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1. Introduction

Himachal Pradesh is a mountainous state with two-thirds of its geographical area under forest and other natural ecosystems (DoEST, undated). More than 90% of the population in the state is rural, most of which is dependant on forests for at least part of their livelihoods (DoEST, 2012; DoEST, undated). Besides supporting the livelihoods of people in the State, forests protect catchment of important river systems such as Indus and Sutlej, hence providing hydrological services to millions of people downstream (HPFD, 2005). Besides, forests in the state regulate weather and rainfall across the entire region, hence influencing the economies of neighbouring states such as Haryana and Punjab (ibid).

State is rich in floral and faunal biodiversity. Its vegetation varies from dry scrub forests at lower altitudes to alpine pastures at higher altitudes (HPFD, undated). State is home to over 7% of the species out of the reported 45,000 floral species in the country, (ibid). More than 95% of the species are endemic to Himachal Pradesh. Similarly, there is a range of animal species including musk deer, ibex, snow leopard, Himalayan Tahr and western Tragopan.

The state has established a large network of protected areas including 2 national parks, 30 wildlife sanctuaries and 2 conservation reserves (ibid). It suggests that forests have a much large ecological significance beyond the state and should be conserved. But there are a range of issues affecting the quantity and quality of forests in the area. Open and scrub forests constitute over one-third of the forest cover in the state underlining the widespread degradation.

This paper aims to analyse some of the critical issues affecting forestry sector and suggest strategies to over come these in the state of Himachal Pradesh. The first section gives the state of forest resources. It details out the forest and tree cover, policy context, ownership and management pattern of forests in both the states. The second section elaborates the key issues afflicting forestry sector in the state. The third and final section provides the strategies to address the issues.

2. State of Forest Resources

2.1 Forest and Tree Cover

The state has recorded forest area of 66.52% but forest and tree cover constitutes only 27.63% of the total geographical area (FSI, 2013). It has been reported that only 30.5% of the recorded forest area can support vegetation, as rest of the area is uncultivable because of terrain and snow (HPFD, 2005). State has 14683 sq km of forest cover and 697 sq. km of tree cover constituting a total of 15380 sq. km of forest and tree cover (ibid).

Forests are distributed across four zones in the State- *viz* sub tropical forests, sub-temperate forests, wet-temperate and dry temperate forests (GoHP, 2002).

Sub tropical forests occur at an elevation up to 915 meters above mean sea level (msl) with annual rainfall between 700 to 1000 mm. These comprise of dry deciduous Sal, Chir Pine and other miscellaneous species (ibid).

Sub temperate forests are found at an elevation between 916 to 1523 MSL with an annual rainfall of 900 to 1200 mm. These include Oaks and various broad leaved species.

Wet temperate forests are found at an elevation ranging from 1524 to 2472 meters above msl with annual rainfall of 1000 to 2500 mm. The forest vegetation includes conifers, oaks, firs and rhododendron species.

Dry temperate forests are found above 2472 meters where mean annual temperature is around 10°C. Annual precipitation is about 2500 mm, most of which is received in form of snow. Species include willow, Robinia and Chilgoza (ibid).

Forests play an important role in social, cultural and economic life of the people in the state (DoEST undated). Approximately 90% of the population in the state live in rural areas, most of which depend on the forests for their livelihoods (ibid). Hence, a large forest area in the state has to be surveyed and legally settled.

Table 1 Legal status of forests in Himachal Pradesh

S.No	Category	Area (Mha)	% area
1	Reserve forests	0.19	5.13
2	Demarcated protected forests	1.18	31.97
3	Undemarcated protected forests	2.12	57.30
4	Unclassed forests	0.10	2.64
5	Other forests managed by FD	0.04	1.00
6	Forest areas not managed by FD	0.07	1.97
	Total forest area	3.70	100

Source: HPFD, 2010

Forests fall under three legal categories of reserve, protected and unclassed forests. The reserve forests offer minimum (at best) rights of use for local people. These are managed for environmental protection and biodiversity conservation. The protected areas such as national parks and wildlife sanctuaries come under this category of forests. The protected forests recognise many rights including timber, grazing and non-timber forest produce for local people. Almost 90% of the state forests fall under this category (Table1). 57% of the protected forest areas have not been demarcated i.e. their limits have not been set through legislative orders. The unclassed is a category of forest in transition i.e. after surveys and settlement of rights, these could be either shifted to reserve or protected forest category (Vasan, 2001). However, the Supreme Court order of 2001 restricted state governments to finalise such claims without its prior approval (Sridhar, 2015). Now, these claims and rights are to be settled under Forest Rights Act, 2006.

2.2 Change in Forest Density

Comparable data on forest density categories is available from 2005 to 2013 in India, hence this is the best period to study such change. In case of Himachal Pradesh, the area under very dense forest cover has been stable from 2005 to 2013. Area under the category of moderately dense forests has slightly declined during this period.

Table 2 Change in forest density classes in Himachal from 2005 to 2013

S.No	Category	Year				
		2005	**2007**	**2009**	**2011**	**2013**
1	Very Dense Forest	3224	3224	3224	3224	3224
2	Moderately Dense Forest	6386	6383	6383	6381	6381
3	Open Forest	5056	5061	5061	5074	5078
4	Scrub	331	327	327	328	298
	Total	14997	14995	14995	15007	14981

Source: FSI, 2007; FSI, 2009; FSI, 2011; FSI, 2013

The open and scrub forest area constitute 35% of the total forest cover. The open forest area has slightly increased whereas area under scrub vegetation has decreased for the period (table 2). Overall open and scrub forest area has slightly declined, which could be attributed to the plantations in the State (Fig 1).

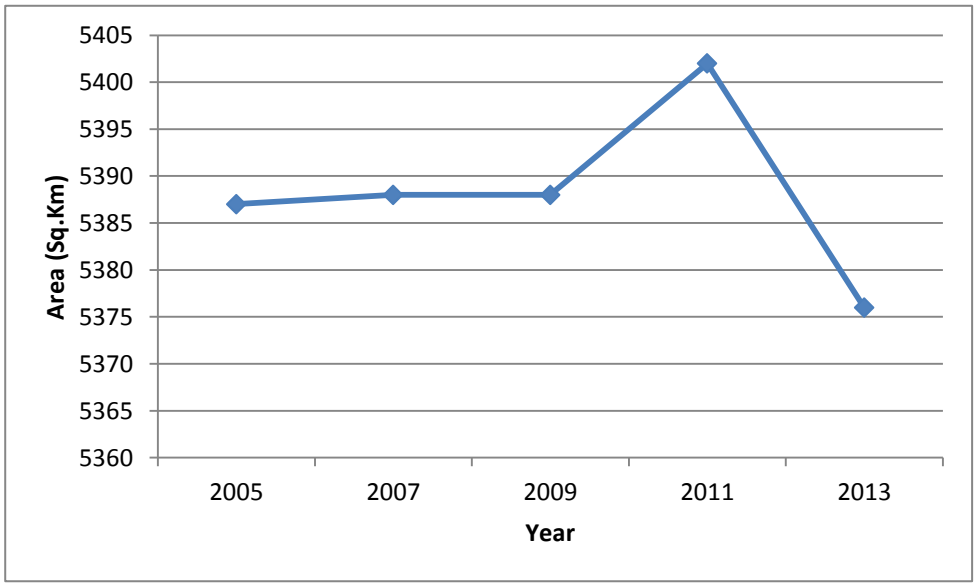

Figure 1 Change in open and scrub forest areas in Himachal from 2005 to 2013, Source: FSI, 2005, 2007, 2009, 2011, 2013)

3. Policy context- Himachal Pradesh

3.1 State Forest Policy, 1980

Himachal Pradesh is one of the few states in India to have a forest policy, which was adopted in 1980. The policy takes into account special role of forests in the livelihood of people and economy of the state. It envisages increasing forest cover in the state to 60% with a massive afforestation drive and through conservation efforts (HPFD, 2005). It constitutes an important part of land use policy in the state and issues guidelines for management of timber and non-timber produce from the forests. It aims to check grazing, encroachment and other forest offences and enhance forest cover and its quality in the state.

3.2 Participatory Forest Management (PFM) Rules 2000

After JFM order of 1993 in the state, Participatory Forest Management rules were framed in 2000 further streamlining and consolidating role of communities in the management of forests (Gouri *et al.,* 2004; HPFD, 2014). It entitles a Village Forest Development Society (VFDS), to manage the forests under the jurisdiction of a village ward. These rules allow 100% right to non-timber forest produce such as fallen twigs, branches, lopping, grass, fruits, flowers, seeds, leaf fodder cost and partial right to timber benefits. These rules also define the structure and responsibilities of VFDS.

3.3 Sanjhi Van Yojana, 2001

Sanjhi Van Yojana Scheme was started in 2001 after merging various schemes such as Sanjhi Van Yojna Scheme of 1998, the Parisharam Hamara Van Hamara Scheme, 2000 and the Apna Van, Apna Dhan Scheme (Gouri *et al.,* 2004; HPFD, 2014). The objective of the policy was to streamline participatory forest management efforts in the state. It envisaged a greater role of local institutions such as Village Forest Development Societies and *Gram Panchayats* in management of forest resources. It gave 100% income from plantations and usufruct rights to people through local institutions (ibid). It emphasised the involvement of women and other marginalised sections in management decisions.

3.4 H.P Forest Sector Policy and Strategy 2005

This policy takes into account changes in the social, economic and environmental context of the state and the country (HPFD, 2005). It promotes the concept of forestry as 'Sector', which includes various biophysical and environmental components such as land and biological resources in a comprehensive manner. It bases the management of forests on the principles of multiple stakeholders and multiple forest values, which could fulfil livelihood needs of local people and contribute to their welfare (ibid). It provides comprehensive guidelines for forestland use and planning, distribution of rights and concessions, grazing, timber distribution, non-timber forest produce and various ecosystem services.

One of the important features of this policy is that it recognises the geographical constraints of the state and posits that as envisaged in the national forest policy, 66% of the area under

state can not be brought under forest and tree cover. It argues that around twenty thousand sq. km of the area in the state is uncultivable as it falls in snow peaks, nullahs and barren land. Hence, only 35.5% of the geographical area, constituting of 30.5% of forest cover and 5% under tree cover can be brought under forest and tree cover (ibid)

3.5 State Strategy and Action Plan on Climate Change, 2012

This strategy and action plan aims to analyse climate vulnerabilities in the state especially related to sectors like agriculture, water, forests and biodiversity (DoEST, 2012). It collates the available information on the vulnerabilities and impacts carried out by various national and international studies and present a comprehensive strategy to mitigate these impacts.

3.6 Payment for Ecosystem Services (PES) policy 2013

This policy recognises the role of forests in providing various ecological services such as watershed management, climate regulation and biodiversity conservation. It aims to 'institutionalize Payments for Ecosystem Services and ecosystems approach as instruments of sustainable development' (HPFD, 2013:2).

3.7 Joint Forest Management

Joint Forest Management (JFM) was initiated in 1990 as a collaborative arrangement between Forest Department (FD) and local communities to regenerate and manage degraded forests. It has been reported that there are 1,18,213 JFM committees across 29 states managing 22.94 Mah of forest area, which constitutes 29.80% of recorded forest area of the country (FRI, 2011). These committees are receiving benefits in form of fuel wood, fodder and various other non-timber forest products (NTFP).

There is a long tradition of participatory forest management in Himachal Pradesh. Cooperative Forest Societies (CFS) envisaging the role of local people in the management of forest were constituted in district Kangra as early as in 1940 (DoEST, undated). There were other areas where sacred forests or Deo Van were being managed by the people. Based on these community traditions, various participatory programmes such as Indo German Dhauladhar Farm Forestry project and *Van Lagao Rozi Kamao* scheme were launched in the state prior to JFM (ibid). JFM was initiated in Himachal Pradesh in 1993. It was strengthened through Sanji Van Yojana or participatory forest management scheme in 1998. Various community institutions have been created under different projects and programmes such as Village Development Committees under Kandi project and Indo German Eco development project; Village Forest Development Committees under HP (HPFD, 2014).There are 1023 committees managing 205000 ha of forests constituting 11% of the forest area in the State (FRI, 2011). It has been estimated that JFM generates 2.7 lakh person days of annual employment in the state (ibid).

Though involvement of communities in the management of forest resources has been strengthened through JFM, but there are various issues related to legal back up, tenurial security, gender, equity, decision making powers, linkage with Panchayati Raj Institutions (PRIs), ownership of NTFPs, financial sustainability, and conflict resolution mechanisms

(FRI, 2011; MoEF and WII 2005). Some studies suggest a positive impact on vegetation, income and relationship of communities with Forest Department (Ravindranath and Sudha 2004). It has been reported, for instance, that there has been increase in wage employment, income, savings and agricultural productivity along with reduction in distress migration across many JFM villages (FRI, 2011; MoEF and WII 2005). But other studies raise issues related to effectiveness of JFM institutions (ibid). Financial sustainability of VFPCs is a major issue, after completion of various foreign funded projects. The current JFM model is also seen to be weighed in favour of state forest department; many communities see it as top-down regime, which imposes external rules and ignores traditional management institutions (ibid). These issues need to be addressed to strengthen role of communities in management of forests.

There is a range of national and state level policy and legal instruments, which guide the management of forests in the state. Many of the policy and legal instruments with in the forestry sector and across other sectors contradict each other creating policy confusion (see Gupta and Gulati, undated). One of the salient examples of these contradictions is different prescriptions of the ideal area under forest and tree cover. As argued earlier, the National Forest Policy of 1988 and State Forest Policy of 1980 have different visions for the area under forests in the state and recommends 66% and 50% of the area under the forest cover respectively (ibid). The H.P forest sector Policy and strategy of 2005 and State Environment Policy argue that both these expectations are unrealistic as large area of the state is permanently under snow cover or have conditions that does not support vegetation (DoEST undated).

Besides these policy contradictions, there are many other concerns, which plague the forestry sector in the state. This paper analyses on two of the most important issues *viz.* climate change and forest degradation afflicting the state forestry sector for the sake of focus and extensive discussion.

4. Issues

4.1 Climate Change

Climate change is likely to have significant and differential impacts on different forest types. Gopalakrishnan et al. (2011) studied the impacts of climate change on Indian forests through dynamic Regional Climate model and dynamic global vegetation models. This study suggests that 45% of forest grids in the country are vulnerable to impacts of climate change. The most vulnerable forest landscapes lie in upper Himalayas, central India, north Western Ghats and Eastern Ghats (ibid). Another study by Chaturvedi *et al.* (2010) suggests that 77% and 68% of forest grids across the country could witness changes in forest types due to change in climate.

Himachal Pradesh is likely to experience an increase in temperature by 3^{o}C by 2100 in a most probable scenario (DoEST, 2012). In context of the temperature rise, there are likely changes in precipitation pattern and shift in snow and vegetation lines. These climatic changes would have an impact on water resources, agriculture and livelihood of people in the state.

It has been reported that even under a moderate climate change scenario forests in 56% of the grids in the state are vulnerable to climate change (ibid). The forest types and species composition is likely to change as early as by 2030 in these areas. In the long term i.e. by 2080, more than 80% of the state forests are vulnerable to change. These changes might affect forest composition and productivity. In fact many of these changes have already been observed.

Many forest species are migrating to higher altitudes and some species even face extinction (Dubey et al., 2003; Rana et al., 2009). It has been reported that species such as *Pinus logifolia, Lilium polyphyclum* , *Aconitum heterophyllum* and *Woodfordia fructifose* have migrated to 400 to 500 m higher altitude in a span of 100 years (Rana et al., 2009). These climatic changes have resulted in shift of apple cultivation areas in the state affecting livelihood of local people.

High altitude species have become more vulnerable. It has been widely reported that *Pinus roxburghii* is invading the habitat of *Quercus leucotrichophora*. Other economic species such as *Cedrus deodar* and *Dalbergia sissoo* are declining sharply due to a mix of anthropogenic and climatic factors in the State (DoEST, 2012).

Besides these impacts, climate change is also likely to increase incidences of forest fire and pest attack due to increase in temperature affecting survival and growth of forest vegetation (DoEST, 2012). These could further aggravate issues related to forest based livelihoods and man-animal conflict (ibid).

4.2 Forest Degradation

The open and scrub forests constitute 35%of the forest cover of Himachal Pradesh which is largely degraded. Some of the key factors behind the forest degradation are demand and supply gap of forest products, shifting cultivation and forest fires, which have been discussed in detail.

4.3 Demand and supply gap in fuel wood, timber, and fodder

There is a substantial demand and supply gap in major forest products across India. This trend is reflected across most states including Himachal Pradesh. This leads to a vicious circle where the unsustainable exploitation of forests contributes to their degradation which in turn reduces the supply of products and services.

4.3.1 Fuel wood

India is world's biggest consumer of fuel wood with 40% of the population dependent on fuel wood for basic energy needs. It is estimated that 65% of the rural population and 22% of the urban population depends on fuel wood for cooking (NSSO 2001). Fuel wood collection and sale is a source of livelihood for 11% of the population, making it the single largest employer in the energy sector (World Bank 2006)

It has been reported that 93% of the population of Himachal Pradesh use fuel wood as a source of energy (Parikh, 2009). 94% of the fuel wood users in the state collect it from forests (ibid). As per official estimates, 46 MT of fuel wood was extracted from the forests in

Himachal Pradesh in 2008-09, which is an underestimate (HPFD, 2010). Actual fuelwood extraction is much higher and is harvested far beyond the sustainable levels of extraction (ibid).

Various studies underscore the relation between unsustainable extraction of fuel wood and degradation of forests (for example Bhattacharya and Joshi 2000; Heltberg et al. 2000). Unsustainable extraction is a consequence of both demand factors- increasing population, inefficient use of fuel wood, and lack of energy alternatives for poor households- and supply side issues, which include low productivity of forests (MoEF 2006).

4.3.2 Timber

Timber distribution is a big issue in the state. Around 95% of the rural families in the State have timber rights as per 1870 and 1920 forest settlements (Gouri et al., 2004). Each family is allowed to harvest assigned timber every 3 to 5 years for domestic purpose on a nominal price, which is generally 1000 times lower than market rate (ibid). It accounts for 0.1 million $m^3$of timber (Planning Commission, 2002). It has resulted in selective felling of commercially important species such as Deodar (*Cedrus deodar*) and Kail (*Pinus roxburghii*). In 1999-2000, more than 45% of the total wood extracted by the rights-holders was Deodar and about 25% Kail (*Pinus roxburghii*). Similarly, concessional rates are offered to saw mill industry for making the apple packing crates. These subsidies have created a timber mafia engaged with large scale illegal harvest and sale of timber in the State (ibid). 0.22 Mm^3 of timber was legally harvested from the forest in 2008-09, however, the actual harvest might be much higher because of illegal harvest (HPFD, 2011).

4.3.3 Fodder

There are 5.23 million cattle with highly inadequate pasture area in Himachal Pradesh (FSI 2011; DoEST undated-b). It makes more than 90% of the forest area in the state open for grazing, which arguably has put pressure on its quality (DoEST undated). But there are conflicting views in the state policies on grazing and its impacts (Gupta and Gulati undated). The forest and environment policies posit that grazing especially by goats is a major threat to the forests and accordingly prescribe their reduction over time, whereas the grazing policy advocates for '*no compulsory decrease in any species not even the no. of goats*' (Gupta and Gulati undated: 8). Similarly, there are contrasting views on nomadic grazing and its impacts on forests (Saberwal 1996; DoEST undated). Every now and then, the issue is politicised but without much change. Gouri *et al* (2004: ii), term it as '*an old political hot potato (which is) regularly re-heated*'.

4.4 Encroachments

It is a complex issue which has legal, rights and livelihood dimensions. As per the government estimates, 1.34 m ha of forest area is encroached in the country (ibid). State governments have failed to act on the directives and guidelines issued by the central government and Supreme Court to avoid any adverse political response which has led to further encroachments (MoEF 2006).

In Himachal Pradesh the official data for 2011-12 reports 1560 ha of encroachments on forest land (HPFD, 2012). The encroachments are most prevalent in Shimla, Dharmashala and Kullu forest circles (ibid). The encroached land has been diverted mainly for agriculture or horticulture purposes. Apple orchards have been established in Shimla and Kullu forest circles (Bhat, 2004). In Dharmshala, some of land has been used by Tibetan refugees for settlement (ibid). This issue is complex as it interrelated to the issue of forest rights being currently addressed through Forest Rights Act, 2006. As encroachments are spread in small patches, these affect not only the land use of the affected area but also impact the continuity of a large patch of forest ecosystem.

4.5 Forest fires

Fires affect 3.73 million ha of forests area annually in the country causing loss to forest products and services (Bahuguna and Upadhyay, 2002). Most of these fires are man-made, created to facilitate the extraction of NTFPs, ensure a good yield of grass, or to clear forests for shifting cultivation. In some parts of the country, fires are set up for socio cultural and religious purposes as well. The traditional system of fire control through fire lines has serious limitations.

The forest fire data for Himachal presented in table 3 indicates an increasing trend of the number of forest fire incidents and resulting loss. Though latest data for forest fires in the state is not available however, the table indicates that more than 10000 ha of forest area is affected due to forest fires in the state (DoEST, undated). Most of the forest fires are man-made either due to negligence or intention. Chil (*Pinus roxburghii*) forests are prone to forest fires during summer months while fires are very common in the high Blue Pine (*Pinus wallichiana*) forests during November and early December when winter rains are delayed (ibid).

It results in the loss of valuable timber and biodiversity. Although it is very difficult to understand the total damage to forest ecosystem but most common impacts are drying of saplings and trees, stunting of growth and burning of soil organic matter. Forest fires also expose soil to erosion (Planning Commission undated; DoEST, undated). Biodiversity is severely affected both above and below ground level. Controlled burning, clearance and maintenance of fire lines are some of the common control measures.

Table 3 Incidence of forest fires and resulting loss in Himachal from 2000-2004

Year	Area (ha)	No. of Incidents	Loss (million INR)
2000-01	5719	301	4.67
2001-02	4204	282	4.02
2002-03	9896	550	7.43
2003-04	12865	769	8.64

Source: DoEST, undated

Forest fires result loss of biodiversity and affect the productivity of the entire ecosystem. Very often, fires created in small patches spread into large areas. The traditional system of fire control through fire lines has serious limitations.

5. Way forward

The discussion clearly points to a number of policy and implementation challenges in the forestry sector in Himachal Pradesh. Based on the above analysis, we suggest strategies to address issues of forest degradation, climate change, rights and livelihoods of local people. Gap in the demand and supply of forest products is one of the major reasons of forest degradation not just in HP but also across most parts of the country. Two types of strategies addressing demand and supply of these products have been suggested. Similarly, strategies to address other drivers of degradation such as forest fires, encroachments, weed infestation have been elaborated. Finally, strategies to adapt to climate change have been presented.

5.1 Supply side management of forest products

5.1.1 Development of improved planting material

The productivity of planting material can potentially be increased manifold by using superior planting stock raised through tree breeding programmes, as well as through clonal technology and tissue culture. For instance, annual productivity of a seed-raised eucalyptus plantation is presently only 6 to10 m^3 per ha, which can be increased up to 40 to 50 m^3 per ha with the introduction of genetically improved plants as illustrated by initiatives of ITC (Kulkarni, undated).

Unfortunately, tree improvement programmes have not received sufficient attention and funding. With the promulgation of the National Forest Policy (1988), the priority of forest management shifted from production forestry to conservation forestry. Consequently, research activities on silvicultural and development of improved planting material took a back seat. Limited availability of funds, and lack of coordination, efficiency and accountability among forestry research institutions are some of the other issues which plague forestry research in the country. Private sector companies are popularising advanced forestry techniques such as Green houses, mist chambers and root trainers. These efforts could be scaled up if Forest Departments from the state could identify private companies, research organisations and NGO and collaborate with them.

5.1.2 Plantation of degraded forest areas and wastelands

Himachal has 35% of its forest cover under open and scrub categories, which are largely degraded. It reflects national trend, where more than 40% of the total forest cover is under these two categories. It has been suggested that half of the degraded areas have good root stock and hence can be regenerated through assisted natural regeneration with the help of JFM committees (MoEF 2006). Areas without adequate rootstock can be brought under multipurpose tree plantations under a tri-partite partnership between the state forest department, JFM committees and wood based industries as discussed below. Himachal Pradesh aims to increase its area under forest and tree cover from 26.52% to 35.5% (HPFD, 2005). Based on geographical and climatic conditions, mixed plantations of locally useful species such *Oak, Deodar, Kharsu, Kail, Walnut* can be undertaken. Similarly, in cold desert conditions at high altitudes sea buckthorn could be planted.

One of the main hurdles in rehabilitation of degraded lands is inadequate and delayed release of funds. This hurdle can be overcome by promoting a tripartite partnership between the private sector, local community and the State Forest Department. In this model the forest department acts as a facilitator who provides land on joint lease to the JFMCs and wood based industries for a fixed period. The continuation of the lease is subject to adherence to a pre-approved technical scheme. The industry invests money to raise plantations and the harvest is shared between the JFMCs and industry according to predefined JFM guidelines. The JFMC is responsible for day to day management and social fencing of the area. However, in order to meet the subsistence needs of the local communities, the industry also invests in a separate forest patch where trees of importance to the local communities are planted.

Presently, however, there are no enabling laws or policies to facilitate private sector participation in forestry activities. It is recommended that a policy directive from the central government be issued enabling private sector involvement of the type suggested above, followed by resolutions and guidelines by individual state governments. The guidelines should also clearly spell out the roles and responsibilities of the three stakeholders and the benefit sharing mechanisms.

5.1.3 Promotion of agroforestry/farm forestry

Agroforestry involves the raising of trees along farm boundaries, as intercrop and as pure block plantations. This practice offers the potential to increase productivity up to 50 cum/ha/year (Kulkarni, undated). In case of Himachal Pradesh, agroforestry area can be increased from 1.25% to 5% of the geographical area. Tree cover constitutes only 1.25% of the geographical area in Himachal Pradesh, which predominantly accounts for horticulture and agroforestry plantations. Agroforestry in Himachal Pradesh accounts for 15.81 million cu.m of growing stock fulfilling people's fuel wood and small timber needs. The area can be increased to 5% by plantations of fuel wood, fodder, NTFP and small timber species such as *Kikar , Bamboo, Aonla and Eucalyptus* .

Agro forestry practices can be made ecologically and economically beneficial to the farmers through developing various plantation models and promoting research on improving productivity of the farm forestry tree species. It would require extension work to educate farmers, removing legal barriers (like felling and transit restrictions), and encouraging industries to intensify their linkages with farmers. Availability of microfinance is another important factor that can go a long way in promoting agroforestry. The role of financial institutions like such as NABARD (National Bank for Agriculture and Rural Development) is important in this context.

There is need to increase inputs in planning, implementation and monitoring on farm land plantation and seedling distribution component. Genetically improved clonal plants of *Poplar, Eucalyptus* and *Drek* etc., should be supplied by the Department at reasonable rates. Forest department should strengthen Farm Forestry extension services. Package of practices for important species printed in local languages should be supplied to tree growers. Sufficient resources should be allocated for the success of the efforts.

5.1.4 Integrated management of different types of land for meeting fodder needs

Plantation and management of forest, wastelands and agriculture lands can increase the supply of fodder. At the same time, the supply of fodder from agricultural crops needs to be increased by promoting the cultivation of leguminous fodder crops with cereals and the cultivation of grasses like elephant and napier in agricultural wastelands and pasturelands (Singh 2008).

Similarly, there are large areas of common pastureland, which can be used for cultivation of fodder trees and grasses in Himachal Pradesh.

5.2 Demand side management of forest products

Alternatives to forest products need to be explored and promoted to reduce the pressure on forests. An increase in the use of LPG from 6% to 10% in rural areas close to townships can save about 1.22 MT of fuel wood every year without additional costs on infrastructure at national level. This is especially relevant for the hilly state like Himachal Pradesh. It has been argued that if LPG and Kerosene supply were increased by 10%, 20% or 30% the corresponding annual reduction in fuel wood consumption would be 220, 440 and 661 thousand tones respectively (GoHP, 2002). The promotion of clean fuels will not only reduce pressure on forests but will provide health related benefits as well.

Similarly improved efficiency in the use of forest products through incentives for efficient technologies and a rationalized subsidy regime on forest based raw material can ease the pressure on forests. An important example here relates to improved cook stoves (ICs)- there is an estimated potential of 85 million ICs in the country, each of which is expected to save about 400 kg of fuel wood per household per year. Even if half of this potential is met, 17 MT of fuel wood can be saved each year. To make the IC programme more successful than in the past, it is necessary to make it more market driven and need-based.

Likewise, efficiency in the use of fodder can be enhanced through a number of technological and management options like chopping, grinding, wetting and soaking of fodder and enrichment of crop residues with urea and adding mineral supplements to dry fodder. This will not only result in efficient use of available fodder but also improve its nutritional value (Roy and Singh 2008).

5.3 Strengthening JFM

Overall, JFM has proved to be an effective strategy to involve people in regeneration and management of forests though the concerns associated with the programme as discussed above need to be addressed. In particular, there is need for ensuring financial sustainability and devolution of more management and decision making power to the communities, along with greater involvement and integration with the *Panchayats.* FPCs should be linked to other natural resource management and livelihood schemes such as watershed development, National Rural employment Guarantee scheme (NREGA) and other rural development programmes being implemented through *panchayats.* . Forest Rights Act , 2006

provides a good framework to manage community forest resources with the help of *gram sabha* and link it to other developmental schemes.

Women and other marginalized sections of the community need to be empowered so that they can participate in JFM. These groups can be organised and trained as small Self Help Groups (SHGs). These SHGs should be linked to schemes like the *Swaran Jyanati Gram Swarojagar Yojana* (SGSRY) run through local block development departments to initiate new enterprises. JFM micro plans should be comprehensive development documents which dovetail and synergise efforts with various schemes and linked with the working plans of FD. Similarly livelihoods of FPC members need to be strengthened through various farm and non farm based enterprises possibly in collaboration with private sector. This issue has been dealt in detail below.

5.4 Strengthening livelihoods of forest dependent communities

The misclassification of diverse kinds of cultivated as well as community lands as state forest land has resulted in loss of habitat and livelihoods of forest-dependent communities especially in Himachal Pradesh. This must be remedied to the extent possible by implementing the Forest Rights Act 2006 in earnest and by adherence to Constitutional provisions for Schedule V areas including PESA (the *Panchayat* Extension to Scheduled Areas Act, 1996), which provides special powers to the *gram sabha* in Schedule V areas to safeguard and preserve the traditions and customs of the people, their cultural identity, community resources.

Apart from clarifying tenurial rights, it is necessary that efforts be targeted at organizing the collectors of NTFPs, building their skills and linking them to markets. Forest departments with the help of other departments such as social welfare or tribal development should undertake to organise collectors at the village, tehsil and division levels. Other government agencies, research organizations and NGOs can be involved in building the capacities of communities in sustainable harvest and trade. Forest departments should also facilitate linkages between forest-based communities and private companies which depend on forest produce such as paper and ply board, pharmaceuticals and timber products. This would call for enabling legislation for participation of private companies not only in procurement of raw material directly from the communities but also for investment in the resource. The forest department can act as facilitator and collect revenue in form of tax.

States like Madhya Pradesh, Chhattisgarh and Andhra Pradesh have done some progressive work in this direction. In Madhya Pradesh local collectors' cooperatives have been federated at state level. These experiences can be useful for Himachal Pradesh.

5.4.1 Promoting forestry enterprises

There are several bottlenecks for forestry enterprises in India. These include government control over profitable forest produce, constraining regulations, lack of credit availability, poor technologies and low value addition. Requirement of transit permits and felling regulations for nationalized species discourages private enterprise. Forest-based communities should be trained as processing and value addition entrepreneurs.

Himachal forestry sector has enormous scope for establishing and promoting forestry enterprises. There are various NTFPs *viz.* seeds from horse chestnuts, Deodar and *Kail* cones; resins from *Pine* spp; Katha from *Acacia catechu*; wild fruits like *Berberis* and herbs like *Dhoop, Patish and Dioscorea*. Medicinal plants based enterprises have huge untapped potential in the State. State's current annual trade of 1 million INR in medicinal plants is minuscule compared to world trade of US 1.03 billion considering the facts that state has more than 800 species with medicinal use (HPFD, 2006). Many plants are being illegally exploited from the wild endangering their survival. Cultivation of medicinal plants is limited to only a few species such as *Kuth, Pushkarmool, and Taxus*. Hence a two pronged strategy needs to be adopted with the conservation of wild gene pool and promoting agro techniques of cultivable medicinal plants (ibid).

Horticulture constitutes one of the main businesses of the state with apple as its main fruit crop. It is estimated that state supplies 200 million kg apple in India and abroad (Gouri et al., 2004). Due to climatic variations, the yield of apple crops is declining hence diversification of fruit crops such as pear, plum and citrus fruits can be useful. State has good potential of sericulture as well (ibid).

Medicinal and herbal plants can be promoted through in situ propagation and conservation practices especially in the Shiwaliks.

5.4.2 Alternative livelihoods

New opportunities such as ecotourism, carbon revenues and payment for ecosystem services should be studied for the benefit of local communities. Similarly alternative livelihoods options need to be created by dovetailing forestry activities with other development interventions.

It has been estimated that ecotourism and other ecological values from JFM areas alone could yield $ 1.7 billion by 2020 in India (World Bank 2006). It could be well above $ 6 billion for all forest areas of the country. Ecotourism has been exploited at a limited scale but has the potential to become a major driver of local economies. The ecotourism programme should be up scaled gradually by identifying hotspots, creating infrastructure and facilities with the help of the private sector, and building the capacity of local communities.

Himachal has enormous potential for ecotourism due to its scenic beauty and variety of recreational activities available. It has many ecotourism hot spots with potential for diverse activities such as *Lahaul Spiti* for its culture and landscape, *Tirthan* valley for trekking and angling, Pong dam for bird watching etc. State has taken some initiatives to promote ecotourism. Ecotourism policy of 2005 envisages making Himachal 'a leading Ecotourism Destination in the Country by 2010' (HPFD, 2005). Despite these efforts, there is still lack of awareness and infrastructure for realising the full potential in both the states. A public-private initiate can fulfil this gap by bringing in investments for development of infrastructure and facilities.

Similarly, there is potential for generation of carbon revenues from forests ecosystems. Though methodologies under Clean Development Mechanism (CDM) of Kyoto protocol are

complicated as far as the forestry sector is concerned, there is a window of opportunity in voluntary markets such as Chicago Climate Exchange (CCX). Communities can earn revenues for new plantations and sustainable management of forests. Similarly, another mechanism - Reducing Emissions from Deforestation and Degradation (REDD+) – being discussed presently could bring substantial revenues to the communities in the near future.

5.5 Addressing other drivers of forest degradation

Other major drivers of forest degradation *viz.* forest fires, encroachments and weeds need to be addressed through use of scientific tools and involvement and capacity building of communities and local institutions.

Forest Survey of India is monitoring forest fires through MODIS satellite system, which has been jointly developed by NASA and University of Maryland. A web based fire reporting system has also been initiated for the public (Satendra and Kaushik, 2012). However, these efforts need to be up scaled and strengthened for effective fire management at the local level. Fire Management rules of 1999 need to be revised in context of new technological advancements. Field staff at range and division levels needs to be fully trained and equipped with communication and fire fighting equipment. JFM committees and *Panchayats* need to be involved in information collection and communication on fires. Traditional methods of creating fires lines need to be integrated and strengthened with the modern techniques. Firewatchers can be employed insensitive areas during summer months.

Encroachments can be addressed by quickly identifying the legitimate rights and subsequently vacating illegal occupations with the help of local institutions. In Himachal, around 71% of the forest land area has not been surveyed and entered into revenue records (IIED and HPFD 2000). As mentioned earlier, this is a common issue across all land categories but more so in the forest category. It means that in practice for large areas it is difficult to tell which category land fall into, and accordingly which department has the jurisdiction. It often leads to conflict between the state revenue department and forest department, the biggest landholders (ibid). The rights of people over the forests are still based on the settlement process carried out during colonial times between 1855 and 1934 and have not been rationalised ever since (Vasan 2001; Chhatre 2003). It has resulted in mismanagement and use of rights. One of the most important of these rights is related to grazing, which have become contentious and political in nature over the years (Gouri et al. 2004). Many of these unsettled rights over ownership, management and use of the forestlands can be recognised under The Forest Rights Act of 2006 (FRA), which was enforced in the year 2008 across the country.

Weeds such as *lantana camara* in Shiwalik hills region spread across the state can be addressed through biological and mechanical methods. Collaboration with research institutions such as Himachal Forestry Research Institute is key to such efforts. Small scale experiments of using weeds in compost have been undertaken. These needs to be further field-tested and up scaled.

5.6 Adaptation to climate change

It is clear from the available research that climate change is affecting ecosystems and vegetation in the state. Vegetation in Himachal Pradesh especially in upper altitudes is more vulnerable because of its sensitivity to higher temperatures. Though more research needs to be understand the impacts of climate change on ecosystems through the use of dynamic vegetation models, which require developing a robust database on forest vegetation characteristics, plant functional types, physiological parameters, soil and water, however 'no regret' adaptation strategies should be implemented based on the 'precautionary principle' approach. (Ravindranath et al 2006).

Some of the adaptation measures could be:

- Maintaining health and hygiene of the forest ecosystems to reduce vulnerability to pests and diseases. Undertaking prophylactic measures is important in this context.
- Developing efficient fire detection and management system is another very important measure. The state forest departments need to work very closely with NRSA (National Remote Sensing Agency) for operationalising this. Ensuring sanitation measures to prevent incidence of fire is also very crucial.
- Reducing fragmentation of forest areas and developing forest corridors.
- Discouraging monoculture and promoting mixed species plantations.
- Promotion of ex-situ and in situ conservation of germplasm.
- These measures need to be built into the working plan prescriptions of state forest departments. At the same time, the capacities of forest department to understand the vulnerability of forest ecosystems to climate change need to be enhanced.

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