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Diversifying livelihood options of timberline resource dependent communities in Uttarakhand Himalayas: Conservation and development implications

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Abstract: The Timberline ecotones and their nearby areas in Central Himalayas remain under pressure due to the resource use by people, often resulting in ecosystem degradation. In the study Chopta-Tungnath treeline ecotone area, livelihood options for local communities are limited, and largely based on vegetation and biodiversity. The consumption of firewood is very high in the study area, accounting to an average of 7–8 ton fuel wood per household annually. In case of shops/restaurants, serving tourists and local people consumption goes up-to 10–14 ton fuel wood per year. The frequent extreme weather events in a warming climate have further worsened the situation for the communities. In this study, we have analyzed (i) the socio-ecological condition of local communities connected with a timberline ecotone of central Himalayas (Tungnath) and (ii) the impact of a few development interventions on them. Traditional forest resource-based subsistence, agriculture continues to be the primary occupation in this remote area, but people heavily depend on the income generation from summer time religious tourism. It accounts for about 47% of income of studied households (882 households) of timberline linked villages. In regard to the income generated by all livelihood options, contribution of the non-farm activities was nearly 97%. Among the non-farm sources the second major share was of business/self employment (an income of about 33.8% with an engagement of 31.25% households) connected to tourism. On the basis of the need assessment, willingness of the community and timberline connectivity, for the first time some livelihood interventions were carried in two villages. They dealt with off-season vegetable cultivation, mushroom cultivation, floriculture, vermin composting and rainwater harvesting. Among them off season vegetable cultivation in polyhouses was most favoured (adopted by 120 families) followed by mushroom cultivation. About 1600 kg vegetables and 60 kg of *Pleurotus* mushroom worth INR 35,000 and INR 42,000 respectively were produced. Cultivation in polyhouses gives protection against climate extremes, which are on increase in high and remote Himalayas.

Key words: Appropriate technologies, community, household well being, livelihood, technical interventions, timberline, tourism.

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Introduction

In the Himalayan region, the high altitude areas have remained marginalized in the context of larger development process. The people of these areas face harsh climatic conditions, difficult terrains and infrastructural deficiencies, due to which they remain away from the mainstream development (Mohinder 2013). Invariably forest resources and agriculture provide the major livelihood for such communities, and forests are also used extensively for grazing, fuelwood and fodder collection by them (Rahmani 2003). However, degradation of forests due to

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indiscriminate biomass harvesting and reduction in agricultural production has considerably affected livelihoods of these communities. Presently, social and economic stagnation is the major concern in Indian Himalayan Region (IHR), as elsewhere in Himalayas. In this region 30–40% population lies below poverty line and over 45% people are unemployed resulting in a poor physical development, weak immune system of inhabitants, and high maternal and infant mortality (Anonymous 2010). In addition, over last few decades, climate change has emerged as an overriding factor, impacting upon very sustenance of people.

In the above context, the conservationists and the development practitioners equally agree that livelihood improvement and diversification hold a key to promote poor people's livelihood and encourage them to minimize exploitation, thereby reduce degradation of natural resources (IMM 2008). Despite this understanding, the attempts supporting livelihood enhancement and diversification have remained supply-driven and more focused on single 'blueprint' solution with limited market appeal and poor reflection for fast changing people's aspirations for future.

Within IHR, people in high altitude areas (i.e., 2000 m asl) still heavily depend on neighbouring forests, including those of timberline ecotones. Because of the inherent vulnerability to climate change, timberline ecotones are particularly stressed by pressure of diverse subsistence uses by local populations. Furthermore, widely recognized aesthetic, cultural and spiritual attributes of these high mountain areas have historically made them attractive to people, resulting in an additional pressure due to the continuous growth of religious, spiritual and adventure tourism.

The high elevation residents also remain disadvantaged and marginalized from mainstream economic processes due to general lack of economic enablers for marketing, institutional credits, energy, technologies and information, etc. All these have resulted in (i) a poor life quality of inhabitants, and (ii) an increased rate of forest degradation and loss of other natural resources. Considering the long term consequences of this situation, there is a need for an immediate attention from all concerns. Keeping this in view, the present study attempts to promote bio-resource based diversification of livelihood options as one of the potential solutions for maintaining ecological integrity of timberline ecotones and improving life quality of inhabitants in high altitude areas.

This paper analyses a case study of villages nearby timberline in the central part of IHR with focus on some livelihood interventions as a possible way-out to reduce pressure on valuable biodiversity components and ecosystem services of this important zone. The available studies on this theme have mostly focused on figuring out the factors that enable households to diversify livelihoods options (Adhikari 2008b; Blaikie & Coppard 1998; Ghimire *et al.* 2014; Rahut *et al.* 2014). Such studies have definitely provided inputs for policies and programmes that would foster enabling environments for livelihoods diversification. However, a larger question has broadly remained under-attended- to what extent and in what socio-economic condition livelihood status of the community residing nearby timberlines can be enhanced? The present study, to a large extent, attempts to fill this gap by measuring the impact of existing on-farm and non-farm livelihood options on household well-being and identifying the socio-economic conditions that favour a particular option for livelihood improvement. This has been achieved by way of: (i) developing a composite well-being index and identifying 'high' and 'low' return livelihood activities in terms of contribution to community well-being, (ii) analyzing economic, social and demographic characteristics of households that determine their involvement into different on-farm and off-farm sectors, and (iii) demonstrating appropriate livelihood interventions and strengthening capacities of communities for adopting and expanding such interventions. Needless to say, developmental activities take a long time to achieve targets, hence our inferences are likely to be premature, and should be taken with caution.

Methods

The study targeted four high altitude villages of Chopta-Tungnath area in Rudraprayag district (30°28′56.3″ to 30°30′57″ N and 79°08′3.79″ to 79°09′44.9″ E, a border district), Uttarakhand. Being located in a high altitude zone, study area faces topographic and climatic constraints that limit agricultural production. Traditional climate regulated agro-pastoral transhumance is a common practice in this area. Owing to remoteness and harsh climatic conditions, the market and the trade options are limited. Only 2.2% of total cultivated land of the studied villages is irrigated (Census of India 2011); therefore, agriculture, by and large relies on natural precipitation, and is highly vulnerable to vagaries of weather. In general, as

Table 1. Socio-economic profile and energy consumption in four timberline (Tungnath, Uttarakhand) connected study villages.

Socio-economic profile	Sari	Huddu	Tala	Makkumath
Mean Altitude (m asl)	1963	1788	1872	2096
Total Households (HHs)	230	106	96	450
Total Population (nos.)	995 (784*)	550 (361*)	544 (544*)	1500 (950*)
Number of HH surveyed	115	53	48	225
Average family size (Ind./HH)	4.33	5.19	5.67	3.33
Average land holding/family (ha)	0.13	0.28	0.35	0.26
Average annual income per family (INR)	9248	14183	13386	35683
Livestock				
Households having livestock (%)	97	94	89	97
Livestock density per HH	3.91	5.58	5.72	3.61
Average fodder consumed HH/year (ton)	9	8	6.5	11
Distance covered for fodder collection (km)	2.5±1.0	2.5±0.5	2.8±0.25	3.0±0.5
Number of days when fodder is collected in a year	200	175	150	250
Energy consumption by villagers				
Average Fuelwood consumption/HH/year (ton)	6.5±1.0	7±0.5	7.5±1.5	8.5±0.5
Distance travelled for Fuelwood consumption (km)	2.0±0.5	1.5±1.0	1.5±1.0	2.5±1.0
LPG using families (%)	94.6	94	100	95.2

Source: Survey under the project study, 2016; * Census of India 2011.

Table 2. Study villages with social construct.

Study Village	Households	Male	Female	Literacy rate (%)*	Brahmins (%)	Rajputs or Thakurs (%)	Schedule Caste (%)
Sari	230	488	507	69.85	10.0	80. 1	9.91
Huddu	106	282	268	70.0	5.0	71.0	24.0
Tala	96	269	275	70.03	-	100.0	-
Makkumath	450	702	798	75.67	45.0	30.2	24.8

Source: Survey under the project study, 2016; * Census of India 2011.

elsewhere in Himalayas, the agriculture production in study area remains grossly inadequate to meet the food demand (Adhikari 2008a).

To understand the pressure on timberline ecotone, the village people were interviewed at a household level about their requirement of fodder and fuelwood the use of alternative fuel like LPG. Various methods were applied for collecting precise and quantitative data for income generation and livelihood resources i.e., questionnaires, Focus Group Discussion (FGDs), general observation, individual interviews, meetings and discussion with village representatives i.e. Villlage head, Sarpanch, etc. The data collected also include information on family size, education level, land holding size, number of livestock, livelihood resources, income and income sources, energy, dependency on forests for fuelwood/fodder/NTFP, enrollment of females in livelihood and agriculture activities and others. These exercises helped us to develop an idea about socio-economic status of people. The information on distance travelled to collect fuelwood and fodder and the time consumed was also gathered (Table 1).

Traditionally, there are three prominent social groups (i.e., caste/ethnic groups), namely Brahmins, Rajputs and Dalits (Schedule Caste). Of these, nearly 80% belonged to upper caste (i.e., Brahimins and Rajputs) and remaining 20% to Schedule Caste. Details of studied villages and their social construct are given in Table 2.

The data from selected villages were collected

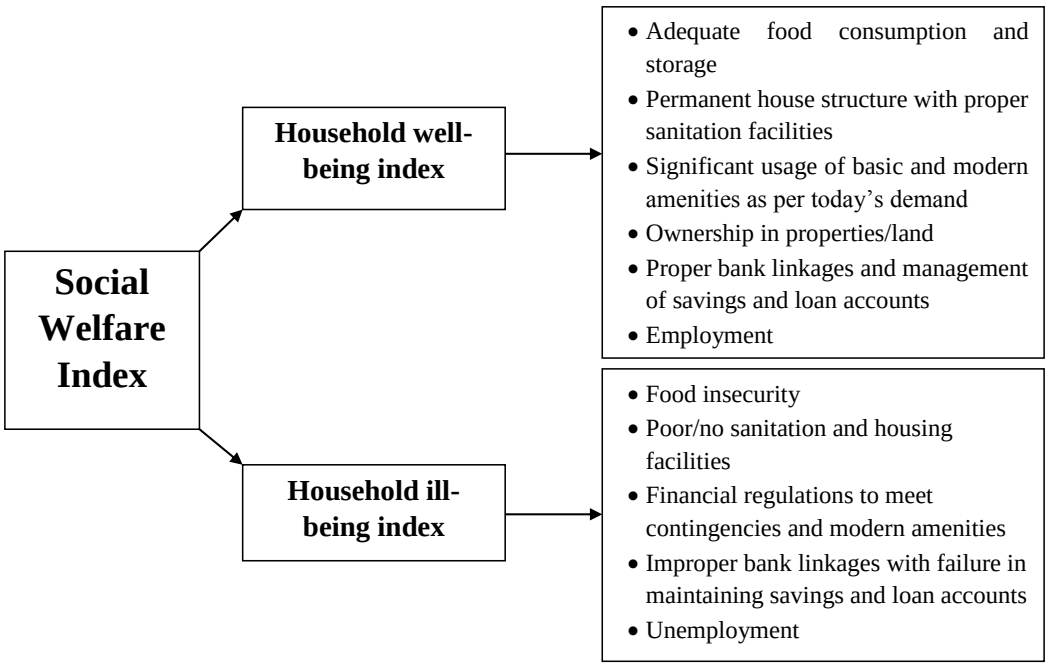

Fig. 1. Derived social well-being index and associated household characteristics.

Table 3. Participation of social groups and gender in group discussions across the studied villages.

Social Groups	Male	Female
Brahmin	30	25
Rajput	140	85
Scheduled Cast	65	45

during 2016 following household surveys, focus group discussion and Participatory Rural Appraisal (PRA). The design and administration of the survey questionnaire were based on rapid and extensive preliminary qualitative inquiries. At the beginning, a series of informal discussions and several in-depth interviews with villagers were conducted. This was followed by a total of 10 village level group discussions to generate information on various aspects of the local livelihoods.

In addition, a local wealth classification, employing locally valued asset criteria for household well-being, was also attempted. The assets/ components considering household well-being was elicited by discussing with the community members to figure out the major differences between the wealthy and poor households (Fig. 1). In the contextof assets, selected variables for composite well being index included: food consumption, housing/logistics, connectivity and dependency on banks, land holding, infrastructure, livestock and employment. While conducting group discussions, recognizing that social groups (i.e., caste) and gender form the major factors in shaping local power relation, the groups were composed in such a way to maintain homogeneity within groups and heterogeneity between groups (Bedford & Burgess 2001). The total number of group discussions was based on the concept of 'theoretical saturation' (Agar 1996; Bryman 2004). Therefore, inclusiveness of social groups and gender in participation across group discussions was ensured (Table 3).

Before the household surveys, a structured questionnaire was developed to gather the baseline information, and administered to 450 households (>50% of the targeted households) which represented statistically sizable population of all the major castes/ethnic groups. Considering that well-being of the residents is the major desirable outcome of assessment of existing livelihood options, the indicators of well-being remained central to the analysis. Better livelihood is associated with having things or resources of 'prudential values' (Griffin 1986) that enables meeting various elementary needs of life. The idea of a better lifestyle, therefore, makes well-being a relative concept, defined according to material circumstances as well as individual preferences and social and cultural contexts. The group discussants were asked to (i) inventorize the key components/assets characterizing a 'quality of life' or household 'well-being'; and (ii)to classify and categorize of the components which would represent households livelihood status.

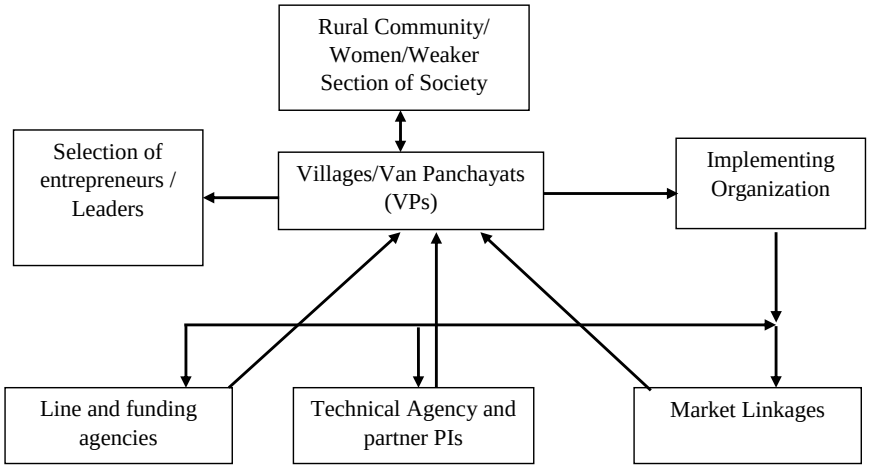

Fig. 2. Implementation mechanism following participatory approach.

Table 4. Composite Household Well-being Index in context to different social groups in all studied villages.

	Brahmins (%)	Rajputs (%)	SCs (%)
Food consumption	100	100	70
Housing/ Logistics	95	90	12
Connectivity and Dependence on Banks	90	85	50
Ownership of land	100	100	20
Infrastructure	100	100	100
Livestock	100	100	70
Employment	98	95	60

Source: Survey under the project study, 2016.

While linkages of inhabitants with timberline ecotone were major consideration for village selection, it also considered the willingness of the community and resources availability for the implementation of technical interventions. Compact Area Approach was adopted for implementation of the livelihood interventions, and to gear up activities for entrepreneur development and ensuring market access (Singh & Rawal 2017) (Fig. 2). Our assumption was that the positive results, if any are likely to be adopted by other beneficiaries and there is every livelihood that they also get replicated in nearby villages. Based on the engagement of households for livelihood generation and contribution of different livelihood activities in income generation, the existing options were analyzed. Based on PRA, FGDs and discussion with allied stakeholders, the main options were categorized based on certain criteria (i.e., economic viability, availability of local inputs, post produce analysis (market), risk assessment, sustainability and willingness of inhabitants for adoption of activity, etc.).

The cost-benefit analysis of each intervention (at a demonstration scale) was worked out and mainly depends on the nature of intervention, materials/items required for infrastructure development, land area treated/covered and other monetary inputs, yield of the products (agro and others) and their monetary equivalent. The major monetary inputs for the technologies tested/demonstrated included materials/items such as UV polythene, bamboo poles, vegetable seeds, mushroom spawns, etc. The monetary output included yield of the produce/products and their monetary equivalent based on the current market rates. The manpower required for different activities/operations under each technology was calculated based on the existing daily wage labor rates.

Results

Household characteristics and well being

In the study area there was no food deficit, though food production was inadequate to meet people's food requirement for whole year, because people could get food from Public Distribution System and purchase from market. Dependency of SC households was high on government supply through PDS in comparison of other groups. At least one individual from each household was engaged in one or the other income generating activity (other than farming). On the basis of food security criteria, which considered elements of adequacy, access and food preference, >90% households were food secure (Table 4).

Table 5. Percentage of household engagement in different livelihood activities at village level.

Village	On farm activities		Off farm activities			
	Agriculture (%)	Horticulture (%)	Business (%)	Labour (%)	Tourism (%)	Service (%)
Sari	94	65	15	80	70	10
Huddu	90	61	10	70	20	5
Tala	100	47	20	60	32	7
Makkumath	95	85	80	20	80	10

Source: Survey under the project study, 2016

As for basic household facilities and goods, the households falling in upper caste/ethnic groups had access to toilets, safe drinking water, LPG and improved stoves. They also had TV, radio, telephone, etc. In contrast, only 10–12% of the SC households had access to such amenities. Nearly all households had bank linkages. About, 50% of SC households (80 households) had bank and private loans, but 30% of them (24 households) were not able to repay the loans. The poorer households revealed that their subsistence living often got affected, due to the unforeseen events, such as loss of crops, diseases, and marriage, etc. which put an additional financial burden on them. On an average across all villages the cultivable land was 0.21 ha per household, and it was relatively smaller for SCs. In general SCs were found to be the most disadvantaged also in terms of other socio-economic indicators. Compared to state level literacy of 78.8%, entire population level literacy was 71.4%. Almost all households cultivated agricultural and horticultural crops (viz. wheat, paddy, finger millet, barley, jhangura, kidney bean, garlic, onion, cucurbits, cauliflower, cabbage, tomato, soyabean, brinjal, malta (citrus fruit), walnut, etc.) most for self consumption. However, some of the households treat malta (a citrus) and walnut as cash crops. Of the total livestock (3,470), cows were about 40%, buffaloes 4.6%, sheep and goats 21.3%, horses and ponies 4.1% and poultry 30.2%. The villagers reported an increase in the population of buffaloes and decrease in sheep and goats population in recent years. However, PRA indicated a decrease of 5–7% in buffaloes and sheep and goat population in last one decade. Cows and buffaloes were generally stall-fed, while sheep and goats were left for grazing in nearby forests and for about 6 months (April–September) in alpine meadows. With the increase in stall-feeding for a decade, the demands for fodder and workload on women have increased. Fuelwood and fodder collection is a major household activity, forcing women to travel considerable distances and spend a lot of time on fuelwood and fodder collection from the adjacent forests. On an average fodder and fuelwood were collected on194 days during a year and women spent about 3–4 hours and travel on an average 2.75 km per day to collect 40–45 kg fodder or 30–35 kg fuelwood as their backload in the studied villages. Days for fodder collection varied in studied villages. Demand for fodder is uniform round the year, though scarcity of green forage during winters is common feature (Dhyani & Maikhuri 2012). Fuelwood consumption varied in different villages. People's dependence on forests for collection of fuel wood, and fodder is considerable viz. 7–10 ton fuel wood and 8–12 ton fodder per household per annum. The consumption goes up-to 10–14 ton fuel wood per year in restaurants of Chopta-Tungnath area. In general, the fuel wood consumption was comparatively higher among 15% of households, most of which belonged to SC families as they could not afford buying cooking gas and enough warm clothes.

Existing livelihood status

Most households are engaged in agriculture, but it does not produce enough food to meet their needs. That is why households are engaged in other activities, such as horticulture (64.5%) (vegetable and fruit cultivation); business (31.25%) which included running restaurants, shops, lodges, camps, etc.; labour work (57.5%) which included employment at restaurants, shops, and under different government schemes such as MNREGA etc.; tourism and allied jobs (50.5%) and government jobs (8%) (Table 5). Farming was common to most of 94.75% households. It may be pointed out that in many cases, households were involved in more than one income generating activity, that is why sum of all percentages exceeds 100%. The long winter period is generally a lean period for

agriculture, which offers a window of opportunity to attempt non-farm income sources beyond local settings. Employment as laborer was the second most important income resource in the studied villages. Many youth migrate to foothills or other regions seasonally for wage labor (wage migrants ~ 50% households). They return before the beginning of the next farming season with small amounts of cash and consumer goods.

About 50% households and 75% youth population were directly engaged in tourism sector and its allied jobs such as local porter, guides, and bird watcher etc. As tourist flow is seasonal, the tourism based livelihood is not a continuous income source. However, individuals involved in tourism related activities (TRAs) earned ₹ 1500–3000/day, but only during tourist season. Tungnath and Deoriatal are the most favourite tourist destinations of the study area. On an average approximately 30,000–35,000 tourists visit Deoriatal annually in a season; while 20,000–25,000 tourists visit Tungnath during the tourist season. The total income generation through tourism activities like local porting, guiding etc. in a season is approx. INR 80,00,000 and at household level it accounts for INR 23,000 for Makkumath while for Sari it is approx. INR 15,00,000 and INR 10,000 at household level. The record of Rudraprayag district shows that 68,60,306 tourists visited Rudraprayag district during 17 years (2000–2016); of which 18,143 (more than one fourth) were foreigners and the rest were domestic tourists (Tourist Statistical Handbook, Rudraprayag district). As per the information available with Uttarakhand Tourism Development Board (UTDB) in Rudraprayag about 58% of the international tourists visited for holidaying, 22% for enjoying nature and adventure, and 19.4% for pilgrimage/ religious functions. However, for domestic tourists main purpose was pilgrimage/religious (44.2%), followed by 43.6% for holiday/trekking/bird-watching, etc.

Business (trade) largely connected with tourism engaged about 31% of households. Among others, ringal (hill bamboo) weaving and handicraft making are also important income sources mostly for SC households. NTFP collection was reported by about 12% households. Among NTFPS, collection of medicinal plants such as *Picrorhiza kurroa* (Kutiki), *Aconitum heterophyllum* (Atees), *Rheum australe* (Archa), *Datcylorrhiza hatageiria* (Hatajari), *Bergenia legulata* (Pakhanbed), *Morina longifolia* (Biskandara), *Aconitum balfourii* (Meetabis), *Polygonatum verticillatum* (Kanthalu), *Zanthoxylum armatum* (Timur) and *Delphinum denudatum* (Nirbisi), *Angelica glauca* (Chora), *Allium consanguineum* (Faran), *Tinaospora cordifolia* (Geloi), *Phyllanthus embilica* (Anwala), *Terminalia chebula* are major species. In general, these medicinal plants are collected by the local residents for self-use in traditional health care system.

To summarize, while agricultural involvement continues in this timberline area, tourism, both religious and non-religious contributed significantly to economy and has kept out migration in check. On an average tourism accounted for 47.3% of the total income generated in studied villages, followed by business (33.8%), labour (12.8%), government job (3.2%), and horticultural cash crops (2.6%) and agricultural cash crops (0.16%). The income has kept most people rooted in their villages, but is not enough to have health security and quality education. Poverty still is a major issue.

Interventions for livelihood diversification

Following the results of rapid field surveys and the review of secondary data, five most viable additional interventions were considered for promotion and demonstration keeping in view discussion with stakeholders, and resources and time period available. They were off-season vegetable cultivation, mushroom cultivation, floriculture, vermin-composting and rainwater harvesting tanks.

The two villages, Makkumath and Sari were selected for demonstration of the appropriate livelihood options based on willingness of communities, timberline connection and potential resource availability. A total of 15 training sessions (each of 2–3 days) on appropriate rural technologies were organized in selected villages. During 2016–2017, a total of 595 participants from different social groups were trained. The target group for training and demonstration were rural and marginal farmers (50%), youths (16%), marginal shopkeepers (3%) and restaurant owners (5%) while 19% of the targeted population was female. Exposure-cum-training events were organized for students of high school to post-graduate level so as to inculcate professional and scientific spirit, and popularize knowledge and approaches of simple rural technologies. As a direct result of these efforts, there are now a number of households which have adopted such technologies and enhanced their income significantly. Among all the livelihood

Table 6. Introduction, adoption and cost-benefit (C-B) analysis of innovative livelihood options.

Name of technology	Adopted families (nos.)	Total monetary input (INR±SE)	Net monetary return (INR±SE)	
			I year	II year
Vegetable Cultivation				
Low cost bamboo Polyhouse	24	14500±1000	5800±250	9700±350
Open conditions	120	750±150	1850±175	2000±200
Organic composting				
Movable composting bed	12	1170±200	850±100	900±100
Open conditions	120	00	150±30	150±30
Mushroom cultivation				
Pleurotus spp.	8	1000±350	3500±250	3500±250
Non farm income generating technologies				
Floriculture	12	5000±250	900±150	1400±200
Ringal weaving	5	1200±100	3000±200	5000±300

interventions, off-season vegetable cultivation was most favored (adopted by 120 households), followed by organic composting (24 households) and mushroom cultivation (8 households). Some important vegetables viz. *Lycopersicon esculentum* (tomato), *Brassica capitata* (cabbage), *Brassica oleracea* (cauliflower), *Capsicum annuum* (capsicum), *Pisum sativum* (pea), *Coriandrum sativum* (coriander) etc. were selected for cultivation trial using high value seeds. The net monetary return was higher under mushroom cultivation followed by off-season vegetable cultivation, vermi-composting, and floriculture. The participatory action research and demonstrations on rural technologies created awareness among and acceptability the people. Performances of important vegetable crops under poly houses and open field condition were evaluated. Observations recorded for two successive growth seasons indicated that the yields of that several vegetables increased significantly by 25% in poly houses as compared to open conditions (Table 6). Thus off-season vegetable cultivation under polyhouses can be used as a strategy to deal with climate change and to create favorable conditions for production in adverse climatic conditions.

Discussion

Our findings are broadly in agreement with the understanding that a household can enhance its well-being by pulling into its livelihood portfolio in a high return sector(s) among various non-farm opportunities available. The asset-poor households, often fail to overcome the entry barriers and are confined to low return sectors that make insignificant contribution to well-being. There is also a positive feedback effect in this nexus that reinforces the well-being conditions: already rich households accumulate assets that form the basis for further lucrative diversification. The poorer households, on the other hand, are trapped in the same low return sectors resulting in overall widening of inequality (Barrett *et al.* 2001; Canagarajah *et al.* 2001; Reardon *et al.* 2000). This can be better explained using a schematic framework (Fig. 3) which recognizes that the ecosystem services and livelihoods issues are interdependent. The equilibrium between the two is the solution to achieve wellbeing in the region. However, it may be pointed out that in these remote mountain villages, most of the households are asset-poor, and rich households are not rich in the sense the term is used in mainstream economics. It is too early to assess the impact of developmental interventions we introduced in the project, however, their easy adoption at household level is quite encouraging. Our household level interventions played a role in generating cash, which has been scarce in the region historically.

Production is comparatively high under polyhouses and it can be managed round the year. Thus it can be treated as a useful climate change adaptation. Rural people are now able to grow vegetables for their own consumption, and market some amounts to the nearby market places. In our present study area, tourism seems to have emerged as a viable non-farm economic activity. The holy shrines located at mountain peaks in nearby alpine grasslands have great cultural and aesthetic values. Further, considering that the Tungnath-Chopta area is rich in biodiversity and provides

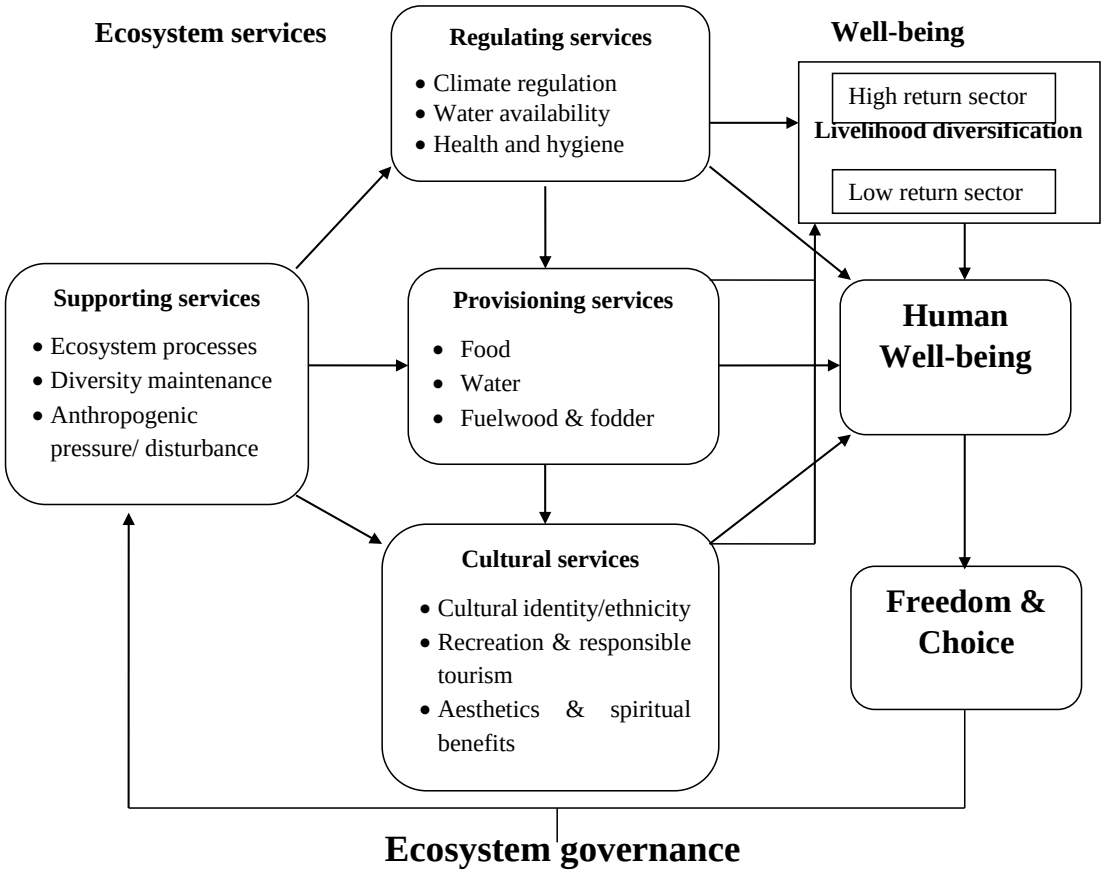

Fig. 3. Schematic framework of ecosystem governance for well being of human.

wonderful opportunities for socio-cultural and natural interactions, there exists a vast scope for promotion of livelihoods activities in this sector. In many parts of the Himalayas, nature and biodiversity based tourism activities have succeeded in improving livelihoods of local inhabitants and conservation of biodiversity (Bhalla *et al.* 2016; Huyett 2013; Lama 2016; Rai & Sundriyal 1997), but due to the lack of awareness, training, entrepreneurship approach and capital, this sector could not grow enough to bring about a major economic change. There is huge potential and scope to develop it by promoting home-stays, capacity building of porter and guides, bird watching, nature interpretation, wilderness trekking, herb based health tourism, handicrafts, etc.

As the data at state and local levels indicate, the income from tourism does not correspond to the number of tourists. Some of the reasons include: tourists' stay period is short and getting shorter; locals are poorly trained in managing nature tourism, and the share of money distributed locally is low in overall economy. Neither local workers have enough knowledge about vegetation, animals and overall natural assets to make tourists interested, nor tourists are interested in them on their own. Some centres are needed to train local bodies and individuals, and tourists. However, involvement in this sector is determined by education, good social networks and financial investment capacities. The social groups (i.e., caste and ethnicity) most notably reflect distribution patterns of these assets and therefore the resultant patterns of livelihood diversification in Chopta-Tungnath area. The rich biodiversity (flora and fauna) embedded with religious sentiments of people along with the natural scenic beauty of this area marks the origin and sustenance of tourism. We tried to make people to cultivate flowering plants and connect flowers with religious tourism.

In spite of some non-farm activities, the local people connected with Tungnath treeline ecotone still heavily depends on natural ecosystem services and goods. About 62% of the total fodder need is met from the forests (tree, shrub, leaves and herbaceous

ground flora), the remaining 38% fodder materials come from agroforests, low-altitude grasslands, degraded lands, high-altitude grasslands and crop residues (Malik *et al.* 2014). During the rainy season, although the fodder is available abundantly, it is not managed efficiently due to the lack of awareness and practices to store them for feeding during lean periods. Despite abundant resources with immense potential for producing quality and quantity fodder, the issue remains unsolved (Dhyani & Maikhuri 2012).The increase in tourist flow results in increased demand for energy for cooking, heating and campfires by lodges as well as trekking and mountaineering expeditions. Although, the initiatives have been taken to promote alternative sources of energy for reducing dependency on natural resources, at present they are still very limited and uncertain. Initiatives like installation of solar panels, solar water heaters in lodges/restaurants and bio-gas units at village level can play significant role in promoting clean and alternative energy.

Presently, it is estimated that more than 15,000 sheep and goats, 2000 buffaloes and about 8000 mules graze in temperate and subalpine region of Kedarnath Wildlife Sanctuary (Singh 2008). The unregulated grazing by domestic livestock around summer cattle camps has led to the loss of about 8% of forest cover around the outer fringes of KWLS during the last three decades (Thakur *et al.* 2011) and such current levels of pastoral practices in and around this protected area are clearly unsustainable. Dhyani & Maikhuri (2012) advocated for the establishment of fodder banks across high-altitude village clusters of Western Himalaya.

It is evident from the PRA conducted and the interest shown by the communities towards new interventions that households with limited livelihood options are more likely to invest in appropriate modern technologies or ideas aiming at economic diversification. In addition, the collective approach of farming and production through groups could be strengthened. The floriculture specifically marigold cultivation can be up scaled in consultation with temple committees. The nonfarm sector is also vital to have livelihood options and mushroom cultivation is one of them. To upscale the activity, master trainers will be developed in the project area with focus on production of spawn for mass scale promotion. The all above activities will result in developing Rural Resource Persons (RRPs) who can further upscale and support the interventions in the region.

The Brahmins have served the region as priests of the Tungnath Temple in the higher altitudinal areas for several years, whereas the Maithanis and Rajputs occupy more productive land in the valley-bottoms that offers better food self-sufficiency. SC population originally comprised landless laborers and artisans. They are traditionally engaged in a wide range of activities (Bishop 1990). Arguably, this variation in land ownership in the study area can explain why SC households are more likely to be involved in wage labour.

The determinants of business sector, another high return non-farm activity, are also related to human and social capitals. The prospects for business are meager for the majority of people with poor education, social networks and capital investment, and the opportunity skews heavily toward households having educated members, social networks and investment. The poor subsection of the population, unable to get involved in non-farm livelihood generating activities, is often forced to adopt activities that do not require high investment capacities.

The individuals from SC community are involved in various occupations, such as making of a wide range of traditional agricultural tools and handicrafts (*ringal* weaving) through which they serve upper caste who offer a certain amount in exchange (Adhikari 2008a). Handicraft and tool making reflects a need as a strategy to meet or maintain survival which does not contribute substantially towards better livelihood due to inadequate land by majority of SCs (Ellis 2000).

Conclusion

Although it is too early to conclude, yet two main indications have emerged from this study. First, responsible tourism can play a role in promoting inhabitants income as well as in contributing to biodiversity conservation; our study clearly reflects that the tourism in the study area is dependent on biodiversity, natural beauty and religious sentiments, therefore, a strategy which considers all these factors would be required to promote this sector. Second, diversification, as such does not contribute to wellbeing; rather a household's ability to pull high return sectors into its livelihood portfolio is more instrumental in enhancing well-being. A household's ability to diversify into a high return sector is dependent on antecedent level of resources and assets: both tangible and intangible assets. Therefore, a prospective look at future livelihoods is needed. This highlights the need for small-scale

rural poverty reduction interventions that directly target creating opportunities for most under-privileged ones. The functioning of system is complex; hence consequences of interventions can be unpredictable. Increased income can help conserving forests by replacing firewood with cooking gas. On the other hand a tourist restaurant can increase pressure on forests by cutting trees for firewood. So it is important to link income generation to conservation.

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