Commons in Jeopardy
Longitudinal Evidence on People-Forest Interactions in A Fragile Tract of the Western Himalayas

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ABSTRACT[1]

Based on a decadal socio-ecological re-study of eleven villages, this paper traces the drivers of change and local environmental outcomes of contemporary rural development in fragile mountainous tracts of the Western Himalayas. The inter-temporal research endeavor, based on intensive field studies, revealed that there was a phenomenal increase in economic well-being across the wide geographical expanse of the study area. However, the environmental costs of socio-economic transformation appeared to have risen. Preference for lucrative farm based market oriented livelihood alternatives have triggered inclination towards "village-centric" existence resulting in high population growth. As livelihood systems continue to depend heavily on forest resources, the emerging trends have accentuated local anthropogenic pressure on forest commons resulting in its degraded status. Such mounting biomass extractive pressures implied that the local ecological footprint on montane forests is an issue of serious concern in the present context. All in all, inability of the community or State to upscale recruitment in forests, reckless construction of roads and dams together projected a dismal picture of the transforming landscape. An ardent plea for making sustainable development a reality is therefore envisioned through innovative intervention by mobilizing collective-action.

Key words: Western Himalayas, rural development, local ecological footprint, forest degradation, sustainable development

1. Introduction:

The Himalayas are believed to be one of the youngest mountains of the world. Geological insights indicate that the crustal movement of the Indian subcontinent against Central Asia formed the Himalayas, 47 million years ago (Mathews et al. 2015). These tectonic dynamics have not ceased altogether which is why some geologists confer that the Himalayas are still growing, causing

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severe earthquakes and mostly minor ones in and around the north of India. The 2500-kilometer long Himalayan arc is marked by dramatic elevation changes, varied weather conditions and precipitation rates resulting in distinct natural environmental enclaves hosting diverse as well as endemic biota that are quite sensitive to stress and disturbance (Zurick et al. 1999). In the mid-elevation belt of the Western Himalayas, between 1800 and 3000 meters where the ecosystem is extremely interconnected and fragile, these features assume extreme dimensions.

Despite these harsh topographical realities, meteorological extremes and periodic seismic shocks, these mid-mountain ranges have hosted a variety of human habitations, over centuries (Fisher, 1985 and Dang 1998). Insights on the agro-pastoral livelihood systems of these far flung highland communities indicate that they were truly *'ecosystem users'* and forests played a crucial role for catering to their survival exigencies (Gadgil et al. 1995 and Singh 1998). Leaf litter swept from the understory for generating organic manure, fodder for cattle, firewood for domestic energy, timber for construction and a host of medicinal herbs was entirely tapped from common forests in the surrounding vicinity. In order to cope with the environmental extremities, meagre resources and acute shortage of labour necessary to overcome the hardships of the sloped mountain terrain, the traditional hill peasantry essentially resorted to *´adaptionist mechanisms'* exhibiting great ingenuity in harnessing unruly elements in their natural environment while conceiving risk averting diversified livelihood strategies for sustenance amid a restrictive, low yielding and unpredictable environmental domain (Guillet 1983). Relative isolation, self-sustaining economies and small demographic sizes of these settlements ensured that the regenerative capacity of the village forest commons far exceeded the subsistence requirements of the population (Das 2000a and Jodha 2006).

Just as the tectonic movements of the Himalayan crust has not ceased entirely, in the more contemporary context, these once semi-isolated mid-elevation landscapes of the Western Himalayas have been witnessing a phase of considerable change as these human habitations are progressively integrated with the 'outside' world particularly due to improvements in road connectivity. Environmental critics have unanimously expressed concerns that the rate and intensity of recent changes due to mounting human pressures on the fragile ecosystem may raise dire consequences for the sustainability of the mountains as natural areas and as places for human life (Dang 1998, Zurick et al. 1999 and Gardner et al. 2013).

In order to confirm and validate some of these untoward socio-ecological ramifications of transformation and change in the more recent era, the present study seeks to gather *ground-truthing* evidence on people-forest interface through a decadal field study in the mid-elevation belt of the Western Indian Himalayas in the State of Himachal Pradesh. The longitudinal study

over two time periods was facilitated by the existence of baseline data as an outcome of the researcher's own field engagements in the area, a decade ago. The following section outlines important characteristics of the study area and the research methodology adopted for unearthing relevant trends and inferences. Section 3 highlights important findings emerging from the study as regards changing livelihood circumstances and its consequences for the forest resource base. Concluding remarks and some innovative policy prescriptions are articulated in the final section of the paper.

2. Study Area Characteristics & Research Methodology.

The study area encompasses representative tracts of Banjar and Ani Forest Divisions[2]. A mountain spur originating from *Shrikhand Mahadev* passing through *Bashleo* and *Jalori Pass*, separates the two divisions into distinct zones thereby providing scope for comparative analysis of socio-ecological parameters under investigation. The undulating mountain landscape is marked by a scattered cluster of villages in close proximity to essentially temperate coniferous forests of 'deodhar' *(Cedrus deodara,)* 'kail' *(Pinus wallichiana)* and 'spruce' *(Picea smithiana),* which account for nearly 85% of the stand density in the study area. These forests continue to play a crucial role in the agro-pastoral livelihood systems of the local community. Ever since the era of formal forest governance under the colonial British regime, locals have been granted customary rights to extract fodder, firewood, leaf-litter, and timber as well as non-timber forest produce such as medicinal herbs from forests in the village surrounds.

The base line study, conducted during 2000, encompassed a representative sample of eleven villages, carefully selected through a joint stratification procedure that captured variation in altitude, demographic characteristics and the degree of remoteness. In keeping with the objectives of the inter-temporal research study, these rural habitations, located between 1900 and 2500 meters, were re-visited in 2011. The inter-temporal study entailed a re-evaluation of household characteristics and forest resource dependence by collecting data on replicated questionnaires administered to the sample of 220 households in 2001. All the forest sites in the vicinity of the villages, surveyed a decade ago, were reassessed using the same tools of forestry science adopted for the base line study for evaluating the condition of the forest stock. In all, 439 representative circular plots of $100mt^2$ each were laid across 57 local forest stands. In addition to the household and forest surveys, village level ethnographic studies were conducted for procuring insights on the more qualitative dimensions of the process of

[2] The Ani (Outer Seraj) Forest Division lies between latitude 31^0-39'-32" N & 31^0-20'-40" N and longitudes 77^0-41'-22" E & 77^0-23'-12" E. The Banjar (Seraj) Forest Division lies between latitude 31^0-30'-32" N & 31^0-50'-0" N and longitudes 77^0-10'-0" E & 77^0-27'-30" E.

transformation and change that the structured quantitative surveys could not capture. These studies were based on key informant open-ended interviews and participant observation techniques.

3. Findings Emerging from the Decadal Study:

3.1 *The Trajectory of Rural Development:*

Village revisits in 2011 exhibited a strange-mix of continuity and rapid change all across the study area. Although regional narratives of a transforming mountain belt portrayed diverse scenario governed by local specificities, the expansion of the road network appeared to be an all-pervasive and significant driver of change. In a region where seasonal transhumance paths and some ancient trade-routes traversed on foot were the principal corridors of movement for a very long time, accessibility developments of this nature has radically impacted the living conditions of local communities and the overall landscape in a myriad of ways. Motor roads in the Himalayas are essentially a post-planning phenomenon of the fifties. Most of the major road arteries in the region owe their origins to national security requirements following the Chinese aggression in 1962. Meant to defend territorial claims in the event of insurgencies or invasion from neighboring countries, this strategic measure has fueled unintended yet far-reaching socio-economic consequences for the local community all along the route and even further away, integrating the region with the *'outside world'* (Sarkar, 2010). However, in the more recent era, village link roads connecting major highways and road arteries have also come up through fund disbursals enabled by a centrally sponsored scheme of the Ministry of Rural Development known as the *PMGSY*. The objective of the program is to promote rural development through better road access.

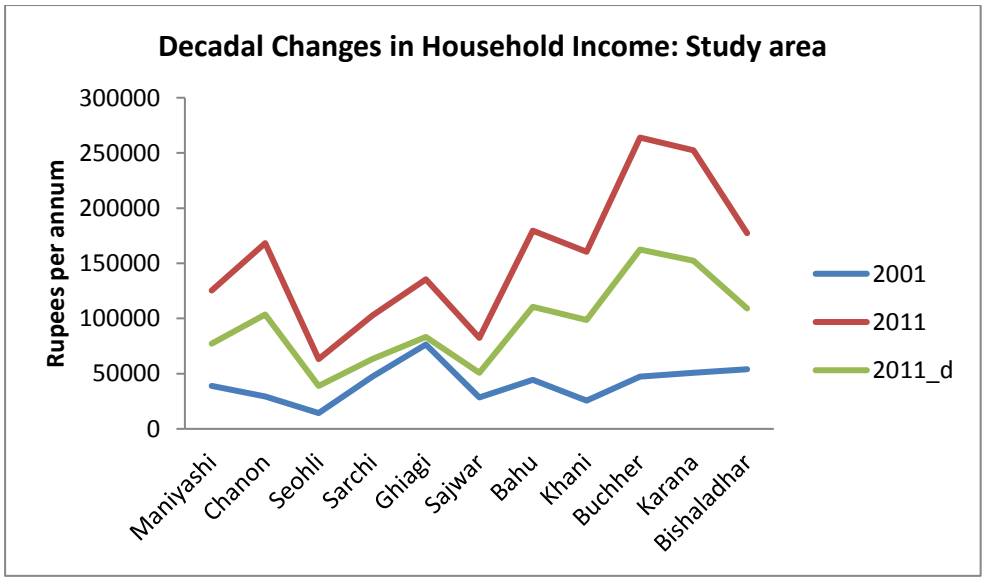
All along the study area, the impetus provided by better accessibility has enhanced the pace of transition towards cash crop cultivation. These trends observed a decade ago in the year 2000, have gathered considerable momentum in the present context. The favorable temperate climate, adequate landholding, individual entrepreneurial drive and initiative has fostered the nurturing of temperate fruits such as apples and off-season vegetables. Tilt towards market oriented crop production in place of subsistence crops has become a lucrative venture as the 'niche' produce tends to fetch a very high price in wholesale centers in the plains.

Table 1: Decadal Change in Household Socio-Economic Characteristics

2000-01								
	HOUSEHOLD-SIZE	CONSUMPTION EXPENDITURE		LAND	CULTIVABLE LAND	LIVESTOCK		
		Monthly	Annual		(cash-crops)	Cows	All-big	Goat & Sheep
Division	(Nos.)	(per-capita)	(per-household)	(hectares)	%	(Nos.)	(Nos.)	(Nos.)
BANJAR	6	480	37214	0.78	24.12	2	3	6
ANI	6	732	49098	0.62	44.73	2	3	1
2011-12								
	HOUSEHOLD-SIZE	CONSUMPTION EXPENDITURE		LAND	CULTIVABLE LAND	LIVESTOCK		
Division		Monthly	Annual		(cash-crops)	Cows	All-big	Goat & Sheep
	(Nos.)	(per-capita)	(per-household)	(hectares)	%	(Nos.)	(Nos.)	(Nos.)
BANJAR	7	866	67888	0.67	56.87	2	3	7
ANI	6	1201	85455	0.6	84.65	2	3	1
Source: Household surveys : 2000-01 & 2011-12								

This is adequately reflected though analysis of quantitative socio-economic data gathered in course of the inter-temporal household surveys. The magnitude and nature of these transitions across the two divisions are summarized in table 1 above. What is most striking from these data trends is the phenomenal increase in cultivable land under cash crop cultivation. For instance, at the household level, the mean percentage cultivable area under cash crops has increased from 31% to 67% during the last decade. In the present scenario, 76% of the cultivable land under cash crops is accounted for by apple orchards.

Figure 2 Inter-village Variations in Decadal Income Trends in the Study area (Banjar & Ani)



***Note: '2011_d' in the above figure refers to the current household income figures for 2011, deflated by the Himachal Pradesh agricultural labor wage index, to account for inflation.*

Concomitant to these changes, the economic condition of the local population has improved dramatically and poverty is a non-issue in these areas. Local narratives of change consistently pointed towards the important role of improved road access and cash crops in transforming the

economic façade of this region. Based on household surveys these emerging trends are depicted in figure 2 above.

The figure reveals that between 2000 and 2011 the increase in household income is quite consistent across all case study villages. Even the deflated 2011 inter-village income levels that was computed to assess 'real-income' changes shows a fairly remarkable augmentation in economic position in most cases. A cursory glance at table 2 below, indicates that these changes are attributable to greater reliance on farm based sources of income. The share of non-farm based sources of income, such as casual employment has declined in both the divisions. Because a larger fraction of the households find it more lucrative to focus on tapping horticulture and livestock rearing for economic returns, the need to rely on non-farm avenues of employment for supplementing income has started declining. This is particularly significant in the case of Ani as the locals rely much more heavily on sale of apple as well as milk for income generation, as compared to the last decade. The villages in Banjar division appear to be following the same trend.

Table 2: Decadal Change in Sources of Income

2000-01								
Division	**MEAN HOUSEHOLD INCOME**							
	Total	Farm	Non-Farm	Forest	Apple	Milk	% Farm	% Farm
	(Rs.)	(%)	(%)	(%)	(Rs.)	(Rs.)	(Apple)	(Milk)
BANJAR	39,934	28	54	18	8022	523	74%	5%
ANI	44,373	35	59	7	13,607	856	83%	5%
2011-12								
Division	**MEAN HOUSEHOLD INCOME**							
	Total	Farm	Non-Farm	Forest	Apple	Milk	% Farm	% Farm
	(Rs.)	(%)	(%)	(%)	(Rs.)	(Rs.)	(Apple)	(Milk)
BANJAR	1,22,578	45	49	5	43,716	1581	75%	3%
ANI	2,12,244	71	28	1	1,01,117	33322	67%	22%
Source: Household surveys: 2000-01 & 2011-12								

These trends are fairly distinct in comparison to other marginalized rural belts of India where the economic condition of the local population based primarily on agriculture is declining due to poor economic returns. Therefore, the share of farm based income is on the decline and there is a progressive tilt towards non-farm avenues of employment and even migration to cities (Jodhka 2016).

Preference for village-centric existence due to potential gains from cash crop cultivation and the resulting nature of 'village introverted patterns of economic growth' (Epstein et al. 2002) has led to a 13% increase in village population in the region between 2001 and 2011. The

evidence of out-migration was meagre. The surveys indicated that only 0.12% of the population in the study area had left the villages for employment elsewhere.

This nature and pace of rural development and the resultant demographic outcomes has inadvertently enhanced anthropogenic pressures on forests because a larger quantum of biomass needs to be extracted to cater to firewood for domestic energy, fodder for cattle, timber for house construction and leaf-litter for generating organic manure which is crucial for raising productivity levels of orchards and other cash crops. In addition, the lure for 'cash' has triggered land use change through encroachments into forests for expanding orchards in many areas as well as excessive and unsustainable extraction of a host of non-timber forest produce such as high value medicinal herbs with dire consequences for biodiversity. Therefore, as livelihood linked activities continue to be heavily dependent on forest resources, the pressure on local forests has increased in consonance with rising demographic pressures and greater prospects for commercialization in the farm sector. These trends are outlined in the following section.

3.2 Impact of Rural Development on Local Forests:

The field surveys indicated that the rapid market-oriented pace of rural development accompanied by rising demographic pressures has created new exigencies for forests in the surrounding vicinity. This is because productivity in agriculture and animal husbandry continues to be intricately linked to the use of forest resources such as leaf-litter for manure and fodder for cattle. Further, due to non-availability of perfect substitutes, reliance on firewood for domestic energy and timber for dwelling construction persists. Due to improved market access and quest for 'cash', non-timber forest products, such as morel mushrooms, lichen, Himalayan yew and a host of medicinal herbs, are over extracted as these resources now fetch a high value in urban whole sale centers. Experts have reiterated that excessive biotic pressures are detrimental to the vegetation structure of forests and overall functioning of the ecosystem it nurtures (Singh 2002).

The decadal data base consistently indicated rising extractive pressures all across the study area. For instance, leaf-litter collection levels have doubled over the decade. As observed in 2001, productivity in agriculture and horticulture is still heavily dependent on forest resources such as *leaf-litter* for manure. In course of field interactions, locals appeared to be convinced about the efficacy of organic manure over chemical fertilizers for sustaining and raising yield levels in orchards. They affirmed that because of the rising importance of cash crop cultivation there is a greater compulsion to extract a large quantum of this resource from forests as compared to a decade ago. Excessive levels of leaf-litter removal can deprive the forest soil of essential nutrients such as carbon and nitrogen necessary for overall health of the forest. Besides leaf-litter creates very favorable habitat for a host of living organisms in the forest (Wohlleben, 2016). Through field studies, forestry science experts have confirmed that while some litter removal

is congenial for light penetration, removal of large quantum of this resource could thwart seed germination and seedling establishment adversely affecting forest regeneration and therefore sustainability of the forest stock in general (Shrestha 2003).

Because of non-availability of "appropriate" substitutes and easy resource access, *firewood* extracted from the forests continues to be the main source of domestic energy for cooking and heating in the study area. In 2001, 95% of the households had reported that firewood was the primary source of cooking in summer. Further, firewood was found to be the primary source of cooking and heating for all households in winter. The scenario seemed to be unchanged as per the surveys conducted in 2011. As per household surveys, an average size household of six members needs to collect a whopping six to seven tons of firewood to cater to its annual energy requirements. With mounting demographic pressures, the quantum of firewood collection at the village level was estimated to be 1943 tons per annum, in 2011.

What seems paradoxical is that heavy reliance on firewood continues despite increase in the number of LPG owners. In 2001, only 10% of the households owned LPG cylinders. With rising levels of economic prosperity, 56% of the households had acquired LPG connections in 2011. Field investigations pursued across the wide geographical expanse of the study area in order to throw light on this anomalous trend revealed that the high price of LPG and an additional carriage cost make this alternate source of energy an expensive resource for the local community. Therefore, they tend to restrict LPG use to emergency situations when there are unforeseen time constraints and wood fired stoves may take long to ignite.

In the forests, there was corroborative evidence of very high levels of lopping on account of near total dependence on firewood. Even young pole stage trees and saplings were subjected to pressures on account of firewood extraction. Experts have reiterated that frequent and such high levels of lopping can result in the rapid drain of stored reserves leading to reduction in tree girth and production of leafy biomass and regeneration in general because loss of photosynthetic surface impairs the ability to coppice (Singh 2002 and Shrestha 2003). As per their field inferences, trees do have inbuilt mechanisms for withstanding such lopping pressures for some time. But beyond a certain level, resilience to such shocks declines drastically affecting the metabolic processes and potential regeneration possibilities due to lowered cone production, thereby threatening the overall sustainability of the forest stock (Saxena and Singh 1984, Bhat et al. 1995, Wohlleben 2016)

In 2001, only 8% of the households were relying on stall feeding their cows while in 2011, 40% of the households preferred stall-feeding across all seasons. Stall-feeding facilitates greater generation of organic manure which is an important reason supportive of these trends. In some villages, due to excessive encroachment pressures in village commons and forests, potential

grazing zones are now far away and the locals prefer to stall-feed their cattle due to time or labor resource constraints. Therefore, as indicated above, although livestock strength has not changed much, some grazing pressures must have declined due to increase in the incidence of stall-feeding. Due to mounting stall-feeding exigencies about six tons of grass-fodder and two tons of leaf fodder are extracted by a household from forests. But 60% of the households continue to graze their bovine livestock in the forests. Ocular evidence gathered in course of forest transects indicated fairly high levels of grazing in the forest. Grazing accompanied by browsing and trampling of seedlings are considered to be important causes behind failed regeneration in forests (Thadani 1995 and Sapkota et al. 2009) Trampling also leads to excessive soil compaction that deters moisture infiltration adversely affecting the recruitment of seedlings and saplings.

The local community appeared to be non-committal about their *timber* extraction activities in course of the structured household surveys due to curbs on timber felling in the after math of the Forest Conservation Act (1980). Therefore, it was difficult to arrive at village level timber pressures and insights on timber use had to be gathered through informal open ended interviews. It appeared that an important outcome of rising economic well-being was the desire for better living conditions reflected in a perceivable increase in the construction of new dwelling units in the village or renovation of older ones. In many instances, it was found that a household in fact aspires to have multiple homesteads, one to substitute an inherited unit that is in a dilapidated condition, another close to the road head for facilitating seasonal transportation of cash crops and yet another at higher altitudinal elevations for keeping vigilance and managing orchards. Traditional construction techniques based on timber and dry stone masonry was mostly observed to be adopted for erecting these structures, even in the contemporary context. Local interactions invariably revealed that this indigenous technique was climate sensitive as well as resistant to seismic shocks and was therefore preferred to modern systems of construction based on brick, cement and reinforced cement concrete. Though timber content has declined over the years due to non-availability of good quality timber and prohibitions imposed by the State, the resource is surreptitiously acquired from forests. An average size unit requires about 15-20 trees for completion as per their responses. Deodhar (*Cedrus deodara*) is the most preferred species for timber but spruce (*Picea smithiana*) and fir *(Abies pindrow)* are also used for construction. 'Kail' *(Pinus wallichiana)* is usually used for door and window panes.

Although clear felling in large tracts was not observed in the forests in course of the field surveys, there was ample evidence of selective felling of mature and pole stage trees all across the study area forests reflecting local timber pressures which persist to cater to dwelling construction needs of an economically buoyant local community. Decadal comparison of the size-class distribution of trees in the forest, based on field data gathered over the two time periods adequately corroborated narratives of timber extraction documented through local interactions as highlighted in the next section. The analysis revealed that mature trees particularly in the DBH classes between 50-65 centimeters, considered to be most suitable for construction, had declined drastically over the decade.

In this region, locals seasonally extract *non timber forest produce* such as lichen, morel mushrooms and a host of medicinal-herbs for sale. In the past, when these villages were somewhat remote, extraction was mainly for self-consumption. A small fraction was periodically sold. But these were mostly in the nature of distress sales fetching meagre returns for the extractor. Improved market access in the more recent era has resulted in assuring a higher value for the extracted produce. Integration with the "outside" world manifested through better dissemination of information has also increased the diversity of medicinal-herbs extracted for the market. The "small-volume high-value" nature of the resource commensurate with the time and effort needed to collect the same is an incentive enough to extract as much possible for quick but significant lucrative gains. Locals were found to be quite articulate while sharing these facts in course of informal interviews but hesitant to disclose these specificities in course of the structured household surveys due to fear of scrutiny by the State that imposes a permit for exporting the resource outside the local area. The respondents revealed that 90% of the households irrespective of economic status and even age found it profitable to engage in medicinal herb collection earning as much as 50-60,000 rupees per annum. It was quite evident that these processes have led to excessive and unsustainable methods of resource extraction raising grave biodiversity concerns besides hampering the ecosystem in multifarious ways. Many of these extracted herbs are rare and the only source of survival for alpine fauna such as the blue sheep and the Himalayan bear during the lean season in these high altitude belts (Dang 1998).

The overtly rising significance of horticulture has also subjected the forests to *encroachment* pressures. Though quantitative estimates of encroachment were hard to come by through the

household surveys, due to fear of prosecution, informal local accounts indicated that as much as 20% to even 60% of a household's landholding may have been expanded by encroaching into forests. Decline in the size of landholding due to property division across male heirs coupled with the incentive to reap benefits from expanding cash crop cultivation is an important reason for encroachments. Further, the locals also narrated that because of climate change and warmer temperatures, which was becoming apparent over the years they preferred to expand orchards in higher elevation zones as a security against the risk of declining apple crop productivity in the existing lower areas. As the village morphology is invariably characterized by forests in the higher altitudinal belt and homesteads surrounded by fields on the slopes below, these processes have made the forests increasingly susceptible to threats of encroachment.

At the regional level, the growth of the *road network* has no doubt been an important factor promoting the expansion of economic opportunities. However, the environmental costs of road expansion have not always been benign. Well established patches of slope stabilizing vegetation in the vicinity of villages has been lost to pave the way for circuitous road alignments. Due to the rising commercial significance of cash crop cultivation, locals are usually unwilling to part with their own landholding for an upcoming link road. In the face of such dissent which can make a local political leader unpopular, alignments through forests are invariably proposed as the last resort to overcome obstacles to the coming up of a road. Therefore, the economic significance and potential advantages of gaining political patronage invariably take precedence over the environmental consequences of the loss of forest cover and threats to natural vegetation due to debris disposal. A review of the link roads that have come up in the vicinity of the case study villages, over the last ten years indicates that mature forests have been damaged in most cases.

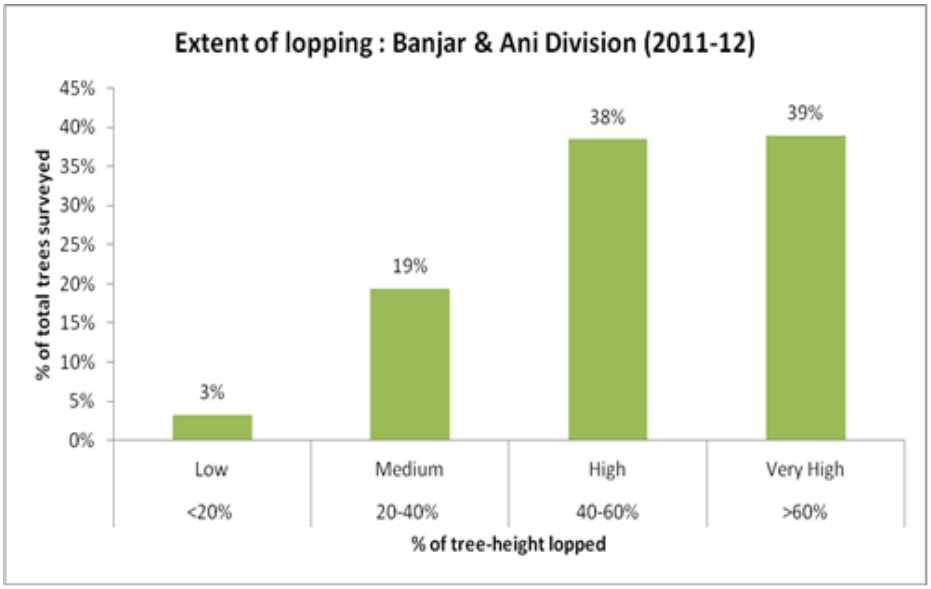
Unprecedented increase in economic wellbeing, over the last decade, has triggered demand for urban goods and services as well as supportive infrastructure necessary to cater to cash crop cultivation and trade. At the regional level, this has led to the growth of unplanned *quasi-urban settlements* that cater to a multiplicity of functions serving as a core retail center, a transport hub, an administrative as well as institutional locus, all together in one location.

Physical expansion of such areas is also prompted by emerging potentials for tapping rental income. The haphazard growth of such agglomerations, in the midst of essentially forested rural confines, devoid of regulatory mechanisms such as building bylaws or urban design guidelines has led to uncontrolled and vertical expansion of concrete structures, inadequate drainage and sewer lines. This nature of settlement growth threatens the surrounding environment by blocking natural water channels besides endangering prime tracts of forest vegetation on sloped terrain.

3.3 The Debilitating Status of Local Forests:

The above trends highlight that the rapid pace of rural development attributable to the progressive transformation towards a market oriented economy, as well as rising demographic pressures, over the last decade, have created untoward exigencies as regards the forests in the surrounding vicinity. Sustained resource extraction for firewood, grazing and leaf-litter accumulation, selective felling of trees for timber, unsustainable and excessive extraction of non-timber forest produce and a receding forest boundary on account of encroachment pressures undoubtedly imposes a threat to the condition of the local forest resource base and the ecosystem it nurtures. Experts have asserted that such chronic disturbances are less recognized but can be quite detrimental to the vegetation structure of the forests and their future sustainability.

Figure 2 High levels of lopping in the study area



The inter-temporal assessment of the forest stock in the surrounding vicinity reflected these adverse trends. Though there was some improvement in tree density over the decade, the standing forest stock appeared to be badly lopped. Evidence of very high levels of *lopping*, observed in these forests, is supportive of near total dependence on firewood for domestic energy requirements which was recorded through the household surveys. Lopping of tender branches for cattle bedding and manure, during monsoon months, was also visible in the study area. The frequency distribution of lopping levels based on forest surveys is presented in figure 2 above. The histogram reveals that 77% of trees encountered in the survey plots, all across the entire geographical expanse of the study area, had high to very high levels of lopping.

The status of natural regeneration is an important factor for deciphering the long-term sustainability of a forest. As per conventional tools of forestry science, an assessment of natural regeneration is arrived at by reviewing the size class distribution of seedlings, saplings and trees in the forests. Typically an inverse 'j-shaped' curve that shows very high proportion of seedlings and saplings in relation to trees is considered to represent a healthy regenerating forest tree population (Singh et al 1997, Duchok et al. 2005 and Shahbuddin et al 2006). Any other kind of distribution is not indicative of a stable population and there are threats to sustainability. The regeneration status of forests over the two time periods based on data collected through forest surveys can be deduced from figure 3 and 4 below for each of the divisions. As per the trends depicted in these figures, the current status of regeneration is poor. For both divisions, the actual population structure of forests deviates radically from the ideal scenario depicted by the dotted reverse 'j' shaped curve that characterizes successful regeneration. The number of seedlings and saplings per hectare is meager and insufficient to sustain the current forest stock. Decadal comparison presents an equally dismal picture. On the whole, seedling and sapling counts have actually declined over the two time periods. Protracted biotic disturbances, and the resultant harsh physical environment seems to be inhibiting natural regeneration. High levels of lopping may be thwarting potential cone production. Livestock continue to graze in the vicinity of forests making these zones susceptible to damage on account of browsing or trampling of young recruits. Their hoofs tend to compact the soil, posing obstacles to moisture permeability. Excessive litter removal for catering to expanding local manure needs necessary for raising productivity levels in orchards

and that of other cash crops may be draining the soil of valuable nutrients such as carbon & nitrogen that emanates from decomposed leaf-litter.

Figure 3 Regeneration Status in Banjar Division

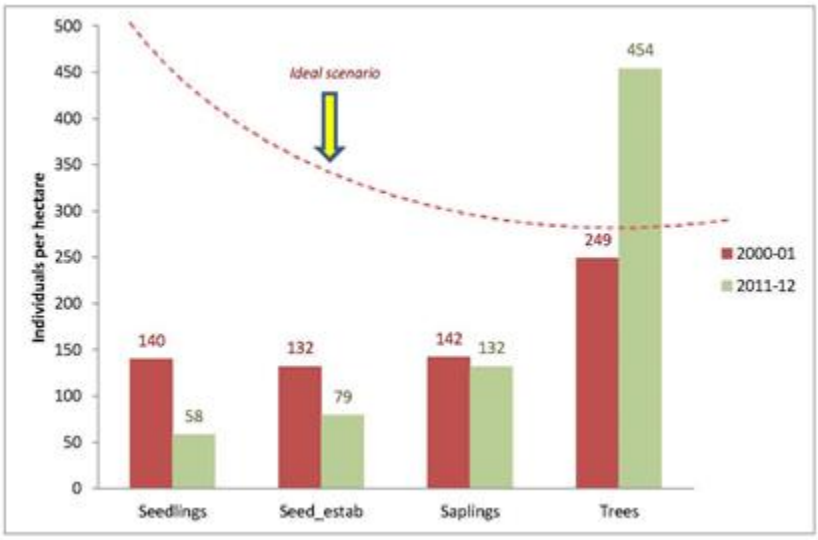
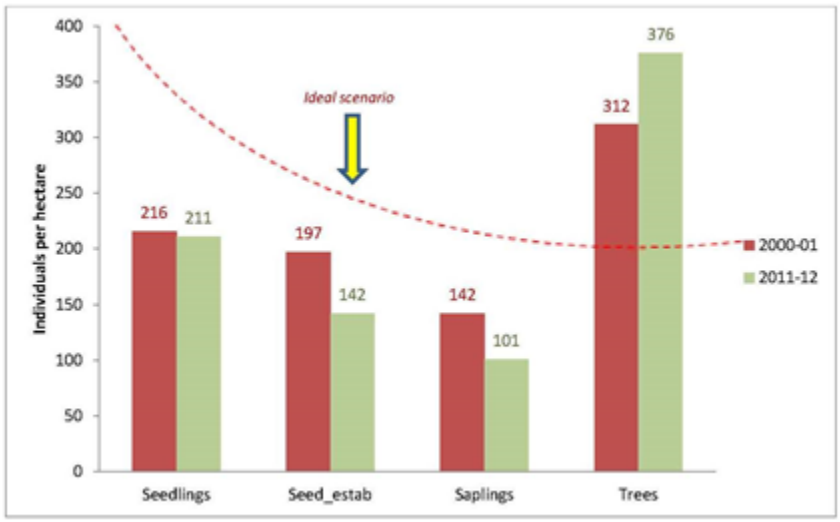


Figure 4 Regeneration status in Ani Division



Climate change characterized by decline in snowfall and rainfall, as per oral history accounts, could also be jeopardizing natural regeneration. Experts have indicated that inadequate regeneration has become a general phenomenon in Indian forests because of grazing, firewood

collection, timber extraction, fire and expansion of cultivation into forest areas (Shankar 2009) Poor status of natural regeneration observed in the study area, reinforces these national level trends.

4. Concluding Remarks & Policy Recommendations:

4.1 Introduction

This research endeavor establishes that, in the more contemporary context, degradation of forests is an outcome of changing socio-economic processes. Forests have always been closely linked to livelihood needs of the local community, since traditional times. In the past, subsistence oriented agriculture and animal husbandry as well as low population levels were not unsustainable for the natural resource base. However increased market access resulting in progressive tilt towards commercial farm base livelihood systems coupled with demographic pressures, especially over the last few decades, has enhanced the level of anthropogenic pressure on forests. People's narratives as well as findings from the household and forest surveys were found to be mutually reinforcing and converged on to a paradoxical trend. While there has been an all-pervasive and overwhelming increase in economic wellbeing of the local population, the nature and pace of rural development has been detrimental to the forests.

The degrading status of forests characterized by excessive lopping and poor regeneration mainly due to mounting biomass extractive pressures implied that the local ecological footprint on montane forests is an issue of serious concern in the present context. The chronic extractive pressures on account of booming local economies has reached insurmountable proportions resulting in forest degradation and threats to the fragile mountain ecosystem. It can be implicitly inferred that the regenerative capacity of these village forest commons may be thwarted unable to cope with to such extractive pressures raising long-term sustainability issues. The environmental impacts of local resource extraction activities are somewhat neglected and overlooked by both authorities and conservationists probably because these activities constitute a cryptic and chronic disturbances thought to be of less concern in the face of other major causes of biodiversity loss such as deforestation due to land use shifts (Das 2000b, Specht et al. 2015 and Singh et al. 2015).

There is cause for concern because these forests are crucial not only for catering to livelihood needs but also aid in local environmental protection in these ecologically fragile areas. For instance, forests provide a host of ecosystem services such as watershed stabilization, soil protection, water flow regulation thereby ensuring security against adversities such as floods and landslides (Hamilton, 1992, Singh 2002 and Wohlleben 2016). The degrading forests which would have otherwise mitigated vulnerability to natural hazards, accentuate threats to the local environment in terms of enhanced surface erosion, greater susceptibility to shallow landslips and more flooding caused by frequent but low intensity short duration storms. Forests also sequester carbon mitigating the undesirable effects of global warming. Besides, these high-altitude forests harbor an interconnected ecosystem consisting of plant, animal, insect and soil microbes such as fungi that display a symbiotic relationship necessary for the overall sustainability of the forest ecosystem (Wohlleben 2016). Their survival is also endangered due to high levels of anthropogenic disturbances. This nature of forest and environmental degradation, which afflicts sizeable belts of mountain upland areas in the developing countries, is often not recognized or even ignored because of the perceived higher benefits of economic gains (Beniston 2000). Therefore, forest management regimes are currently not geared to respond to the growing economic aspirations of the local people and increasing population pressure (Sen et al. 2002)

These findings emerging from the study clearly point towards the inability of the local community or State to upscale recruitment in forests. The scientific intricacies of a fragile interconnected ecosystem is not always common knowledge for the local community whose resource use regimes have transformed to changing livelihood imperatives for better living that reign supreme in their aspirations and perceptions of day to day existence. Reconciling rural development and livelihood concerns at the local level along with the need to sustain forests is the greatest challenge in the present context. This vision of development is often thwarted because the role of the State as the custodian of forest resources is at cross purposes with the State's pervasive role in promoting economic prosperity of the rural masses. The State needs to embark on more environmentally sustainable paths of rural development by initiating an amalgamation of measures that promotes environmental conservation and careful resource use so as to nurture a 'dual environment-economic system nexus' which is mutually sustainable and can survive for a long time. While formulating such policies, judicious trade-offs may need to be made to minimize conflicts

embedded in trajectories designed to achieve economic growth without thwarting environmental objectives. Section 4.2 outlines new directions that could be pursued towards this end.

4.2 Guidelines for Sustaining the Forest Resource Base

- Reducing dependence on forest resource oriented livelihood options:

The existing forest resource intensive farm-based livelihood systems need to be reassessed so as to reduce threats from agriculture and livestock rearing to the forest ecosystem. Of prime consideration is the need for initiating alternate forms of soil fertility management mechanisms so that excessive extraction of leaf-litter and lopping of conifer branches for manure can be progressively arrested. It has already been asserted that leaf-litter is an important source of fertilizer for the forests. More recent research indicates that above ground leaf-litter layer also plays an important role in sequestering carbon and therefore needs to be managed and protected for tempering the undesirable effects of green-house gas emissions. Grazing in forests also needs to be managed (Beedlow et al. 2004). Unregulated grazing, as observed in most forests, is a threat to regeneration and establishment of young recruits that hampers sustainability of the forest stock.

Besides ensuring that farming systems are less conducive to forest ecosystem damage, there could be more emphasis on the introduction of niche local *agro-processing* ventures that ensures greater value for agricultural produce and inhibits the extensive nature of the present cash crop cultivation scenario, making forests susceptible to encroachment pressures. These agro-processing units can be collectively managed and eco-certified for sustainable use of natural resources so that better returns ensue when the produce is marketed. Above all, new forms of employment opportunities need to be locally generated so that there is a progressive shift from farm based to *non-farm based avenues of employment* in the village. This can be promoted through appropriate vocational training programs necessary to impart requisite skills to budding youth who tend to drop out after school and with no other avenues available to them, tend to rely on the family's existing farm based sources of income threatening forests in the vicinity.

- Promoting technological innovations targeted at forest resource conservation:

There is an ardent need to explore alternate sources of energy for reducing excessive reliance on firewood. Subsidized LPG, which is itself based on non-renewable sources of energy and a drain

on the State ex chequer, may not be the best feasible alternative. However, unhindered and *better supply of electricity* can certainly be an effective alternative for catering to energy needs particularly in winter when dependence on firewood extracted from forests tends to peak. As domestic energy requirements are quite substantial in these high altitude areas, besides tapping the State grid, the supply of electricity can be locally augmented by setting up small-scale *environmentally sustainable hydro-electric projects* in suitable locations. Once installed, these hydro-electric projects can be managed by the local community. The scope for *solar energy* as a viable option has yet to make a relatively aggressive dent in the energy scenario of rural areas or even the State policy making arena of Himachal Pradesh. In this regard, more scientific studies are needed to exploit an untapped and relatively benign resource. These technological innovations may take time to materialize. In the interim period, efforts need to be invested in designing and disseminating *firewood conserving 'chulas'* or stoves for reducing firewood collection levels. In course of field studies it was evident that over time, locals have indigenously designed smokeless *'chulas'* in order to overcome discomfort associated with indoor air pollution. However, there was no evidence of any attempts on their part to devise firewood conserving *'chulas'*. The pressure cooker is an illustrative example of an 'appropriate' energy conserving technology for the mountains. The cooking device was found to be widely adopted all across the entire geographical expanse of the study area and also across different social factions of the rural masses.

In similar vein, evolving alternate building construction technology that conserves timber use is crucial to prevent damage to the existing forests amidst a scenario where economic prosperity has resulted in growing demand for dwelling construction. Besides conserving on the use of timber, design specifications should ensure resistance to seismic shocks and adequate responsiveness to extreme climatic conditions that characterize these regions. For all kinds of technological innovations that are proposed cost-effectiveness should be an important consideration so as to ensure wider adoption of the new technology or building materials across all socio-economic factions of the local community.

- Ensuring sustainable means of transportation:

Environmental considerations need to be given top priority while constructing rural link roads. Road alignments should be planned only after taking due cognizance of geomorphologic constraints so as to cause minimum threats to natural drainage channels and slope stabilizing forest

vegetation. As alternatives to circuitous road alignments that have caused high levels of damage to forests, the efficacy of high capacity spans for goods transportation can be explored. Once installed, these spans can be managed collectively by the local population. In many villages, locals have overcome road accessibility obstacles by setting up these goods transport pulleys that work on gravity. This indigenous technology which has come up through local private initiative can be improvised and made more effective as an alternate means of goods transports that is less damaging to the environment.

- Ensuring sustainable design of emerging local urban settlements:

The mushrooming of urban settlements in the region is a new phenomenon. Haphazard growth of these new towns and built environment therein, poses threats to the surrounding ecosystem. As of now, there are no building bylaws for such habitations because these do not always meet the conventional demographic criteria to be classified as 'urban', even though they are urban in character in terms of land use and functionality. This is an appropriate time to initiate planning and design guidelines for these agglomerations so that growth is proposed after due considerations to environmental constraints such as natural water and waste disposal channels, slope stabilization vegetation while civic amenities such as sewer systems are in place.

- Creating ecologically responsible local communities:

The findings emerging from this research study indicates that the debilitating condition of the local forest resource base is attributable to unsustainable extraction, and acute anthropogenic pressures. However, during field studies in the region, locals were invariably found to be myopic about the damage they were causing to forests. In course of interactions, they appeared to be unaware of the long-terms ecological implications of their actions. Only the present mattered and accessing forests for their livelihood needs seemed to be of primary concern to them. Creating environmental awareness amongst the local community is therefore a basic policy requirement.

There has been considerable outcry over the seizure of local access rights to forests because conversion of forests to non-forest uses for initiating mining, power generation and industrial ventures. This is justified particularly in areas where there are threats to livelihoods of forest dependent communities. But while access and customary rights is one issue, the quantum and manner in which the community extracts the natural resource to cater to livelihood needs is another

issue. Unsustainable and excessive resource use could jeopardize the resource besides threats to other associated components of the ecosystem. Therefore, in addition to preservation of ecological rights, awareness levels need to be raised to make the local community *ecologically responsible* while using the resource thereby mitigating the degradation of the forest ecosystem. Introduction of environmental education as part of the school curriculum can be made an integral part of the drive to build environmentally conscious rural communities.

It may be worthwhile to note that research results emerging from field studies initiated by forestry-science experts indicates that moderate disturbance is actually beneficial for regeneration of forests Therefore, some level of livelihood linked extraction can easily be accommodated (Thadani 1995, Shreshtha 2003 and Sapkota et al. 2009). However, the science of sustainability is still in its infancy and a lot more research needs to be conducted for determining sustainable harvesting rates that can cater to livelihood needs and also help in propagating forests. The results emanating from these studies can be transmitted to the local community along with resource conserving alternatives suggested above, so that there are minimum threats to the local forest resource base and the ecosystem it nurtures. A citizen science kind of framework is specifically proposed through an amalgamation of scientific spirit and indigenous knowledge so that the locals can confront and gauge the gravity of their natural circumstances and act accordingly to ensure a more resilient socio-ecological systems in future (Toomey et al. 2013). These ideas can be propagated through new forms of citizen collectives based on reciprocity and self-governance and by promoting incentives for sustainable practices.

There has already been a considerable loss to the forest wealth of Himachal Pradesh on account of conversion of forest zones to non-forest uses, despite a moratorium on green felling. It is estimated that in the last decade alone, nearly 7739 hectares of forest cover has been lost due to the coming up of hydro-electric projects, roads, mining ventures and the construction of transmission lines (Lohumi 2013). In the more recent years the coming up of university campuses and educational institutions has led to the loss of well-established natural forests. Findings emerging from this study indicate that a large fraction of the forest cover that does remain, particularly in the vicinity of villages, may also be degrading due to mounting anthropogenic pressures on account of the rapid pace of rural development and socio-economic change. It is important to be proactive at all

levels to prevent a worsening of the emerging scenario by implementing innovative management paradigms that address environmental concerns as well as the well-being of the local inhabitants.

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