River, diminishes flood threats in India and Bangladesh. Therefore, management of forest in a sustainable manner is important as it plays a critical role in retaining and discharging the



Figure 3: Number of tourist arrival (TCB, 2015)

water flow.

Ecotourism

Bhutan's relatively undisturbed natural forest landscapes are major attractions to tourists. Tourism is the second largest GDP contributing sector in Bhutan. Ecotourism and communitybased ecotourism, based on foreign tourism markets in the country, can conserve forest besides contributing to community's sustainable livelihoods. Tourism policy and strategy review is underway to reflect and develop a holistic tourism development policy in Bhutan.

Conclusion

The extent of 70.46% forest cover in Bhutan is one of the examples of success of forest conservation. This is due to enabling policies and conducive environment in place. The first forest act and the policy of 1969 and 1974 respectively have laid foundation to forest conservation in Bhutan.

The forest conservation policies further strengthened the forest related management institutions at various levels (Local, Dzongkhag, and National). The well established institutions further empowered local level forest managers through social and economic incentives such as community forest. Bhutan government encourages local peoples' participation in managing forest resources through community forest. So far, 600 CFs are handed over to 25,663 households involved in managing an area of 66,934 hectares. Such practices in long run will help communities reap the benefit besides mitigating climate change.

It has been reported that warming in the

Himalayas is greater than the global average of 0.74° C over the last 100 years. Bhutanese people have lived with and survived through hazards such as flash floods, forest fire, and droughts for these years. However, the climate change may expose the lives of people as well as the environment at greater risk in future.

Sustainable forest management practices at the state and community forestry programme can contribute to the forest conservation. Payment for ecosystem services can also add to conservation. These activities reduce vulnerability to climate change by mainstreaming mitigation and adaptation options in forest policy, legislation and practices. Therefore, it is essential to revisit development policies, management and conservation practices. Need assessment for appropriate technologies and capacity building to adapt and strengthen the socio-ecological system in the face of climate change is extremely important

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