Analysis of factors determining Wasteland in Kalsa River Basin of District Nainital, Uttarakhand

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ABSTRACT

One of the serious issues of environmental degradation is the land degradation due to which land productivity is decreasing and problems of food scarcity, lack of fuel and fodder are arising in the mountainous regions. This problem is very critical in the Himalayan Mountain region and affects its ecology adversely. During the past years, various developmental schemes in the Himalayan region have given rise to destruction of its environment. The irreparable damage to this mountain system through slope cutting for construction of roads, blasting for construction of dams, canals, settlements, and other institutions has given rise to the serious degradation of land. Due to various construction activities occurring in the region, the problem of soil erosion, landslides etc. are rapidly increasing. Simultaneously land degradation due to desertification, soil salinity, water logging, flooding, droughts, excessive soil erosion due to deforestation and unscientific agricultural practices have resulted in the creation of wastelands (Moghe&Kalra, 1988; Choubey, 1997; Soni & Lave Son, 2003; Goyal et al, 2005). Such mis- management of land resources are converting more and more land into wasteland. Wastelands are type of lands which are formed due to the complex interaction of various processes at varying intensity. The combined impact of man and environment interaction and the varying levels of technology inputs are the main factors in the formation of wastelands. The present investigation provides a detailed study of various factors that determine wasteland in the region.

1. INTRODUCTION

Although the concentration of wasteland area is basically governed by the pressure of population on the land, physical, agronomic, and socio-economic hazards such as unhealthy agroclimatic conditions, corrosive action of surface drainage, low fertility of the soil, lack of irrigable water, salinity or alkalinity, deep rooted grasses and weeds, damage by wild animals and limited economic means (Kharakwal, 1990). Factors determining wastelands in Himalayan region are somewhat different from the plain regions. The main factors associated with mountain environment are altitude, slope, soil composition, drainage pattern, complexity of local climate, accessibility etc. These factors are responsible for determining land use and its capability in hilly regions. For investigating the factors determining wastelands in the study area which lies in lesser Himalayan region of Uttarakhand two broad factors Anthropogenic and Physical were analyzed.

2. Study Area

The catchment area of the Kalsa river basin lies in the lesser Himalayan zone demarcated by Siwaliks in the South. Kalsa one of the principal tributaries of River Gaula is located between the latitudes of 29°16" to 29°27" north and longitudes of 79°32" to 79°47" east (Fig. 1).

The Kalsa river basin covers an area of 145.5sq.km. The river has its source at an altitude of 2080 m above mean sea level. Average elevation of the basin ranges between 1400 m to 2400 m. Administratively Kalsa River basin falls in district Nainital of the Kumaon division of Uttarakhand. It is represented in the survey of India topographical sheet no. 53O/11. The study area includes portions of Dhari, Bhimtal and Ramgarh blocks. 36 villages of these three blocks fall in the study area having a population of 23226 people according to Census 2001.

Location Map of Kalsa Basin

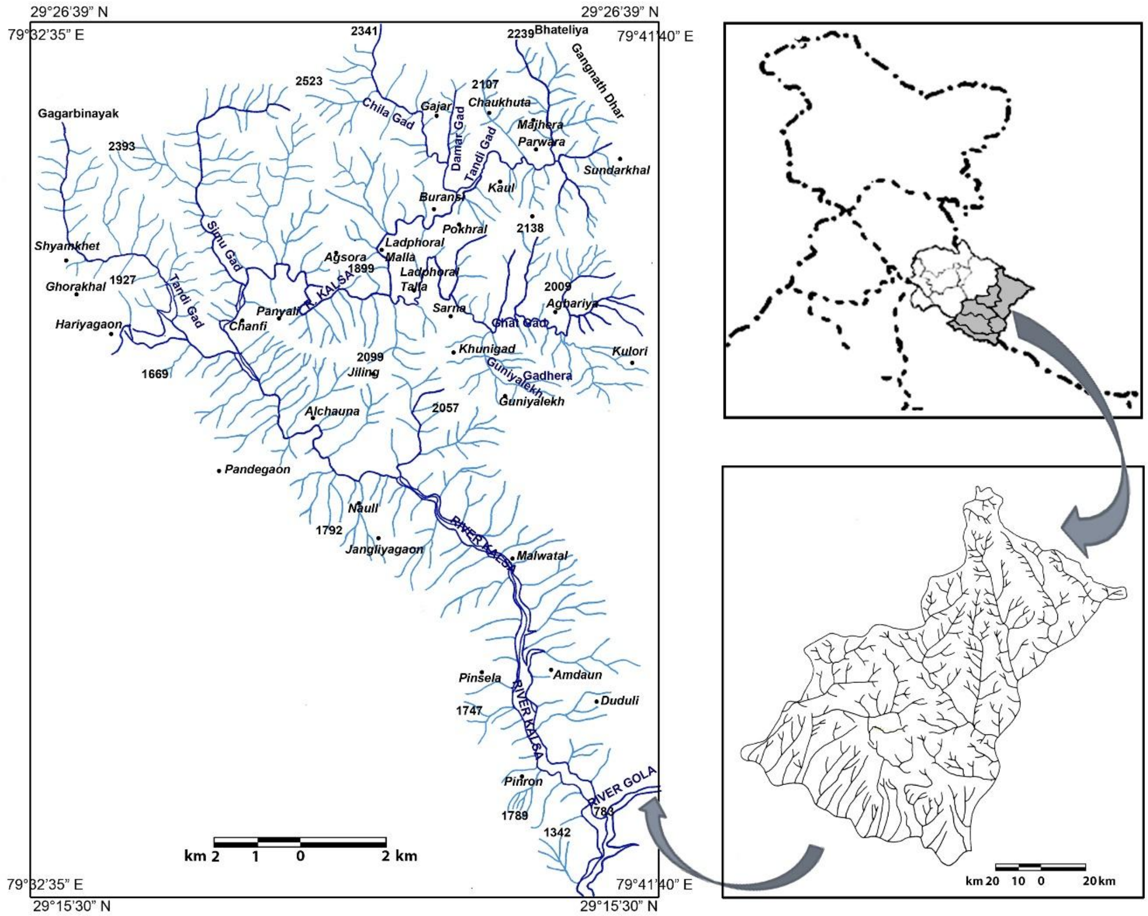

Figure .1

3. Methodology and Database

3.1 Primary Data base

Case Study

Field mapping Exercise - Two types

(I) Inventory of damage land through Dairy records- Natural and Human Factors

(II) Delimitation of existing land use through Cadastral maps

3.2. Secondary Data base

a. Tabular data- Census data, Land Record, Statistical handbooks

b. Map data – Topographical sheet, cadastral maps

4. Village Level Analysis of Physical Factors

Each component of landscape has a considerable effect on the distribution of wasteland. The distribution of wasteland in relation to height, slope and slope aspect has been considered in this section for interpretation. Village level analysis of physical factors has beencarried out here on the basis of Secondary data of all 36 revenue villages in the study area.

4.1 Height and Wasteland Formation

It is presumed that the relationship between height, magnitude of slope and cultivated land is generally negative while it is positive between height, slope and cultivated wasteland. Table1 shows that a maximum of 41.67 percent villages lie in the height group of 1700 to 1900 m and a majority of them (30%) are in the wasteland group of 30 to 40 percent. A minimum of 27.77 percent villages are in height group of above 1900m of which 40 percent falls in the wasteland group of 30 to 40 percent. While below 1700m group constitute 30.55 percent of the villages of which highest 36.36 percent falls in wasteland group of above 40 percent. It can be observed from the table that a maximum of 12 villages fall in the wasteland category of 30 to 40 percent in various height groups. Minimum of 4 villages have wasteland below 20 percent of their total geographical area while 11 villages have wasteland above 40 percent. Wasteland group of 20 to 30 percent comprises 9 villages in various height groups

Table 1 Distribution of Villages under Height and Wasteland categories in Kalsa river basin

Height in metres	Percentage of wasteland				
	Below 20	20-30	30-40	Above 40	Total
Below 1700m	1 (9.09)	3 (27.27)	3 (27.27)	4 (36.36)	11 (30.55)
1700-1900	2 (13.33)	4 (26.67)	5 (30)	4 (26.67)	15 (41.67)
Above 1900m	1 (10)	2 (20)	4 (40)	3 (30)	10 (27.77)
Total	**4 (11.11)**	**9 (25)**	**12 (33.33)**	**11 (30.35)**	**36 (100)**

Source: Field Survey, 2011

4.2 Average Slope and Wasteland Formation

The main reason for the large proportion of land as wasteland is construction of small size of field parcel by digging the sloppy mountainous land and their fragmentation to different places. Table 2 shows that the maximum 58.33 percent of the villages were found in the slope group of 20 to 30 degree with a maximum of them (28.57%) having wasteland between 20 to 40 percent followed by 30.55 percent villages accounting for below 20 degree of slope. A minimum of 11.11 villages fall in the slope category of above 30 degree. Highest percentage of villages is found in the wasteland category of 20 to 40 percent covering 20 villages in various height groups.

Table 2 Distribution of Villages under Different Slope and Wasteland Categories in Kalsa River Basin

Slope in degrees	Percentage of Wasteland				
	Below 20	20-30	30-40	Above 40	Total
Below 20^0	2 (18.18)	2 (18.18)	4 (36.36)	3 (27.27)	11 (30.55)
20^0-30^0	5 (23.81)	6 (28.57)	6 (28.57)	4 (19.05)	21 (58.33)
Above 30^0	1 (25)	2 (50)	--	1 (50)	4 (11.11)
Total	**8 (22.22)**	**10 (27.78)**	**10 (27.78)**	**8 (22.22)**	**36 (100)**

Source: Field Survey, 2011

5. Household level Analysis of Anthropogenic factors

The analysis of anthropogenic factors that influence wasteland is based at household level, these factors include land holding size, number of occupational engagements, working population, number of cultivators, literacy, irrigated land which are being correlated with the wasteland data gathered at household level in three sample villages through questionnaires. Out of total 565 households, 438 households have wasteland. The analysis of the data has been done based on these households' possessing wastelands. A summary of each variable selected for the present analysis is presented below to understand their relationship with the wasteland.

5.1 Land Holding Size and Wasteland Formation

Land holding is one of the important variables which influences wasteland to a very considerable extent. The cultivators hold tiny pieces of land scattered over many locations. According to sample study the average number of agricultural patches per family are 12 and their size ranges between 1 to 2 nali (while 50 nali is equal to 1 hectare). A maximum of 49.08 percent households owned land below1.0 acre. About 50 percent of households in this category share wasteland below 15 percent. Only 10.96 percent of households owned the land holding size of above 2.0 acre having maximum concentration of wasteland in 15 to 30 percent group. The households which own landholding size between1 to 2 acre are 39.95 percent of total households. The maximum percentage of which (38.86%) fall in the 15 to 30 percent wasteland category (Table 3)

Table 3 Land Holding Size and Wasteland formation in selected sample Households in Kalsa River Basin, 2011

Land holding size in acre	Percentage of wasteland			Total Families having wasteland
	Below 15	15-30	Above 30	
Below 1.0	106 (49.30)	78 (44.57)	31 (14.41)	215 (100) (49.08)
1.0 to 2	67 (38.29)	68 (38.86)	40 (22.85)	175 (100) (39.95)
Above 2	13 (27.1)	19 (39.57)	16 (33.33)	48 (100) (10.96)
Total	**186 (42.46)**	**165 (37.67)**	**87 (19.86)**	**438 (100) (100)**

Source: Field Survey, 2011

5.2 Number of occupational engagement and Wasteland formation

It was assumed that wasteland will be observed mostly in those families which have secondary source of occupations other than agriculture compared to those which depend fully on agriculture. From the table (4) about 58 percent of households are engaged purely in agriculture of which 33.46 percent households are having wasteland between 15 to 30 percent, 24.41 percent are having wasteland above 30 percent while highest of 42.13 percent are having wasteland below 15 percent. A total of 42.01 percent households are engaged in agriculture with secondary occupation as main economic supporting system of which 40.22 percent households have wastelands above 30 percent. A total of 150 households (34.25%) have wasteland below 15 percent while highest 152 households (34.70%) of households are having wasteland between 15 to 30 percent. households falling in the wasteland category of above 30 percent are 136 which is 31.50 percent of total households having wastelands.

Table 4 Occupational Engagement and Wasteland Formation in Selected Sample Households in Kalsa river Basin, 2011

No of occupational engagement	Percentage of Wasteland			Total Families having wasteland
	Below 15	15 -30	Above 30	
Only agriculture	107(42.13)	85(33.46)	62(24.41)	254(100) (57.99)
Agriculture with any other occupation	43(23.37)	67(36.41)	74(40.22)	184(100) (42.01)
Total	**150(34.25)**	**152(34.70)**	**136(31.05)**	**438(100) (100)**

Source: Field Survey, 2011

5.2 Cultivators and Wasteland Formation

The wasteland is vitally influenced by the degree of involvement of cultivators in agriculture. It was assumed here that the highest proportion of wasteland shall be observed in those households which do not have a sufficient involvement in agriculture. It is clear from table 5 that out of a total 438 households under wasteland category, maximum of 46.12 percent households are having cultivators above 40 Percent of total family population. There are about 19.86 percent households having below 30 percent cultivators and, in this category, a maximum 0f 43.68 percent wasteland is above 30 percent. While 24.66 percent of households have cultivators, 30 to 40 percent of their total family population. This analysis shows that the lower percentage of cultivators in the household results in the highest amount of wasteland with them. There are 41 families having not a single person involved in cultivation.

Table 5 Cultivators and Wasteland Formation in Selected Sample Households in Kalsa River Basin, 2011

(%) of cultivators to total family Population	Percentage of Wasteland			Total families having wasteland
	Below 15	**15 -30**	**Above 30**	
Cultivators' nil	--	16 (39.24)	25(60.76)	41(100) (9.36)
Below 30	27(31.04)	22(25.28)	38 (43.68)	87(100) (19.86)
30-40	35(32.41)	43(39.81)	30(27.77)	108(100) (24.66)
Above 40	35(17.33)	98(48.51)	69(41.32)	202(100) (46.12)
Total	**97(22.46)**	**179(40.87)**	**162(36.99)**	**438(100)**

Source: Field Survey, 2011

5.3 Literacy and Wasteland Formation

The education seems to exert a positive influence for the wasteland formation since most of the educated family members prefer to move out in search of other jobs, and the unemployed youths are only performing agriculture. It is clear from the table.

6 that out of total families having wasteland a maximum of 42.69 percent fall in literacy group of above 60 percent. On the other hand, a minimum of 22.37 percent households with wasteland are having literacy rate of below 30 percent. About 34.93 percent of households have their literate population between 30 to 60 percent.

The households having below 30 percent literate population have highest percentage of wasteland in below 15 percent group while the households having above 60 percent rate have highest percent of wasteland in 15 to 30 percent category. This shows that as the people attain more education, they show less interest towards agricultural activities and switch to other economic activities rendering their cultivated land as waste.

Table 6 Literacy and Wasteland Formation in Selected Sample Households in Kalsa River Basin, 2011

(%) of literate Population to total family Population	Percentage of Wasteland			
	Below 15	15 -30	Above 30	Total Families having wasteland
Below 30	47 (47.96)	21(21.43)	30 (30.61)	98(100) (22.37)
30 to 60	66 (43.14)	48 (31.37)	39 (25.49)	153(100) (34.93)
Above 60	65 (34.76)	69 (36.90)	53 (28.34)	187(100) (42.69)
Total	**178 (40.64)**	**138 (31.51)**	**122 (27.85)**	**438(100) (100)**

Source: Field Survey, 2011

5.4 Irrigated land and Wasteland Formation

Most of the upland villages are unirrigated and the irrigation facilities, however inadequate, are available in the valley areas. It is therefore assumed here that the highest proportion of wasteland is found in those families which have a small amount of irrigated land or fully unirrigated cultivation. Out of the total households having wasteland, maximum of 59.36 percent households do not have irrigated land (Table 7). About 15.52 percent households having irrigated area above 60 percent. Out of which 27.94 percent fall in the category of wasteland above 30 percent. a minimum of 11.41 percent households are having irrigated land ranging between 50 to 60 percent, while

13.70 percent households fall in the category of below 50 percent irrigated land. Out of the total 438 families having wasteland 260 families or 59.36 percent have no irrigated land. The maximum of 109 families or 41.92 percent of them are having wasteland between 15 to 30 percent.Table 7 Irrigated land and Wasteland Formation in Selected Sample Households in Kalsa River Basin, 2011

% of irrigated land to total land	Percentage of Wasteland			Total Families having wasteland
	Below 15	15-30	Above 30	
Unirrigated Land	93(35.77)	109(41.92)	58(22.31)	260(100) (59.36)
Below 50	17(28.33)	18(30)	25(41.67)	60(100) (13.70)
50 -60	19(38.00)	21(42.00)	10(20)	50(100) (11.41)
Above 60	21(30.88)	28(41.18)	19(27.94)	68 (100) (15.52)
Total	150(34.25)	176(40.18)	112(25.57)	438(100) (100)

Source: Field Survey, 2011

6. Other Factors of Wastelands

The factors such as labor shortage, low agricultural productivity, remoteness, erosion, mining, social disputes, and religious emotions are some of the reasons responsible for the land being not used for agricultural purposes and thus lying unused. These lands are converted into wasteland left for growing grasses. The wasteland due to river cutting is also found in the sample study. However Correlation analysis was performed with only those factors for which data is gathered.

6.1 Correlation Analysis

The summary statistics of some of the variables and their bivariate relationship with wasteland has been attempted. These relationships have indicative of different tendencies of a different formation process of wasteland. The instrumentality of these factors in bringing about a clear picture of the formation of wasteland therefore needs further examinations. The extent of influence exerted by these factors so as to obtain their relative importance as well as their functional association with the wasteland formation is also equally important.

The nature and availability of relevant information regarding these factors posed limitations on the selection of the factors for the study of their functional relationships with wasteland. Hence only limited number of factors has been chosen from multiple of them keeping in view availability of data pertaining to them. Thus the variables selected for the analysis is belonging to socio economic background of the farmers are as follows:

X1 =Wasteland

X2= Total village land X3= Male literacy
X4 =Female literacy X5 = Livestock
X6 =Number of Cultivators

X7=Number of non-agricultural population X8 = Irrigated land

The analysis has been performed for a combined data set of all 565 households belonging to three sample villages. Correlation matrix is worked out among all 8 variables in order to detect the actual contribution of each variable in the formation of wasteland. It is clear from the correlation matrix (Table-8) that there is significant positive correlation between wasteland and total land (0.61) and irrigated land (0.34) which are significant at 0.001 level. This shows that size of land determines the quantum of wasteland. The positive correlation between wasteland and irrigated land reflects wasteland may also be found in those families of sample villages which have sufficient irrigated land and therefore remaining unirrigated land is left barren. It is worth mentioning the fact that the determinant category of wasteland is cultivable wasteland in the study region which is also reflected in the correlation analysis performed in this section. Since the availability of agricultural land is subjected to total cultivated area of the villages and the irrigated facilities existing in the villages. The highest positive correlation of wasteland is therefore found with the above two factors.

Table 8 Correlation Matrix

	X1	X2	X3	X4	X5	X6	X7	X8
X1	1.00							
X2	0.61**	1.00						
X3	0.134*	0.457**	1.00					
X4	0.065*	0.018	0.092	1.00				
X5	0.054	0.61**	0.23**	0.17	1.00			
X6	0.16*	0.28	0.31	0.16	0.21**	1.00		
X7	0.05	0.11	0.468	0.32**	0.16	0.09	1.00	
X8	0.34**	0.47**	0.19*	0.17	0.117	0.065	0.67**	1.00

*significance at 0.01 level, **Significance at 0.001 level.

It shows that a greater number of people engaged in cultivation in a household is a prerequisite for the successful agricultural operations which is but slightly being reflected in the wasteland formation because of the interferences from other socio-economic conditions of the households.

Conclusion

Normally, it is expected that labour shortage in the families make almost impossible to bring all land use under cultivation. However, it is determined by the size of land holding also. Although there are some other factors viz. male and female literacy, migrated persons, fodder scarcity etc. exerting more influence on the extent of wasteland formation. One significant correlation (0.134) was observed between wasteland and male literacy which is significant at 0.01 levels. It reflects the out migration of literate male workers from the households and thereby rendering the land as wasteland in those families. Other factors such as female literacy, livestock and number of non-agricultural populations have almost negligible relationship with the wasteland.

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