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People's Response on Land, Water and Biomass Development in Upper Kosi Watershed, Almora

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Abstract

Land, water and biomass form the core of eco-development more specifically in watershed development. The watershed variables i.e. land, water and biomass do not operate individually rather they are interconnected. The emphasis on trio becomes much more important when it concerns with the rural economy as the triple F: food, fodder and fuel, the basic ingredients of livelihood depends on it. Increasing populations in the study area and consequent exploitation of the resources of the region is definitely bearing an impact on the fragile ecosystem of the study area. Present paper is an attempt to explain the people's perception of land, water and biomass development in Upper Kosi watershed, district Almora, Uttarakhand.

Keywords: watershed, fragile, biomass, eco-development

Introduction

The traditional resource use structure in Himalaya has changed considerably during the recent past, mainly owing to the growth of population and demand of natural resources in the region. This transformation in resource use practices is particularly significant in the more populated tracts of Himalaya. As a result, cultivated land, forests, pastures have been deteriorated, depleted and significantly leading to degraded and non-productive lands. These rapid land use changes have not only disrupted

the fragile ecological equilibrium in the mountains through indiscriminate deforestation, degradation of land and disruption of the hydrological cycle, but also have significant and irreversible adverse impacts on the rural economy, society, livelihood and life quality of mountain communities (Tiwari, 2008).

The area typifies a situation in which there is scarcity of water. The Kosi is the major river in the region. Hydrologically the upper Kosi watershed is a typical mountainous system.

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Besides this river, the area is criss-crossed by several small rivulets constituting the drainage network of the main river and their tributaries. Precipitation takes the form of rain, sleet and hail in the valleys and lower reaches. Like most rivers the river Kosi too is known for its flash floods causing erosion, damage of crops, but this is not exactly the basic water problem of the study area. In the study area, there are many gads and gadheras which earlier used to flaunt an abundance of water throughout the year. As a consequence, a variety of water harvesting structure arose within different socio-ecological settings, mainly for domestic use. After independence various government interventions were down to provide water to remote villages have led to a decline in the creation and management of traditional water harvesting structures affecting huge areas adversely.

Through the ages, these mountain forest biomass in the Upper Kosi watershed have been valued more for the direct subsistence and economic benefits - timber, fodder and fuel wood and as spiritual and recreational non-material enrichments to culture and wellbeing. The people of the area are least involved in any management and decision making to ensure sustainable utilization and conservation practices moreover the consequences of any devastation in these forests provides threats to the stability and protection of these stakeholders.

Objectives

The main objectives of the present study is to know the Current condition of natural resources and investigate Problems responsible for the degradation of natural resources by

perception analysis in the study area.

Data base and methodology

The study is totally based on primary data collection method. A multi stage cluster sampling was adopted for the selection of the respondent. Sampling was down in to three sub-regions respectively valley region, mid altitude region and high altitude region (Krishnaswami, 1999; Scoones and Thomson, 2000). From each region, four villages were selected for the study. Moreover, the household were selected randomly and considered as the ultimate sampling unit of inquiry. The total sampling size was 500. The sample size based on judgment sampling method (purposive sampling method) which is a non-probability sampling method based on researcher's own judgment about the representative population.

Profile of study area

The Upper Kosi watershed is situated in Almora district and extending from 290 33' 10"N to 290 52' 25" N and 790 30' 28"E to 790 44' 55" E covering an area of 462.81 km². The whole region is mountainous with successive mountain range and river valley. The altitude varies between 1,000m to 2,750m above mean sea level. In the north, the study area is separated by Birrachuwakot Dhar mountain from the Gomti river basin. This range is higher in the northwestern part i.e. above 2520 meters in elevation, and acts as the source of the Kosi River. Towards the north east, the demarcation range includes the upper parts of the Kausani reserved forest and follows 1800 meters contour approximately up to jogipatal and finally joins Binasar (2050 mts). It is bordered in the west by Ranikhet Tehsil, in the south by the Nanital District, in the east by the Lamgada block of district Almora and in the

In all sample villages of the study area sex ratio is favorable except in Bari village (806 females/1000 male). The highest sex ratio is found in Rekhai village (1346 female/1000 males). Out of total 12 villages, 9 villages are dominated by Kshatriyas, 2 by Brahmins and 1 by Schedule caste. Table 1 clearly shows that in 9 villages over all literacy is more than 80% while in 3 villages it is 44.45 percent (Deoli Khan), 69.05 percent (Parolia) and 57.09 percent (Naikara). The main source of livelihood of the people in the area is agriculture. Table 2 shows that the net shown area is the most significant of all land use categories e.g. in Lohana (42.5 ha.), Sutoli (35.1 ha.), Dal (28.6 ha.), Parolia (28.1 ha.), Barseela (24.8ha.) etc.

Table 1: Socio-Economic and Demographic Characteristics of Sample Villages

Characteristic	High Altitude Villages				Mid Altitude Villages				Low Altitude Villages			
	Doba	Deoli Khan	Dotial Gaon	Naikara	Lohana	Sutoli	Rekhai	Parolia	Tani	Dal	Bari	arseela
Total Population	386	891	860	268	243	149	251	559	59	531	56	91
Male	185	411	390	125	110	65	107	253	28	261	31	35
Female	201	480	470	143	133	84	144	306	31	270	25	56
Sex Ratio	1086	1168	1205	1144	1209	1292	1346	1209	1107	1034	806	1600
Caste (%)												
Brahmin	18.22	16.57	19.92	34.45	15.69	20.43	9.2	8.2	47.91	22.34	21.68	28.65
Kshatriya	67.45	69	46.56	52.34	38.48	58.45	67.89	35.54	23.89	53.67	49.82	47.9
Schedule Cast	14.33	14.43	33.52	13.21	45.83	21.12	22.91	56.26	28.2	23.99	28.5	23.45
Literacy (%)	86.79	44.44	89.07	57.09	87.24	85.23	86.45	69.05	86.44	85.88	87.5	87.91
Male	98.1	98.25	93.77	85.58	95.92	81.82	95.56	94.06	96	91.28	87.09	85.71
female	83.05	63.56	68.76	50.39	73.68	52.78	73.68	65.45	50	59.66	72.73	72
Agriculture	85.45	89.79	82.45	80.1	79.45	83.79	90.34	88	78.34	85.45	89.21	83.76
Non-agriculture	14.55	10.21	17.55	19.9	20.55	16.21	9.66	12	21.66	14.55	10.79	16.24
Household												
Income	58,000	55,000	56,000	61,000	63,500	54,448	64,778	68,540	78,809	75,567	59,605	58,256

Source: Field Based survey, 2013

Table 2: Land Resource Utilization Pattern in Sample Village (in ha.)

Land Use Category	High Altitude Villages				Mid Altitude Villages				Low Altitude Villages			
	Doba Khan	Deoli Gaon	Dotial	Naikara	Lohana	Sutoli	Rekhai	Parolia	Tani	Dal	Bari	Barseela
Forest	16	0	20	10	15	0	15.6	0	5.8	0	15.8	0
Irrigated land	3	0	2.8	4	61.5	5.2	0	5.2	0	0	0	4.7
Unirrigated land	21	15	300	6.5	0	4.8	17.1	46	5.7	46.3	4.6	11.4
Net shown area	15	2	1.5	0	42.5	35.1	2.7	28.1	6.5	28.6	0.6	24.8
Cultivable	15	2	80	15	0	2.8	7.8	11.7	1.1	0.7	3.3	23.8
Westland Land-holding/ HH (in ha)	.32	.38	.43	.46	.45	.39	.69	.78	.44	.58	.72	.66

Source: Field Based survey, 2013

The proportion of forest land is highest in Dotial Gaon (20 ha.) followed by Doba (16 ha.), Bari (15.8 ha.) and Rekhai (15.6 ha.). The average land holding size ranges between 0.32 ha. (Doba) to 0.78 ha. (Parolia) per household. Thus, the sample villages reveal that the biophysical as well as socio-economic characteristics varies among the villages of different ecological regions.

Resource utilization perception

Responses on need of environmental resource management, most of the respondents laid emphasis on the necessity and importance of resource management (81.6 %) while very few have show indifference nature (2.66%). The highest rate of awareness (81.6%) was recorded in the high altitude village followed by low altitude village (80%) and mid altitude village (78.66%). It reveals that people of high altitude villages are more conscious about their

resource management than the people of low altitude and mid altitude villages (Table 3). The reason might be that high altitude villages solely depend upon natural resources for their daily need in comparison to low altitude and mid altitude regions. Nevertheless, over 16 percent of population is still unaware and about 2.4 percent showed indifferent attitude towards the need and importance of resource management in the area.

Table 4 exhibits that 37.33 percent respondents in mid altitude and 25.6 percent respondents in high altitude villages feel that available environmental resources are fully utilized in the area, while 60.8 percent, 54.67 percent and 52.44 percent of respondents in the high altitude, mid altitude and low altitude villages respectively perceived that resource are not utilized properly. It is also notable that about 13.6 percent of respondents have no clear idea.

Table 3: Awareness on Resource Management, 2013

Sub Region	Respondents							
	Aware	%	Unaware	%	Indifferent	%	Total	%
High Altitude	102	81.6	20	16	3	2.4	125	100
Mid Altitude	118	78.66	28	18.66	4	2.66	150	100
Low Altitude	180	80	40	17.77	5	2.23	225	100

Source: Field Based survey, 2013

Table 4: Perception about full Utilization of Resources in the Watershed

SubRegion	Perception in percentage							
	Yes	%	No	%	No Response	%	Total	%
High Altitude	32	25.6	76	60.8	17	13.6	125	100
Mid Altitude	56	37.33	82	54.67	12	8	150	100
Low Altitude	84	37.33	118	52.44	23	10.23	225	100

Source: Field Based survey, 2013

Table 5 presents the factors that are mainly responsible for low level of resource utilization in the area. 46.23 percent of respondents stated that backwardness is accountable for low level of resource utilization while 34.22 percent, 22.56 percent and 6.74 percent answers that inappropriate government policy, lack of adequate people's participation and

Table 5: Cause of Low Level of Resource Utilization in the Watershed

Sub Region	Perceived Factors (in %)				
	Lack of People's Participation	Govt. Policy	Backwardness	insecurity	No Response
High Altitude	21.45	23.48	46.23	6.74	2.1
Mid Altitude	22.56	34.22	36.78	4.47	1.97
Low Altitude	21.34	32.98	37.55	2.34	5.79

Source: Field Based survey, 2013

growing insecurity are responsible for low level of resource utilization in the area respectively. Nearly 46 percent respondents in the high altitude perceived inaccessible rugged terrain and socio-economic backwardness are the main reason for resource management of the area, while more than 32 percent respondents in the low altitude village blames government policy.

Perception on benefit from resource conservation

The majority of the respondents reported that the benefit from environmental resources management will make easy to collect the fuel, fodder and forage (F3). The highest (17.33%) proportion of respondents stated that fodder/fuel collection is most important benefit in the

low altitude followed by high altitude (14.4%) and mid altitude (10 %) villages. The second benefit is the protection of bio resources in forest and farm land ecosystems. The percentage share of respondents in this category varied from 11.2 percent in high altitude area to 14.67 percent in low altitude area (Table 6). Equally, the third benefit perceived by the respondents

is increasing in land productivity. In this regard, the low altitude area stands first (14.22%) followed by high altitude area (8%) and mid altitude area (5.33%) while the other benefits are income generations, control of soil erosion, water resource conservation, causing rainfall and control of incidence of floods/ landslides etc.

Table 6: Benefits from Resource Conservation in the Watershed

Perceived benefits	Respondents							
	Ridge Villages		Mid Villages		Valley Villages		Key Informants	
	No.	%	No.	%	No.	%	No.	%
Land productivity increase	10	8.0	8	5.33	32	14.22	6	8.10
Regular rainfall	23	18.4	14	9.33	12	5.33	5	6.76
Bio-resource protection	14	11.2	21	14.00	33	14.67	8	10.81
Soil erosion control	11	8.8	17	11.33	6	2.67	9	12.16
Water resource conservation	14	11.2	16	10.66	10	4.44	7	9.47
Easy to get F3	18	14.4	15	10.00	39	17.33	8	10.82
Flood/ land slide control	6	4.8	41	27.33	79	35.11	14	18.92
Income generation	19	15.2	7	4.67	8	3.56	6	8.10
No response	10	8.0	11	7.35	6	2.67	11	14.86
Total	125	100.00	150	100.00	225	100.00	74	100.00

Source: Field Based survey, 2013

benefits perceived by 3.56 percent, 2.67 percent, 4.44 percent, 5.33 percent and 35.11 percent of respondents respectively. However, more than 2.5 percent of respondents have indifferent attitude on the benefit of resource development. On the other hand, 10.81 percent of key informants reported bio-resource protection, 8.10 percent income generation, 10.82 percent F3 supply, 12.16 percent control of soil erosion, 18.92 percent flood control, 9.47 percent of water resource conservation and 8.10 percent productivity increase are the main benefits from the current ongoing

environmental resource utilization and conservation programmes in the area.

Deforestation

Decline in the forest area is one of the severe threats to the environment in the region. Since many decades, the process of ongoing deforestation has lead to the deterioration of environment across the region. Over exploitation of the forest for meeting basic needs and the failure of government policies are the fundamental causes for rapid deforestation. For the last 5 decades, forest resource has continually been decreasing annually by 1000 ha.

Table 7 illustrates factors responsible for rapid deforestation perceived by respondents in the area. All the factors are mutually interrelated to each other. About 18.67 percent of respondents considered over-exploitation of forest for fuel, fodder and forage (F3) are the main factor responsible for massive deforestation in the area while 7.99 percent of respondents felt that uncontrolled grazing and foraging as the second important causative factor accountable for the depletion of forest in the area. Likewise, more than 12.23 percent of respondents felt that the expansion/extension of cultivated land and felling of forest by the contractors for the commercial purpose accelerate the rate of deforestation in the area.

Table 7: Causative Factors of Deforestation (%) in the Watershed

Factors	Respondents = 500			
	High Altitude 125	Mid Altitude 150	Low Altitude 225	Key Informants 74
Conservation in to Cultivated Land	5.71	11.23	12.23	11.56
Hill Slop Cutting/ Land Slide	16.67	8.98	2.34	6.90
Construction Work	3.20	8.65	11.23	9.34
Over Exploitation of F3	18.99	14.10	18.67	15.78
Extraction of Timber by Outsiders	3.45	11.34	13.33	11.29
Freely Extraction of herbal plant	10.49	2.44	4.78	4.67
Overgrazing and Foraging	3.90	15.28	7.99	10.50
Temporal Changes in Forest Policy	12.89	5.30	11.33	8.89
Inadequate Peoples Participation	11.24	14.59	6.44	14.55
Firing	9.50	6.85	10.34	6.52
No Response	3.96	1.24	1.32	

Source: Field Based survey, 2013

However, perception varies at village level. In high altitude village respondent felt that overexploitation to fulfill the need of F3 (18.9%) as well as hill slope cutting, landslide (16.67%) and extraction of herbal plant (10.49%) are major causes for deforestation. In the low altitude region, the major causes are cultivated land (12.23%), construction work (11.23%) and extraction of timber by outsiders (13.33%).

However, the situation in mid altitude vil-

lage is slightly different. In mid altitude region where the majority of respondents stated that the Overgrazing / Foraging (15.28%), inadequate peoples participation (15.49%), subsequent failure of people's support to the government officials are major factor responsible for rapid deforestation in the area. It is pertinent to note that the deforestation in the region is being a result of a complex chain of events, involving a number of different agents and causes in each locality at point in time. At

present, land clearing for agriculture, cattle rearing, infrastructure development, growing human requirements, improper technology, temporal change in forest policy are the main agent which accelerate the process of deforestation in the study area.

Table 8 presents the environmental effects of deforestation in the study area. Overall 20.56 percent of respondents stated that scarcity of F3 is the main ill effect of deforestation followed by erratic rainfall (18.89%), fertility decline (16.77%), incidence of flood and drought (13.27%), water source depletion (12.22%),

intensive soil erosion (10.5%) and extension of bio-species (7.79%). In high altitude region, the major threat is F3 scarcity (22.89%) followed by fertility decline (17.23%), intensive soil erosion and water source depletion. In the mid altitude village 21.23 percent of respondents felt that F3 scarcity is the main effect followed by fertility decline (19.98%), water source depletion (18.22%), intensive soil erosion (16.78 %) etc. On the other hand, during the FGDs it was found that due to deforestation, flood and drought is main threat in the region.

Table 8: Perceived Effects of Deforestation in the Watershed

Perceived Effect	Respondents = 500			Key informants
	High altitude	Mid Altitude	Low altitude	
Intensive Soil Erosion	15.67	16.78	10.50	11.11
Fertility Decline	17.23	19.98	16.77	16.78
Erratic Rainfall	12.45	9.99	18.89	13.29
F3 Scarcity	22.89	21.23	20.56	14.86
Incidence of flood and Drought	12.33	9.78	13.27	21.21
Water Source Depletion	13.67	18.22	12.22	11.21
Extension of Bio-Species	5.76	4.02	7.79	11.54

Source: Field Based survey 2013

It is apparent that most of the respondents considered that deforestation and land degradation are interrelated, the impacts are indivisible, and the crises of fuel, fodder and forages increases day by day. Table 9 exhibits the time and distance covered by the people to collect

fuel and fodder. During the survey it was found that the time and distance increases tremendously in last twenty five years. The time increases up to 1.5hr to 2 hr. and distance up to 2 to 2.5 km in the region.

Table 9: Time Spent in Collecting Fuel and Fodder Wood in the Watershed

Sub Division	25Years ago		Present	
	Distance (km.)	Time (hours)	Distance (km)	Time (hours)
High Altitude	4.0	5.0	7.5	7.0
Mid Altitude	3.5	4.0	5.5	5.6
Low Altitude	2.8	3.5	5.0	5.0

Source: Field Based survey 2013

Soil erosion

Loss of top soil is another serious environmental problem prevailing in the area. Ever increasing demand of land for cultivation, cattle rearing and area under non agriculture accelerate the soil erosion in the area. The slope, topography, geology and climatic variation in

time and space are also seemed equally responsible for the excessive soil erosion. Recently on the name of development several construction works are going on which further intensified soil erosion (Table 10). There is prominent difference in perception level of respondents regarding soil erosion in the area.

Table 10: Causes of Soil Erosion in watershed

Perceived Factors	Respondents					
	High Altitude		Mid Altitude		Low Altitude	
	No	Percent	No	Percent	No	Percent
Deforestation	29	23.2	54	36.0	82	36.44
High Run off	12	9.6	8	5.33	18	8.0
Construction Work	16	12.8	19	12.67	40	17.78
Hill Slope Cutting	28	22.4	34	22.67	26	11.56
Overgrazing	30	24.00	23	15.33	25	11.11
Flooding	10	8.00	12	8.00	34	15.11

Source: Field Based survey 2013

About 24 percent of respondents in the high altitude region felt that overgrazing is the main reason of soil erosion in the area. While in mid altitude and low altitude area about 36 percent and 36.44 percent considered deforestation is the main cause for massive soil erosion respectively. Likewise, 22.67 percent and 12.67 percent respondents in the mid altitude region felt that hill slope cutting and construction work is responsible for excessive soil erosion in the area.

It is evident from the table 11 that the anthropogenic activities are highly responsible for rigorous soil erosion in the entire area. While

gathering information regarding effect of soil erosion, 43.53 percent of the respondent stated that decline in productivity, loss of vegetation cover (36%) and siltation / sedimentation (20.44%) are the main consequence of soil erosion in the region.

There is a difference in the opinion in all the zones. More than 40.89 percent of respondents stated that intensity of drought is the main reason followed by loss of soil fertility (34.67%), overflow and siltation (14.22%) and extinction of organic matter (10.22%) leads to decline of land productivity tremendously over the region (Table 12).

Table 11: Effects of Soil Erosion and Land Slide in the Watershed

Perceived Factors	Respondents					
	High Altitude		Mid Altitude		Low Altitude	
	No	Percent	No	Percent	No	Percent
Loss of Vegetation Cover	54	43.2	52	34.67	81	36.00
Decline in Productivity	59	47.2	82	54.66	98	43.56
Siltation and Sedimentation	12	9.6	16	10.67	46	20.44

Source: Field Based survey 2013

Table 12: Causes of Productivity Decline in the Watershed

Perceived Factors	Respondents					
	High Altitude		Mid Altitude		Low Altitude	
	No	Percent	No	Percent	No	Percent
Loss of soil Fertility	34	27.2	62	41.33	78	34.67
Increasing Intensity of Drought	22	17.6	42	28.00	92	40.89
Overflow and Siltation	24	19.2	28	18.67	32	14.22
Extinction of Organic Matter	45	36.0	18	12.00	23	10.22

Source: Field Based survey 2013

It was noted that most of respondents are well aware about the environmental problems such as causes and consequences of soil erosion, productivity decline, environmental deterioration etc. persist in the region.

Water resource depletion

Over the decade due to massive deforestation throughout the region, water resource depleting rapidly. Several water springs, gads, gadheras and naulas are drying up causing massive water scarcity in the region. While getting the perception regarding the main cause of water resource degradation in the region it was found that in all the zones respondent felt that drying up of springs is the major cause of water resource degradation in the region followed by inadequate water supply (21.78%), depletion of water quality (18.67%), problem of

water leakages (15.56%) are the main cause of water resource degradation in the region (Table 13).

Majority of the people in the study area are aware of the causes and consequences of present ongoing environmental changes and of the opinion that necessary steps should to be taken for resource conservation. The deforestation, soil erosion, growing scarcity of fuel, fodder and water are serious environmental threats prevailing in the area. The perception analysis also brings out the fact of their awareness about the existing problems and measures for natural resource management with people's participation which will certainly lead to ecological regeneration and slow down the rate of environmental degradation.

Table 13: Perceived Problems of Water Resources in the Watershed

Perceived Factors	Respondents					
	High Altitude		Mid Altitude		Low Altitude	
	No	Percent	No	Percent	No	Percent
Drying up of Water Springs	38	30.4	46	30.67	68	30.22
Depletion of Water Quality	16	12.8	24	16.00	42	18.67
Over Flow (Flooding)	7	5.6	3	2.00	18	8.00
Inadequate Water Supply	32	25.6	44	29.33	49	21.78
Problem of Water Leakages	18	14.4	28	18.67	35	15.56
Inter community conflicts	14	11.2	5	3.33	13	5.78

Source: Field Based survey, 2013

Conclusion

For long land, water and forest biomass managements have been tried but separately, The peoples participation and collective actions are critical ingredients for management programs as it involves the trio of sustainability, equity and participation. Integrated watershed management ensures equitable access to livelihood resources and active peoples' involvement in securing and nurturing the ecological, economic, and social well-being of the habitat. It is very clear from the perception study that the Upper Kosi watershed requires a holistic plan wherein the trio of forestland, pastureland and crop land ought to be symbiotic in relationship providing a platform for maximum synergy in managing land water and forest biomass of the region. It is pertinent that the forestland, pastureland and cropland must have a symbiotic relationship amongst each other.

With increasing population both human and bovine, the stress upon the existing pasture and forest land increases as they are converted into cropland, so it is important that a healthy relationship between the trio of watershed management be in symbiotic state.

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