RESOURCE AVAILABILITIES AND GAPS IN HILAUNGAD WATERSHED

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I. INTRODUCTION

Jodha characterizes the Himalayas as inaccessible, fragile, marginal, rich in diversity and human adaptation mechanisms.[2] These features limit the scope for sustainable development based on intensive resource use. In the last century Himalayan states like Uttarakhand and Himachal Pradesh suffered severe environmental degradation due to deforestation. Human activities and livestock are further reducing the carrying capacity of the fragile Himalayan ecosystem. Rapid development with extensive exploitation of natural resources since independence has gradually aggravated the environmental degradation, enhancing resource poverty and triggering outmigration. Thus, rural households in the marginal upper catchments of the Indian Himalayas face critical food security and livelihood challenges.[3]

In the last three decades, degradation of the Himalayan environment and the poverty of the people have been the subjects of many development discussions and debates. Economic development in the region requires use of natural resources, while the fragility of its ecosystem poses constraints.[4,5] Resolving this dilemma is essential for progress in the region to be sustainable. Development experiences of the last quarter century in India have shown that community based integrated natural resource management on a watershed basis is an ideal approach for restoring ecological balance and meeting the basic needs of the rural people.[6]

In response to the need of this region, the People's Science Institute (PSI), Dehradun, India in partnership with International Water Management Institute (IWMI), Sri Lanka Department of Irrigation (DOI), Nepal, Stockholm Environment Institute (SEI), York and Institute of Water and Human Resource Development (IWHRD), Nepal has undertaken an action research study titled "Linking Community-Based Water and Forest Management for Sustainable Livelihoods of the Poor in Fragile Upper Catchments of the Indus-Ganges Basin" supported by the Challenge Program of the Consultative Group on International Agricultural Research (CGIAR). The objective of the study is to identify legal, policy and institutional provisions and their associated institutional structures for

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[2] N. S. Jodha (1991): "Agricultural Growth and Sustainability - Perspective and Experiences from the Himalayas", in Stephen A. Vosti *et al* (Editor), Agricultural Sustainability, Growth and Poverty Alleviation: Issues and Policies, Proceedings of the Conference held from 23-27 September 1991, Germany, pp 423-450.

[3] R.Chopra & S.Passi (2002): "Where Are The Empty Thalis In Uttarakhand: A District Level Food Insecurity Analysis", paper presented at the Uttarakhand State Consultation on Food Security, Dehra Doon, World Food Programme, April 2002.

[4] J. D. Ives and B. Messerli (1989): The Himalayan Dilemma, Routledge, London

[5] J. Bandopadhyay (1992): "The Himalaya: Prospects for and Constraints on Sustainable Development", in P. B. Stone (editor), State of the World Mountain A Global report, Zed Books, London, pp.93-126

[6] …….(2006): From Hariyali to Neranchal, Report of the Technical Committee on Watershed Programmes in India, Department of Land Resources, Minstry of Rural Development (GoI), New Delhi

integrated community management of natural resources for livelihood security. Separate studies have been carried out in Nepal and in Uttarakhand state of India to gain insights into integrated management of natural resources. Assessment of the local resource base, their management and relationship to local livelihoods at a community level was undertaken as a part of the study in a selected sub-basin.

The study was carried out in the Hilaungad watershed, a sub-catchment of the larger Lastargad basin, which lies on the west bank of the Mandakini river. The watershed is spread across an area of 78.77 sq. km (7877 ha) from a lower elevation of about 900m to an altitude of about 2600m. Reserved forests cover 51 per cent (4000 ha) of the total watershed area along the upper northern and western part of the watershed. The remaining area (3877 ha) contains 27 villages with a total population of 11780 persons, the density being 150 persons/km^2. There are 1228 women per 1000 men and scheduled castes (SCs) make up 9.5 per cent of the total population. Six sample villages were selected in the upper, middle and lower slopes of the watershed. Dhan Kurali and Gorti (upper slopes), Mamani and Gharara (middle slopes), and Makhet and Bainoli in the lower slopes. This paper assesses the resources availabilities and gaps and further tries to look into the possibilities of reducing the existing gaps through adoption of appropriate technologies and practices supported by suitable policy and institutional framework.

II. METHODOLOGY

In 2005-08 People's Science Institute (PSI) and Centre for Development Initiative (CDI), a local voluntary organization, carried out participatory research with the selected communities as part of the project and the data generated were analysed to study the local resource use patterns, estimate resources availabilities and assess the resource gaps.

Initially a series of village level meetings was organized in the selected villages to share the purpose and project background among the villagers. Discussions were initiated with elderly village residents to prepare a timeline with particular reference to the availability and use of natural resources. Transect walks were undertaken to understand the geography and resource use patterns followed by extensive participatory social mapping and wealth ranking exercises. In all the villages more than 60 per cent of the families were present during these exercises. Resource mapping was done on village cadastral maps to understand the status of the resources. Biomass surveys were also conducted for different land uses to assess the resources productivity and estimate the availabilities of food, fuelwood, and fodder. The participatory assessment exercise was followed by a 50 per cent households questionnaire-based sample survey to gather data on household level consumption of water, food, fodder, fuelwood and income-expenditure patterns.

Two rain gauges were established in the upper and middle slopes of the watershed to measure the daily rainfall data. Similarly, two hydrological stations were established to gauge the stream flows in the middle reach and near the outlet of the watershed. The daily food consumption of different village communities was determined on the basis of sample household surveys and compared with the ICMR standards.[7] Similarly, fuel wood requirement was estimated on the basis of present collection levels arrived through the sample households' survey. For livestock, the daily fodder consumption of different animals was estimated on the basis of the sample household survey and compared with the

[7] M.S. Swaminathan Research Foundation (2001): Food Insecurity Atlas of Rural India, prepared jointly by MS Swaminathan Research Foundation and World Food Programme (WFP), p.35

conventional standard.[8] The livelihoods requirement is based on the food and non-food expenses of the families surveyed. Finally the gaps were estimated by calculating the differences between the requirement and availability of the basic resources. The identified gaps on the basic needs were finally shared with the concerned communities for initiating discussions on formulating plans for the sustainable use of the natural resources to address the livelihood needs of the selected villages.

III. RESOURCE AVILABILITIES AND GAPS

There are 515 households in the six selected villages having a total population of 2920 persons. Women marginally outnumber men due to the outmigration of men in search of employment. The average household size varies from five to six persons. Demographic details and caste structure for each village are given in Table 1.

Table 1: Demography and Caste

Village	Dhankurali	Gorti	Mamani	Gharara	Makhet	Bainoli	Total
Area (ha)	30.68	100.0	21.66	75.00	40.23	36.16	303.8
Households	58	147	65	88	96	61	515
Total Population	323	931	329	496	521	320	2920
Av. Hhold size*	6	6	5	6	5	5	6
Sex Ratio**	1168	1011	859	1000	1035	1078	1018
Castes							
SC Households	0	72	1	43	-	-	116
OBC Hholds	-	1	-	35	66	-	102
Rajput Hholds	58	69	40	10	30	15	222
Brahmin Hholds	0	5	24	0	0	46	75

Note: * Rounded off to the nearest whole number; ** Females/1000 males
Source: Social mapping, PSI, 2006-07.

The present land use pattern of the selected villages is shown in Table 2. Just under half the geographical area is cultivated land (47%). Gorti, Makhet and Bainoli residents have agricultural lands in other villages also. Community forests, known as Van Panchayats, cover about a fifth of the area. The civil lands (village commons) are quite degraded and are mainly used for grazing animals.

Table 2: Land use pattern

Village	Cultivable Land		Waste Land (ha)	Civil Land (ha)	Van Panchayat Land (ha)	Other Land (ha)	Total (ha)
	Irrigated (ha)	Unirrigated (ha)					
Dhan Kurali	1.0	19.6	0	6.4	0	3.7	30.7
Gorti	3.5	35.4	4.4	41.8	5.7	9.3	100.0
Mamani	5.2	7.5	2	0	4.1	2.9	21.7
Gharara	9	32	0	23	8	3	75
Makhet	8.1	3.4	2.3	2.3	22.1	2	40.2
Bainoli	10.3	7.9	0.2	2.2	13.9	1.7	36.2
TOTAL	**37.1* (12%)**	**105.8 (35%)**	**8.9 (3%)**	**75.7 (25%)**	**53.8 (18%)**	**22.6 (7%)**	**303.8 (100%)**

Source: Land revenue records, 2004.
*The PRA exercises revealed that by 2006 the irrigated command of the six villages had increased to 63.7 ha.

[8] ……. (1978): Nutritive Values of Indian Cattle Feeds and the Feeding of Animals, ICAR Publication

Results pertaining to the availability of basic resources namely, water, fuel wood, fodder and food, in Hilaungad watershed are presented below.

III.1 Water

Hilaungad watershed receives an average annual rainfall of 1243 mm, most of which is received in the monsoon months. Dhan Kurali, the uppermost village in the watershed receives some snowfall during the winter. A substantial amount of the rainwater is lost as surface runoff. A part of the annual precipitation reappears as springs in the watershed. The main sources for domestic water use include hand pumps and public stand posts, besides springs.

Table 3: Daily per capita household water consumption

Village	Total Population (Households)	Daily Per Capita Water Consumption (in litres)			
		Summer	Monsoon	Winter	Average
Dhankurali	323 (58)	22	17	13	17
Gorti	931 (147)	17	12	12	14
Mamani	329 (65)	23	19	15	19
Gharara	496 (88)	21	20	17	19
Makhet	521 (96)	22	16	14	17
Bainoli	320 (61)	29	27	24	27
Total	**2920 (515)**	**21**	**17**	**15**	**18**

Source: Sample household survey, 2005-07

The average consumption of water in the home is 18 litres per capita per day (lpcd), which is significantly less than the minimum prescribed norm of 40 lpcd for rural areas.[9] The seasonal averages range from a minimum of 15 lpcd in winters to a maximum of 21 lpcd in summers. Apart from the above, people also use water at stream and nearby springs for washing clothes, utensils and for their livestock.

Local women spend considerable time every day collecting water from different sources for meeting their domestic needs. They travel a distance of 200m to 800m per trip for this purpose. They have to travel larger distances during summers due to irregular supply at the public stand posts.

The average daily per capita household water consumption in the villages ranges from a minimum of 14 litres (Gorti) to a maximum of 27 litres (Bainoli). Whereas in Gorti women have to travel an average distance of 800m per trip for collecting water, in the main hamlet of Bainoli village water supply reaches each home resulting in higher water consumption levels.

Guhls (earthen channels), masonry canals, tanks and a few hydrams cater to the irrigation requirements. However, villagers reported that due to lack of maintenance most of the departmental irrigation structures were not functioning efficiently. Leakages in the masonry canals often result in low discharge affecting the irrigation supply.

The total annual domestic water requirement of these villages is 44 million litres (on the basis of minimum norm of 40 lpcd). The total annual crop water requirement (considering the cropping pattern and consumptive water use of different crops) is 158.8 ha m (1588 million litres). The total water requirement of the villages is only 43 percent of the total amount of rainfall received in these villages.

[9] ----------:Payjal Sansadhan Vikas Nigam, Dehradun

Table 4: Annual Precipitation and Requirements (in Million Litres)

Village	Area (Ha)	Annual Precipitation	Annual Domestic Requirement	Annual Crop Water Requirement	Total Water Requirement (as % of Precipitation)
Dhankurali	30.68	381	5	177	182 (48%)
Gorti	100.0	1243	14	353	367 (30%)
Mamani	21.66	269	5	164	169 (63%)
Gharara	75.00	932	7	436	443 (48%)
Makhet	40.23	500	8	189	197 (39%)
Bainoli	36.16	449	5	269	274 (61%)
Total	**303.8**	**3774**	**44**	**1588**	**1632 (43%)**

III.2 Fuelwood

The annual requirement of fuelwood has been estimated on the basis of the daily amount of fuelwood collected (through the sample household survey) in the selected villages. The present average daily per capita fuelwood collection in the region is 1.6 kg/p/d (See Table 5). The seasonal averages range from a minimum of 1 Kg/p/d in the monsoons to a maximum of 2 Kg/p/d in summers and winters. Significantly higher collection is recorded during winter season in all the villages (except Dhankurali). The reason of low collection figure of 0.1 Kg/p/d in Dhankurali is that due to the severe winter conditions, villagers here collect and store wood in the summer and monsoon months itself for usage in winters.

Table 5: Daily per capita Fuelwood Collection and Annual Requirements

Village	Daily Per Capita Fuelwood Collection (in Kg/p/d)				Annual Requirement (Tons)
	Summer	Monsoon	Winter	Average	
Dhankurali	3	2	0.1	1.7	212
Gorti	2	0.4	3	1.6	544
Mamani	2	1	2	1.7	216
Gharara	2	2	3	2.4	435
Makhet	0. 5	0.2	2	1.0	190
Bainoli	1	0.8	1.7	1.3	152
Total	**2**	**1**	**2**	**1.6**	**1749**

Source: Sample household survey, 2005-07

The fuelwood collection level in these villages is low when compared to estimates from other adjoining regions, especially remote villages. This is because about 50 per cent of the households of these villages use LPG gas. According to the sample household survey conducted in Hilaungad watershed itself, the average daily fuelwood collection of households having LPG connection is less than 1 Kg/p/d whereas those using conventional *chulahs* harvest as much as 1.7 Kg/p/day. The fuelwood collection level is lowest in Bainoli and Makhet, i.e., the valley villages because 76 per cent of the households there use LPG gas.

The annual fuel wood requirement of the six selected villages is estimated to be 1749 tons. The sources and availability of fuelwood biomass are shown in Table 6. Villagers collect fuelwood mostly from the reserved forests and lop twigs and branches from the trees growing in farmlands. Van Panchayat lands in the upper slopes either do not exist (as in case of Dhankurali) or are devoid of any trees (as in Gorti). In Mamani, the Van Panchayat lands are not being accessed presently, as the plants are young. In the remaining villages, communities refrain from using Van Panchayat lands for meeting their fuelwood requirements. Moreover, the Van Panchayat institutions are defunct except in

Bainoli.[10] Since the farmlands can meet only about 10 to 40 percent of the annual fuelwood requirements, the villagers are primarily dependent on the reserved forests.

Table 6: Sources and availability of fuelwood biomass in Hilaungad watershed

Village	Source	Area (ha)	Biomass Density (Tons/ha)	Total Biomass (Tons)	Sustainable Biomass (Tons/yr)	% age of Need
Dhankurali	Reserved Forest	448.4	489	2,19,268	13,156	6205
	Van Panchayat	-	-	-	-	-
	Fields	19.6	57	1119	67	32
Gorti	Reserved Forest	615	910	5,59,650	33,579	15546
	Van Panchayat	14	0	0	0	0
	Fields	35.4	4	141.6	70.8	11
Mamani	Reserved Forest	615	910	5,59,650	33,579	15546
	Van Panchayat	4.1	NA	NA	NA	NA
	Fields	7.5	82	613	37	17
Gharara	Reserve Forest	247.8	300	74,340	4,460	1025
	Van Panchayat*	8	35	280	17	4
	Fields	32	41	1312	79	18
Makhet	Reserved Forest	247.8	300	74,340	4,460	2348
	Van Panchayat*	22.1	28	620	37	20
	Fields	3.4	287	967	58	30
Bainoli	Reserved Forest	110	274	30,140	1,808	1190
	Van Panchayat*	13.9	270	3761	226	148
	Fields	7.9	121	951	57	37

Source: Biomass survey, 2006-07 * VP not accessed for fuel wood
NA-Not applicable (plantation has been done in 2005 in Mamani)

The study also revealed that some of the reserved forests and most of the Van Panchayat forests (except in Bainoli) are in a degraded state. The biomass density in the reserved forests is less than desired. As a result, villagers often cross over the compartments allocated by the forest department inside the reserved forests to collect fodder grass and wood. Compartments within reserved forests are shared between the different villages of the entire basin for meeting fuelwood and fodder needs, resulting in a cumulative pressure on these forests. Encroachments inside the reserved forests were also reported for agriculture, fodder and other purposes. Since the compartments are shared between large number of villages in the basin, in future timber extraction or biomass extractions might exceed the limit of harvestable productivity of the forest.[11,12]

III.3 Fodder

The livestock population of the villages primarily consists of cows, oxen, buffaloes, goats and sheep. Goats and sheep graze in the open whereas cattle are partially stall-fed. Green fodder mostly consists of grass and leaves of fodder species while the straw of paddy, *jhangora*, *mandua* and pulses is fed as dry fodder. The present daily fodder consumption of cattle livestock has been estimated considering the quantity that is stall-fed. The daily fodder consumption and annual requirement of cattle livestock of the selected villages of Hilaungad watershed is presented in Table 7. The annual requirements

[10] Ravi Chopra, Debashish Sen, Sapna Bhardwaj and Deepa Negi (2008): Disowned Institutions in Hilaungad Watershed, People's Science Instutute, Dehra Doon

[11] J.S. Singh and S.P. Singh (1998): Forests of Himalaya: Structure, Functioning and Impact of Man, Gyanodaya Prakashan, Nainital.

[12] J.S. Singh (1998): "Sustainable development: An ecological viewpoint", in Perspectives for Planning and Development in Northeast India, Himavikas, No. 11, G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal, Almora, pp.5–16.

have been estimated on the basis of standards. The consumption of dry fodder is relatively higher than the green fodder when compared with the standards.

Table 7: Present daily fodder consumption (in kg/head) and annual fodder requirement (in tons) in Hilaungad watershed

Daily fodder consumption (kg/head/day)		**Cows -331**		**Buffaloes- 321**		**Oxen -351**	
		Green	Dry	Green	Dry	Green	Dry
Season	Summer	7	5	8	6	7	5
	Monsoon	10	4	10	5	8	4
	Winter	6	6	7	8	4	6
Annual fodder requirement (ton)		**1208**	**725**	**1172**	**703**	**1281**	**769**

Annual fodder requirement: As per standard (Green-10kg/head/day, Dry-6 kg/head/day)
Source: Present Consumption on the basis of village survey, 2005-07

Table 8 gives the availability of green and dry fodder at the village level. The total availability of green fodder is 458,705 tons per year (including reserved forest stock) whereas that of dry fodder is about 700 tons per year. However, the availability of green fodder drop down to only 896 tons if one does count the reserved forests' supply.

Table 8: Fodder availability in Hilaungad watershed

Village & Source	Area (ha)	Leafy Biomass (tons/ha)	Grass (tons/ ha)	Annual Green Fodder Availability (tons/yr)		Annual Dry Fodder Availability (tons/yr)	
				Total	% age of need	Straw	%age of need
Dhankurali							
R.F	448.4	734	-	1,64,663	30894	-	-
V.P	0	-	-	-	-	-	-
C.L.	6.4	NA	0.75	5	0.9	-	-
Field	19.6	4	-	39	7.3	54	16.8
Gorti							
R.F	615	882	-	2,71,215	32716	-	-
V.P	5.7	NA	0.75	4	0.5	-	-
C.L.	41.8	NA	0.50	21	2.5	-	-
Field	35.4	2	-	35	4.2	133	26.8
Mamani							
R.F	615	882	-	2,71,215	58076	-	-
V.P	4.1	NA	0.75	3	0.6	-	-
C.L.	0	-	-	-	-	-	-
Field	7.5	24	-	90	19.3	78	27.9
Gharara							
R.F	247.8	177	-	21,931	3930	-	-
V.P	8	35	2.3	158	28.3	-	-
C.L.	23	NA	0.75	17	3.0	-	-
Field	32	6	-	96	17.2	194	57.9
Makhet							
R.F	247.8	177	-	21,931	2890	-	-
V.P	22.1	14.7	2.5	218	28.7	-	-
C.L.	2.3	NA	0.78	2	0.3	-	-
Field	3.4	86	-	146	19.2	89	19.4
Bainoli							
R.F	110	0	-	-	-	-	-
V.P	13.9	0	3	42	8.1	-	-
C.L.	1.65	NA	0.75	1	0.2	-	-
Field	7.9	27.8	2196.57	18.7	27.8	145	47.1
TOTAL				**458,705**	**12530**	**693**	**32**

Source: Biomass survey, 2006, NA-Not Available due to absence of trees
R.F.-Reserved Forest; V.P.- Van Panchayat; C.L.-Civil Land

The annual requirement of green fodder for cattle in the selected villages is 3661 tons. The available green fodder from Van Panchayats, civil and farmlands is able to meet only 24 per cent of this requirement. Green fodder availability from the above lands ranges from a mere 7 per cent to a maximum of 48 per cent of the annual demands in the selected villages. Therefore villagers have to rely heavily on the reserved forests.

The annual requirement of dry fodder of the cattle livestock in the selected villages amounts to 2197 tons. However, fodder availability in the form of straw from the farmlands is less than a third of the total requirement. Dry fodder availability in the villages ranges from a minimum of 17 per cent to a maximum of 58 per cent of the annual demands.

Villages either devoid of Van Panchayat/civil land or having degraded Van Panchayat/civil land, especially those in the upper slopes, face more shortage of green fodder. Similarly, villages with limited farmlands and large number of cattle face acute shortage of dry fodder, like Makhet and Dhankurali. As stated earlier, most of the fodder needs are being fulfilled from the reserved forests. This reveals the heavy pressure on the forests in the upper catchments and also contributes to increasing the workload of women, as they have to traverse long distances for collecting fodder from outside the villages.

In most of the villages, some portions of civil land have been encroached and are used for growing grasses. Open grazing is allowed only on the remaining civil lands. Van Panchayat lands have also been encroached upon and are subjected to open grazing.

III.4 Food

The total cultivated area of the selected villages comprises 47 per cent of the total geographical area (In Makhet and Gorti, the cultivated area is as low as 29 and 39 per cent of the revenue area respectively). However, according to revenue records (2004), only 25 per cent of the total cultivated land is irrigated.[13] The percent irrigated area ranges from a minimum of 4 per cent of cultivated land in Gharara to a maximum of 70 per cent in Makhet. Paddy and wheat are the major kharif and rabi crops respectively grown both in irrigated as well as unirrigated conditions. Other important crops include m*andua, jhngora, barley, pulses (rajmah, soyabean, urd)* and mustard. Agricultural productivity is low and decreases as one moves from the valley villages to the villages located in the upper slopes.

The present average daily per capita consumption of cereals, pulses, vegetables, oil and milk in the sampled households is 454g, 32g, 86g, 15g and 215g, respectively (Table 9). The consumption levels of pulses, vegetables and oil are much lower than the ICMR norms.

Table 9: Present food consumption level in the villages (gm/person/day)

Food Item	Cereals	Pulses	Vegetables	Oil	Milk
ICMR Standard (gm/p/d)	**420**	**40**	**125**	**22**	**150**
Dhankurali	409	42	71	16	266
Gorti	463	22	83	14	130
Mamani	470	26	108	17	254
Gharara	407	26	66	13	175
Makhet	498	43	100	18	287
Bainoli	470	41	99	13	312
Average	**454**	**32**	**86**	**15**	**215**

Source: Sample household survey, 2005-07, ICMR standards from MS Swaminathan Research Foundation (2001): Food Insecurity Atlas of Rural India).p.35p

[13] Land Records (2004): Dept. of Revenue and Land Record, Dist, Rudryaprayag, Uttarakhand.

Although the average consumption of cereals in the six villages is higher than the recommended standards, comparisons among the villages show lower consumption level in Dhan Kurali and Gharara villages. The main reason behind this is the low soil fertility and less availability of irrigation facilities in these villages, which results into inadequate farm production. Moreover, these villages also home the poorer families who have less purchasing power.[14]

The consumption of pulses is significantly lower than the standard ICMR norms in the villages located in the middle slopes (Mamani and Gharara) as well as in Gorti (having about 50 per cent of SC households). Dhankurali reported higher pulses consumption because the prevailing climatic conditions promote *rajma* production. The per capita consumption of pulses in valley villages is at par with the standards.

The average milk consumption is more than the prescribed ICMR norm in all the villages, except in Gorti - village with a high proportion of SC population. The SC households own less number of milch cattle, and the grass availability in the civil and Van Panchayat land of the village is also poor. This results in low milk yields and consequently lower consumption levels.

The total annual food requirement of each village has been worked out on the basis of the present consumption level and the population (See Table 10). The availability of different food items as a percentage of the requirement have been estimated on the basis of the sample household survey. The percent availability of cereals, pulses, vegetables, oil and milk is 40, 45, 25, 6 and 97 respectively. Villages in the upper slopes reported less availability of cereals from farms as compared to the villages of middle slopes and valleys. People prefer to grow cereals in irrigated lands.

Table 10: Annual food requirement (in tons) and availability from farm (in per cent)

Food Item	Cereals	Pulses	Vegetables	Oil	Milk
Dhankurali	48 (33)	5 (54)	9 (49)	2 (24)	31 (94)
Gorti	157 (37)	8 (57)	28 (35)	5 (03)	44 (95)
Mamani	56 (47)	3 (50)	13 (12)	2 (06)	31 (120)
Gharara	74 (41)	5 (40)	12 (26)	2 (04)	32 (96)
Makhet	95 (43)	8 (45)	19 (03)	3 (01)	55 (55)
Bainoli	55 (49)	5 (26)	11 (24)	2 (10)	36 (117)
Average	**484 (40)**	**34 (45)**	**92 (25)**	**16 (6)**	**229 (97)**

Source: Sample household survey, 2005-07

Values inside parenthesis indicate food availability from farm in percentage

It is quite clear that there exists a significant gap between the requirements and availability of different food items (except milk), especially vegetables and oil. Villagers revealed that significant low farm production is due to scarcity of irrigation, topsoil erosion, less availability of manure, destruction by wild animals and lack of awareness about appropriate practices. The village communities are therefore forced to purchase food items from the market to fulfill their requirements during most part of the year. Livelihood analysis of the region reveals that agriculture is the primary source of income for less than 15 per cent of the total households!

[14] R.Chopra, D.Sen, S. Bharadwaj and H.Bharti (2008): Livelihood transitions in Hilaungad Watershed, People's Science Institute, Dehra Doon.

The study also brings out the facts that rural villagers in upper catchments do not get sufficient nutrition in their diet. Similar findings are also reported from other parts of Uttarakhand.[15]

III.5 Livelihoods

An attempt was made to estimate the minimum income required to meet basic living expenses (food and non-food expenses) in the region. The minimum expenditure for food estimated on the basis of the ICMR's (Indian Council of Medical Research) dietary recommendations and the prevailing food prices, worked out to be Rs. 5110/p/yr.[16] The basic non-food expenses were estimated on the basis of sampled households' survey. It included expenditure for clothing, fuel (gas and kerosene), education, power (electricity), medicines, local travel and essential social obligations. This figure worked out to be Rs.2501/person/year, which was added to the minimum expenditure for food. Thus, the minimum income required to meet basic living expenses as defined by the local people worked out to Rs. 7611/p/yr or Rs. 634/p/m, which is about 33 per cent higher than the GoI's poverty line of Rs. 478/p/m for Uttarakhand.[17] The figure of Rs. 7611 has been taken as the annual livelihood requirement of a person to meet the basic living expenses.

The annual livelihood availability at the household level was estimated on the basis of the value of the farm produce and income from other sources for the surveyed sampled households. This was then compared with the annual livelihoods requirement of the households estimated on the basis of basic living expenses, i.e. Rs. 7611/p/yr. Table 11 gives village wise details of the number of sampled households who are unable to meet the basic living expenses.

Table 11: Households unable to meet basic living expenses

Village	Households Surveyed	Households unable to meet basic living expenses	Per cent of Households unable to meet basic living expenses
Dhankurali	29	15	52
Gorti	73	38	52
Mamani	32	7	22
Gharara	44	29	66
Makhet	48	15	31
Bainoli	31	10	32
Total	**257**	**114**	**44**

Source: Sample household survey, 2005-07
Livelihoods requirement is estimated on the basis of basic living expenses
Livelihoods availability is estimated on the basis of value of farm produce and other income

As much as 44% of the households in the selected villages are unable to meet their basic living expenses, about 65 per cent of who are either daily labourers or farmers.[18] Therefore, there is a need to promote livelihood development to increase households' incomes and ensure food security in these villages.

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[15] B.R. Pant (1996): "The Geographical study of scheduled castes population in Uttarakhand Himalaya (India)", in The Indonesian Journal of Geography, 28(7), pp 25-30.

[16] R.Chopra, D.Sen, S. Bharadwaj and H.Bharti (2008): Livelihood transitions in Hilaungad Watershed, People's Science Institute, Dehra Doon.

[17] ---------: "Poverty estimates for 2004-05", Press Information Bureau (GoI), New Delhi, March 2007.

[18] R.Chopra, D.Sen, S. Bharadwaj and H.Bharti (2008): Livelihood transitions in Hilaungad Watershed, People's Science Institute, Dehra Doon.

IV. DISCUSSIONS

The research study focused on estimating the resource availabilities and gaps in the six villages selected from the upper, middle and lower slopes of the Hilaungad sub-basin. The major findings recorded from the research study are discussed below.

a) Water consumption in the home ranges between 14 lpcd to 27 lpcd, which is far below the prescribed minimum norm of 40 lpcd. In addition, water is consumed for bathing, washing clothes and utensils at public stand posts or springs. There is ample scope of rainwater harvesting and multiple water use not only to augment the household and irrigation water supply but also to promote cultivation of crops that would enhance household incomes. This in turn would reduce out-migration and drudgery of the rural women. The aim should be to provide water at the household level. Studies undertaken in mountain watersheds reveal that per capita water consumption increases even upto 100 lpcd and more with the availability of water at home.[19] National Rural Health Mission advocates proper hygiene, e.g. washing hands after defecation. This is possible only when there is adequate water supply in the home.[20] Accessibility of water will consequently improve the hygiene of the rural people and provide time, especially to the women for productive works for livelihood improvement or much-needed rest time.

b) The present average daily per capita fuelwood demand ranges between 1.00kg/p to 2.4kg/p. The low end is in those villages, which have significant access to LPG cylinders. The villagers are primarily dependent on the reserved forests for meeting their fuelwood needs as the village farmlands and Van Panchayats can meet only about 10 to 40 percent of the annual fuelwood requirements. Significant shortages of quality green fodder exist in all the studied villages. Green fodder availability from van panchayats, civil and farmlands ranges from a mere 7 per cent to a maximum of 48 per cent of the annual demands in the villages. Therefore, villagers have to rely heavily on the reserved forests for meeting their needs. It also adds to the workload of the women, as they have to transverse a long distance for collecting fodder and fuelwood from outside the villages. Therefore, there is a need to strengthen the Van Panchayats and mobilize the communities to undertake fuelwood and fodder plantations in the Van Panchayat lands. Encroached forestlands (be it Van Panchayats or reserved forests) need to be transferred to Van Panchayats with clearly defined usufruct rights & rules of forest management. The proportion of chir pine can be reduced through scientific felling of chir pine. The degraded civil lands can also provide additional biomass if properly managed. High-density tree plantation of *banj, shahtut, bheemal, kachnar, aonla, dainkan, utees, bans, reetha* and grasses namely hybrid *napier, gini, guchhi, dolni, rai, brome, ons and setaria* in wastelands, community and Van Panchayat lands along with creation of ownership feeling among the villagers will minimize the gaps in requirement of fuelwood and fodder. Fuelwood and fodder plantation, especially in the form of hybrid napier on farm bunds can provide additional biomass. Yield as high as 500 Q per ha has been obtained from grassland development programme in community lands.[21] Supply of LPG cylinders can further reduce the fuelwood requirement and consequent pressure on the reserved forests.

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[19] ---------- (2007): Understanding the Impacts - An Impact Assessment Report of Nine Watershed, People's Science Institute, Dehradun.

[20] ---------- (2005): Reading Material for ASHA (Accredited Social Health Activist), Book No.1, NRHM

[21] ---------- (2007) : Annual Report, Uttaranchal Livestock Development Board (2006-7), pp20.

c) The villagers' diet comprises of inadequate vegetable and oil in all the selected villages, and limited cereals and pulses in specific villages, which are either remote or a have a high proportion of SC population. Milk consumption is adequate in all the villages. Thus, there is a need to increase the farm production through adoption of appropriate agricultural practices and creating additional irrigation facilities. The area is suitable for agriculture diversification. Presently, cultivation of vegetables is quite limited and most of the villagers grow few vegetables in their kitchen gardens for their household consumption. Vegetable cultivation for sale, especially potato, onion and garlic can be promoted. Similarly, pulses and oilseed production can be enhanced in the unirrigated lands. Efforts need to be made to popularize better agronomic measures, establish crop demonstration units on farmers' field, and promote proper composting techniques. Adoption of new methods like green houses and crop intensification has the potential to meet the present gaps existing in the diet of the rural villagers. PSI's field trials of the System of Rice Intensification (SRI) for paddy cultivation on 600 farmer's plots in Garhwal and Himachal Pradesh have showed an average increase of about 85 per cent in paddy yields.[22] Hydrams installed by PSI in the mountain villages have brought an additional annual income of over Rs. 3,900 per household. Similarly, greenhouses have helped farmers to earn more than Rs. 5,000 on an annual basis.[23]

d) The minimum annual income required to meet basic living expenses as defined by the local people has been estimated as Rs. 7611 per person. However, 44 per cent of the households in the selected villages are unable to meet the above expenses, most of whom are daily labourers and farmers. Livelihoods needs are being primarily met through non-land based activities, i.e. service, business, and trade. There is a need to develop livelihood opportunities by diversifying sources of income, enhancing agricultural productivity and through value addition to local products. Tremendous potential exists for increasing the resources' productivity and promote livelihoods development in the region. Region specific appropriate technologies need to be developed and demonstrated for use amongst local communities. Introduction of irrigation itself can lead to increased cultivation of vegetables and cereals in the villages, improving the food security. Mountain watershed programmes have demonstrated that properly planned cropping cycles on irrigated area can increase cereals production and add Rs. 24,000 per ha annually to the net local incomes. A second crop of vegetables can annually add over Rs. 40,000 per ha.[24]

Efforts need to be made to use the capital available with the local thrift (savings and credit) groups and local banks to provide credit for productive purposes, including promotion of micro-enterprises. These might include secondary income generation activities like bee-keeping, mushroom cultivation, poultry farming, pisiculture, sericulture, floriculture, community-based tourism, developing new products for value addition and marketing. Value additions will require additional inputs of technologies, managerial and/or institutional support and knowledge systems support. Thus women's SHGs could be encouraged to invest some of their funds to set up processing units. Instead of selling garlic and ginger, their paste fetches a much higher value and can be manufactured at the

[22] ---------- (2008): Promoting SRI Dhan in Uttarakhand (Under Farm Innovation and Promotion Fund)-Final Report, People's Science Institute, Dehra Doon.

[23] ---------- (2007): Understanding the Impacts - An Impact Assessment Report of Nine Watershed, People's Science Institute, Dehra Doon.

[24] ---------- (2007): Understanding the Impacts - An Impact Assessment Report of Nine Watershed, People's Science Institute, Dehra Doon.

village level. At the watershed level, marketing management support would be required to ensure maximum return for the sale of any surplus produce. Farmers' producer groups (SHGs) can be constituted and trained for this purpose.

The rural communities in the Hilaungad sub-basin practice subsistence agriculture and collect other daily needs, i.e., water, fuelwood and fodder from the immediate environment. The landholdings in the villages are small, an average of 0.24 ha. For SC families the average is less than 0.15ha. With low farm productivities, food grain production at the family level is usually low – and unable to fulfill the annual grain needs of the households, especially the poorer families who also have low purchasing power. As household's food grain production is below sustenance levels, able-bodied male family members are involved in non-land based income generation activities within or even outside the Hilaungad sub-basin. The reduced availability of labour increases the burden on the women. The households react by reducing the number of cattle, leading to less availability of farmyard manure – the main fertilizer for mountain farms, sending the family's agricultural output into a downward tailspin.

In mountain areas such as Hilaungad, forests are essential for productive agriculture. For each unit of energy obtained in agronomic production, seven units of energy are expended from the forest in most parts of Himalayas through the use of firewood, fodder and vegetal manure[25] and therefore a greater ratio of forest to cropland is needed for sustenance of agriculture. Problems have appeared because of the reduction in this ratio. In Hilaungad this ratio is 1:3.7 implying that the carrying capacity of forests has already been exceeded and needs to be addressed urgently on a priority basis. Good forests in or near a village increase fodder availability and hence farmyard manure. Forests also moderate surface runoff ensuring more sustained water flows in the streams. Thus irrigation and trees and grass plantations are critical interventions for increasing livelihoods in the region.

V. CONCLUSIONS

The resource assessment study reveals that significant resource gaps exist in the mountain villages. The daily per capita consumption of water in the houses ranges from an average of 14 litres to 27 litres as against the minimum norm of 40 litres. The daily fuelwood demand ranges from 1.00 kg/p to 2.4 kg/p. However, the availability of fuel from fields and Van Panchayats ranges from 10 to 40 per cent of the requirement. There is a shortage of quality green fodder as well. The availability of green fodder from fields, civil lands and Van Panchayats ranges from a mere 7 to 48 per cent of the requirement. As a result villagers primarily depend on the reserved forests for meeting their daily needs.

In all the villages there is inadequate vegetable and oil consumption, and cereals and pulses consumption is limited to specific villages, which are either remote or have a high proportion of SC population. Only milk consumption is satisfactory in all the villages. Farm production provides well below 50 per cent of the annual requirement of the cereals, vegetables and oil. About 45 per cent of the households are unable to meet the basic living expenses identified by the local communities!

Large potential exists for increasing water, land and forests productivity in the region. Livelihood development strategies need to be developed with focus to provide food security and to increase the primary income from agriculture, trees and grass plantations, animal husbandry and dairying, horticulture and micro-finance. Secondary

[25] U. Pandey and J.S. Singh. 1984. Energy-flow relationships between agro- and forest ecosystem in Central Himalaya. Environmental Conservation, 11, 45–53.

income generation activities based on the local conditions can bring in additional income for the mountain communities.

Gram Sabhas need to be encouraged to undertake micro-planning at the village level and identify interventions which can fulfill the resource gaps specific to foodgrains, fuel, fodder, water and employment to promote self-sufficiency. Every family in the villages owns some land and at least two heads cattle. A core set of physical works for optimum utilization of a household's cultivable land can be planned to include inputs for enhancing foodgrains production, vegetable and fruits production (horticulture) and fodder development to increase the availability of composted manure and milk, along with generating cash incomes. Once the plans are ready, funds can be sourced by the Gram Sabhas from government schemes, like the NREG scheme, PRI funds, BRGF funds, banks and other institutions. The local VOs can play a crucial role by assisting the village communities and PRIs for preparing micro-plans and extending field support for their implementation.

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