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PATTERNS OF LANDUSE AND AGRICULTURE IN GARHWAL REGION

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ABSTRACT

Topographical conditions of any region have a direct bearing on its landuse, economy, socio-cultural aspects, population characteristics and overall development. Garhwal, largely being a hilly region is a living example of it. In the present paper, an attempt has been made to discuss the physical conditions of the study area and the resultant patterns of its landuse and agriculture. This is predominantly a region of agriculture-based economy. There are marked variations in the landuse and agriculture from one block to another, from plains to hills and from valleys to upper reaches.

KEY WORDS:-Patterns, landuse, Agriculture, Cultivation, Garhwal.

INTRODUCTION

The term 'land use' is self-explanatory, i.e., use of available land in various activities. There are several general definitions of landuse. The first land utilization survey of Britain held in 1931 defined it as, "purpose of surface of the country for use" (Stamp, 1948). It also deals with the human activities on land which are directly related to the land (Clawson, and Stewart 1965). Stamp further defines land use as literally the use which is made by man of the surface of the land but in sparsely populated areas including the natural or semi – natural vegetation (Stamp, 1961). Certain geographers have extended the definition in this way to allow the infiltration of types of vegetation as land use categories. There exists a conflict of definitions which expresses itself in two dimensions: the functional use of land for man's purposes (agricultural, forestal, residential, recreational, etc.) as opposed to simply the form of ground cover (crops, trees, houses, moorland, etc.). A general definition, however, has been given as follows:-

Landuse deals essentially with the spatial aspects of all man's activities on land and the way in which the land surface is adapted, or could be adapted, to serve human needs (Best, 1968). The agricultural use of land and the related pattern is again the result of Physico–cultural factors and only 11% of the total area is net sown area of Garhwal as most of it (67.28%) is under forests.

The Study Area

Garhwal region lies between 77° 33' 30" E to 80° 6'E. Long and 29° 5'N to 31° 26'30"N Lat, covering an area of 32,449 Sq. km. The region is separated from Kumaon in the east and from Himachal Pradesh in the west. The northern boundary is demarcated by Tibet (China), while Uttar

Pradesh lies in the South. It incorporates the foot-hill zone and Bhabar belt to snow covered areas of the Himadri. There are 7 districts, 30 tehsils, 54 development blocks, 382 Nyaya Panchayats, 8658 villages and 50 urban centres in the region.

Fig.1

The region has varied topographical features from low river valleys to very high mountains and between these extremes of elevation are high valleys, narrow plains, foot hills, low mountains and plain areas. Thus, there are four main physiographic zones of the region: - (1) Bhabar – upper Ganga Tract, (2) Shiwalik, (3) Himachal and (4) Himadri.

The Bhabar belt is situated south of the Shiwalik Hills, characterised by huge beds of boulders under the porous gravelly soil, remarkable for absence of water. Due to very thin layer of the top soil, heavy soil erosion and absence of water, most of the area is not suitable for agriculture. The upper Ganga plain lies to the south of the Shiwaliks and lacks topographic prominences and the monotony of the physical landscape. In Garhwal, the Shiwaliks form a long chain of narrow and low hills from the north; these ranges have been separated from the Himachal by the M.B.T. These ranges present the latest phases of Himalayan orogeny and are characterized by fault scarps, anticline crests and synclinal

hills (Kharkwal, 1993). This zone reveals a typical drainage pattern. At places, the Shiwaliks and lesser Himalayan ranges are separated by longitudinal structural valleys, known as 'DUNS'.

The Himachal is the central part of the Himalaya. The region comprises of the rocks varying in nature and age and presents a tangled mass of series of ridges divided from each-other by deep valleys. The average relief varies from 1500m to 2700m (ridges) and 500m to 1200m (valley bottoms). A number of hill resorts are located in this zone. The Himadri (Greater Himalaya) zone is structurally separated from the Himachal (Lesser Himalaya) by the M.C.T. These ranges make sudden rise right from MCT. This zone is almost 50 Km wide and the mean relief varies from 4800m to 6000m, and consists of glaciated peaks. This is the source of many rivers like the Ganga, Yamuna and their tributaries. Gangotri–Yamunotri group of peaks, Kedarnath, Badrinath and Nanda Devi (7816 m) are located in this zone.

The climatic conditions of this region are the most important element in their natural setting as they practically influence the entire mixture of physico–cultural phenomena. Elevation, relief features, slope aspect, proximity of glaciers, forests, etc. are the main controllers of climate in the region. Micro climates are of great significance. The two main climatic characteristics of the Himalayan region are the seasonal rhythm of weather and the vertical zoning (Wadia, 1961). The climate of the region varies from hot and sub – humid tropical in the southern part of Bhabar to temperate, cold alpine and glacial in the northern part. The monsoon commences by the end of June and terminates by mid – September. Winter depressions cause snowfall. The annual rainfall varies from 175 cm to 300 cm. The amount of precipitation decreases in the north of the main ranges.

Garhwal region is well known for its water resources as it is drained by a number of rivers and rivulets. It serves as a perpetual reservoir of water for most of the rivers crossing into the Great Gangetic Plain. Most of the region is occupied by the Ganga system. The Alaknanda & the Bhagirathi form the Ganga from Devprayag. The Nandakindi, Mandakini, Pindar, Birahi, Balkhila, Ningol etc. are the major tributaries of the Alaknanda, while the Bhagirathi has the tributaries like Bhilangana, Jadganga, Kaligad, Jaipur, Varuna, Assi, Etc. The Nayar (draining almost the whole Garhwal district) meets the Ganga at Vyasi. Other important system belongs to the Yamuna with its tributaries, like, the Tons, Supin, Rupin, Pabar, Asan, etc. The Ramganga takes its origin in the eastern slopes of Doodhatoli hills and leaves the hills at Kalagarh. Song, Suswa and Hinwal are other tributaries of the Ganga. Garhwal region is bestowed with abundant running water resources as also a number of glaciers, lakes, reservoirs and hot springs. The main glaciers are Gangotri, Pindari, Satopanth, Kedarnath, Bhagat, etc., Dodital, Devariatal, Roopkund, Hemkund, Basukital, Chorabarital, etc.

are the lakes of importance. The Tehri Dam has formed a large lake extending to 44 Km. Some of the hot springs are Badrinath (59^{0}C), Madmaheshwar, Tapovan, Gaurikund, Kulseni, Gangotri, Yamunotri and Gangnani.

Garhwal region has long been considered as the storehouse of immense forest wealth and embraces nearly 67.28 per cent of the total area. There seems to be direct reflection and control of a variety of physical conditions on the character and nature of vegetation like Soil, climate, topography, altitude and aspect, etc. The major vegetation belts have been identified in the region:

1. Sub-Tropical forests
2. Temperate forests
3. Alpine and Sub-Alpine forests and
4. Alpine Bush and Meadows.

Large tracts of forests occur in Western Garhwal and Shiwaliks in the South. In the eastern part, forest area is confined to the water sheds of tributaries like Doodhatoli and Pindar –Mandakini area.

Soil is the product of geological, chemical, biological and cultural interactions. The soils of Garhwal vary as per aspect, vegetal cover, altitude and climate. In the hills, the soil layer is thin but in the valleys it is quite deep. The sedimentary soils are found in most of the hilly parts. Properties of soils are largely determined by the type of parent rock. The soils of the region are generally rich in basic constituents. Soils of the Dun and plain areas and river valleys are quite fertile as compared to hill soils. The main soil types are alluvial soil, brown forest soil, Brown Deciduous and Coniferous forest soil and Mountain Meadow and glacial soils (Kaushik, 1961). Soils provide the firm base for the development of agriculture in any region. On the basis of irrigation, upraon (upper), Talaon (lower) and plain soils have been classified in Garhwal.

Land use Pattern

The concept of land utilisation is basically related to man's physical environment superimposed by cultural landscape. The nature and composition of land use in Garhwal Himalaya differ greatly from those of plain areas due to variations in physiographic, climatic, aerometric and other factors. The climate-ecological gradations have created a casual relationship between the differences in terrain and landuse in them. The following is the general land use of Garhwal Himalaya–

Table:1. Land use Pattern in Garhwal Region

S.No.	Category	Area (%to Total area)
1.	Forests	67.28
2.	Net Sown Area	11.00
3.	Area under use other than agriculture	2.80
4.	Arable barren land	4.99
5.	Not suitable for agriculture	6.52
6.	Gardens, etc.	3.00
7.	Pastures	2.24
8.	Other fallow	1.10
9.	Current Fallow	0.17
	Total	**100.00**

The above table shows that Garhwal Himalayan lands, as put to varied uses, display some of the unique features which are much less identical to general land use of plain areas. They are uneven in greater degrees in space and magnitude. Major part (more than 67%) of the region is covered with forest. If the pattern of land use of Garhwal is compared with some Himalayan states, the clear picture can be drawn.

Table:2 Land-use in Some Himalayan States (%)

State	Forest	Not Available for cultivation	Other than Agriculture	Fallow	N.S.A.
Jammu & Kashmir	61.4	11.7	9.1	2.2	15.6
Himachal Pradesh	54.8	5.7	27.5	1.2	10.8
Uttarakhand	64.6	7.7	13.5	1.0	13.2
Manipur	27.2	65.4	1.1	-	6.3
Arunachal Pradesh	91.3	0.7	3.0	3.0	2.0
Meghalaya	8.3	84.5	-	-	7.2
Nagaland	19.7	75.9	-	-	4.4
Mizoram	62.0	36.1	-	-	1.9
Tripura	60.1	4.9	11.6	0.5	22.9
Garhwal Himalaya	67.28	12.41	8.04	1.27	11.00

Except for Meghalaya and Nagaland, most part of these states are covered with forests but the net sown area is very limited in all the states. Garhwal Himalaya also reveals the same pattern. To understand the land use pattern more clearly, it will be worth-while to analyse it at the block-level which gives quite a different picture.

Table:3 Land-use and Irrigated area in Garhwal Region (% to Total Area)

Sl. No.	Block	Forest	Arable barren	Fallow	Not suitable for Agriculture	Other uses	Pastures	Gardens	N.S.A	Double Cropped Area (% to N.S.A)	Irrigated Area (Net)
1.	Joshimath	24.38	8.19	0.13	53.44	3.52	3.02	5.93	1.34	0.51	6.02
2.	Kamprayag	23.47	1.48	0.42	30.41	3.70	3.50	6.63	30.35	18.12	15.53
3.	Dasholi	56.2	6.82	0.48	6.23	1.67	6.22	6.70	15.62	5.89	7.41
4.	Ghat	58.86	7.11	0.64	4.50	1.70	5.99	4.27	16.90	12.78	3.85
5.	Narainbagar	36.62	1.14	0.42	6.40	4.72	10.11	11.98	28.56	9.34	8.84
6.	Gairsain	48.75	9.22	0.91	8.64	1.26	7.42	5.56	18.20	11.30	6.30
7.	Tharali	52.57	3.43	0.50	5.53	0.87	3.42	5.41	28.24	5.50	10.43
8.	Dewal	54.29	5.09	0.41	13.39	0.98	2.86	13.22	9.72	4.16	3.05
9.	Pokhri	40.73	2.46	0.51	11.98	13.21	4.32	10.19	19.67	18.47	9.83
10.	Okhimath	43.07	5.78	0.29	28.62	3.14	3.78	6.13	9.13	5.64	13.29
11.	Agastmuni	43.07	5.78	0.29	28.62	3.14	3.78	6.13	9.10	5.64	13.29
12.	Jakholi	43.07	5.78	0.29	28.62	3.14	3.78	6.13	9.13	5.64	13.29
13.	Kot	48.91	5.89	3.07	10.23	4.04	4.10	5.69	18.04	10.00	7.47
14.	Kaljikhal	50.41	4.29	0.91	6.02	2.90	8.60	10.84	15.97	10.23	8.17
15.	Pauri	44.52	5.75	0.34	4.74	3.84	6.07	14.51	17.07	8.48	5.52
16.	Pabau	32.93	14.27	4.73	4.47	4.38	12.68	14.70	18.73	14.70	6.81
17.	Thalisain	40.10	4.48	6.97	11.80	2.25	9.85	12.49	11.95	7.44	5.89
18.	Bironkhal	53.11	6.96	1.01	3.71	2.73	6.48	13.15	12.80	14.63	9.88
19.	Dwarikhal	44.30	6.21	3.38	10.98	2.41	5.51	13.81	13.37	13.78	13.40
20.	Dugadda	45.39	15.44	0.60	3.61	8.28	8.41	8.08	17.45	3.87	18.19
21.	Jaiharikhal	52.44	6.26	0.77	2.64	2.62	8.61	11.70	15.04	6.47	6.78
22.	Ekeshwar	52.99	7.82	1.38	2.18	3.24	5.69	6.01	20.66	7.20	8.82
23.	Rikhnikhal	52.08	5.37	4.69	4.48	2.22	7.35	8.41	15.33	7.07	10.90
24.	Yamkeshwar	58.47	6.89	3.33	4.73	2.71	3.58	3.34	16.91	9.63	10.87
25.	Nainidanda	50.31	5.71	3.57	3.82	1.94	6.86	8.30	19.22	8.16	8.18

Sl. No.	Block	Forest	Arable barren	Fallow	Not suitable for Agriculture	Other uses	Pastures	Gardens	N.S.A	Double Cropped Area (% to N.S.A)	Irrigated Area (Net)
26.	Pokhra	46.31	6.39	4.00	3.60	3.13	3.75	11.49	21.29	7.07	6.00
27.	Khirsu	62.09	4.76	2.04	4.41	3.95	3.83	5.45	13.44	5.07	6.47
28.	Pratapnagar	62.86	11.02	1.29	2.72	2.69	0.39	0.01	19.37	10.96	16.00
29.	Bhillangana	87.64	6.08	0.33	8.75	0.64	0.07	1.38	3.71	2.74	18.90
30.	Jakhnidhar	54.57	18.85	1.43	2.65	4.77	0.48	3.04	16.59	10.60	17.70
31.	Jaunpur	56.73	26.40	0.93	4.86	2.24	1.02	2.76	9.46	5.48	15.40
32.	Thauldhar	62.77	15.89	1.45	1.78	1.98	0.78	4.91	14.93	9.64	11.80
33.	Chamba	69.79	5.58	1.84	2.54	3.09	0.81	0.02	15.43	9.64	19.90
34.	Narendranagar	68.32	15.67	1.79	2.69	2.15	0.68	4.15	9.58	5.75	10.50
35.	Devprayag	39.99	24.74	4.27	3.15	3.84	0.69	2.66	23.03	14.76	13.10
36.	Kirtinagar	74.51	6.88	2.44	1.42	1.54	0.22	1.67	12.77	7.84	13.50
37.	Chakrata	79.40	6.03	0.80	0.20	0.74	-	0.08	12.71	5.37	4.10
38.	Kalsi	55.46	15.92	1.76	3.50	3.50	-	0.02	23.19	18.14	33.60
39.	Vikasnagar	66.97	1.11	3.48	0.11	6.93	0.04	0.53	19.80	15.16	72.90
40.	Sahaspur	68.58	1.21	2.73	1.07	8.57	0.04	1.88	16.11	8.20	52.70
41.	Raipur	50.65	5.18	4.49	0.85	15.88	0.01	5.83	16.68	5.56	59.80
42.	Doiwala	75.72	0.78	1.93	0.20	4.46	0.01	0.32	16.55	7.07	55.20
43.	Mori	17.84	10.75	5.89	4.15	2.29	10.56	8.69	15.47	13.77	25.00
44.	Purola	26.07	0.39	2.03	3.14	6.32	4.94	5.98	41.0	13.27	26.80
45.	Naugaon	7.54	7.73	3.48	6.45	7.61	8.11	6.76	33.54	17.93	13.10
46.	Dunda	24.86	3.64	1.13	10.51	7.63	16.95	4.19	31.05	19.58	24.00
47.	Chinyali Saur	26.79	4.59	1.57	13.81	7.85	12.03	4.10	29.23	17.94	19.90
48.	Bhatwari	7.45	17.37	5.40	10.28	5.53	20.89	9.33	23.68	13.68	19.10
49.	Bhagwanpur	1.10	0.71	6.62	0.51	12.83	0.06	0.19	77.95	38.11	67.40
50.	Roorkee	0.44	0.52	2.43	1.09	15.70	0.03	0.14	79.63	33.25	83.90
51.	Narsan	0.11	0.87	2.70	1.72	13.94	0.05	0.06	80.50	48.30	94.03
52.	Bahadarabad	18.83	1.35	2.78	0.87	17.47	0.01	3.41	57.84	29.99	80.04
53.	Laksar	5.61	1.34	3.06	0.87	15.46	0.01	0.01	73.61	29.58	91.19
54.	Khanpur	5.12	2.47	1.10	2.45	7.25	0.07	-	71.55	28.14	88.18

(Source: Bulletins of all Districts – 2011)

The table reveals that there are much variations in the landuse of Garhwal Himalaya as a whole and dividual blocks.

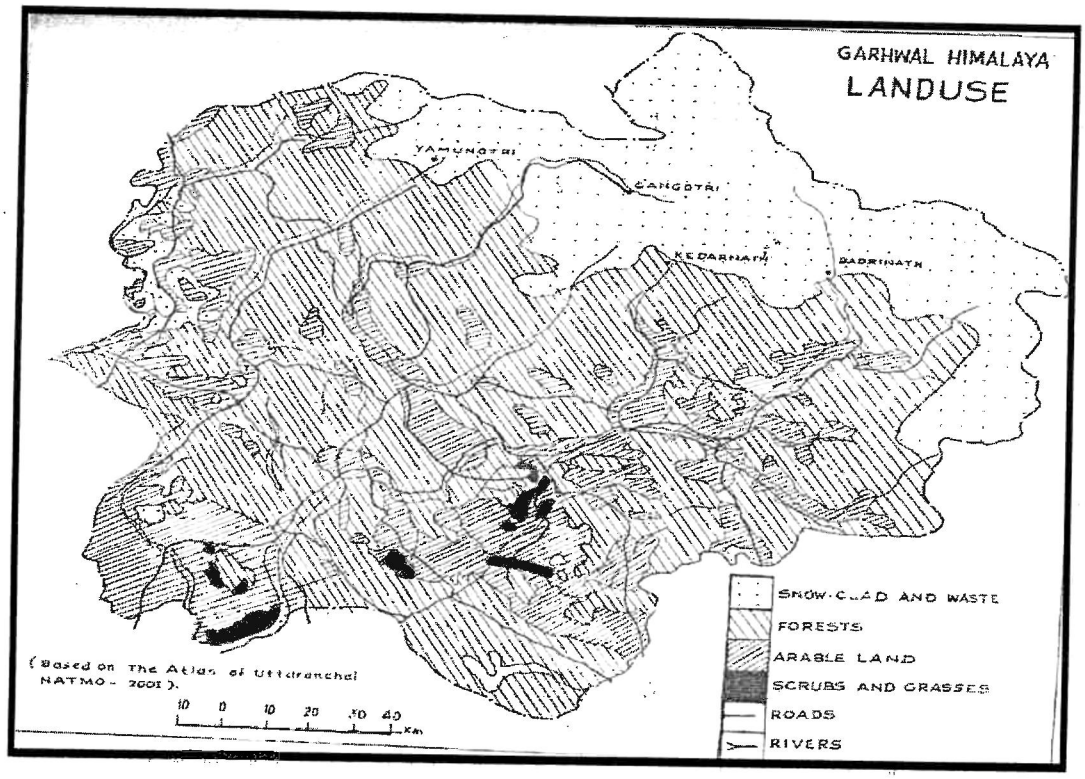

Fig.2

Area Under Forests:

Garhwal Himalaya is well known for its abundant forest wealth and corresponds with the prescribed figure of 60.00 per cent for hill areas as per the National Forest policy with variations in the distribution of forested area in the development blocks. The figure for Garhwal is 67.28 per cent which varies from a high of 87.64 per cent in Bhilangana, closely followed by 79.40% in Chakrata, 75.72% in Doiwala and 74.51 per cent in Kirtinagar to a low of 0.11 per cent in Narsan, followed by 0.44 per cent in Roorkee and 1.10 per cent in Bhagwanpur.

A majority of development blocks (22) have more than 50.00% of forest land which mainly belong to the hill districts. The blocks located in the vicinity of snow covered areas also exhibit a relatively less area under forest. All the blocks of Hardwar district have less forest area.

Arable Barren Land:

This category of land includes the areas which are barren at present but could be transformed into cultivated area. The highest figure (26.40 per cent) has been observed in Jaunpur, followed by 18.85% in Jakhnidhar, 17.37% in Bhatwari and about 15.0 per cent in Thauldhar, Narendranagar and Pabau. The areas marked by higher share of agricultural and (or) forested area are having less land in this category. Most of the blocks of Hardwar, Dehradun and Chamoli district reveal this pattern.

Fallow Land

In order to maintain the fertility of the soil and increase the production, there is applied a practice of leaving the fields fallow. This includes – current fallow and fallow lands. The figure for Garhwal Himalaya is 1.27 per cent which varies from 6.62 per cent in Bhagwanpur, followed by 5.40 per cent in Bhatwari block. A majority of development Blocks as much as 20 have less than 1.0 per cent of fallow land which again belong to hill areas.

Area Not Suitable for Agriculture

This is the land which is not at all fit for agriculture. In view of the rugged topography of Garhwal Himalaya, this type of land is present in a relatively higher per centage (12.41) which is more than (11.00) that of net sown area. This figure is more than 50 per cent of the total area of Joshimath block (53.44), Karnaprayag (30.41), Okhimath, Jakholi and Agastmuni (28.62%) each) have the high share of this land. In the plain areas (Hardwar and Dehradun districts), the percentage of this land is between 1 and 2 per cent.

Net Sown Area

Net sown area is the actual physical area under various crops and the best indicator of the state of agriculture. In Garhwal Himalaya, it is very difficult to have large part of land under cultivation because of steep slopes and typical geological structure of the terrain. The overall net sown area accounts for 11.0 per cent of the total area, which varies greatly from one block to another.

In Narsan block, the highest figure of 80.50 per cent as net sown area has been observed. All other blocks (4) of Hardwar district have more than 70.0 per cent net sown area. Roorkee (79.63), Bhagwanpur (77.95), Khanpur (71.55) and Laksar (73.77) come under this category. Bahadarabad has 57.84 per cent net sown area, Naugaon (33.54), Dunda (31.05), Chinyalisaur (29.23), Purola (41.0) all from Uttarkashi district also have a relatively higher net sown area. Karnaprayag (30.35), Narainbagar (28.56), Tharali (28.24) and Devprayag (23.03) also have better share. The net sown area of Garhwal can be summed up as follows-

Table 4: Garhwal Region: Net Sown Area (%): 2001

S. No.	Category	No. of blocks	Name of blocks.
1.	Below 10.0	08	Joshimath, Dewal, Okhimath, Agastmuni, Jakholi, Jaunpur, Narendranagar, Bhillangana
2.	10.0 – 20.0	28	Dasholi, Ghat, Gairsain, Pokhri, Kot, Kaljikhal, Pauri, Pabau, Thalisain, Bironkhal, Dwarikhal, Dugadda, Jaiharikhal, Rikhnikhal, Yamkeshwar, Nainidanda, Khirsu, Pratapnagar, Jakhnidhar, Thauldhar, Chamba, Kirtinagar, Chakrata, Vikasnagar, Sahaspur, Raipur, Doiwala, Mori
3.	20.0 – 30.0	08	Narainbagar, Tharali, Ekeshwar, Pokhra, Kalsi, Chinyalisaur, Bhatwari, Rikhnikhal
4.	30.0 – 40.0	03	Karnprayag, Naugaon, Dunda
5.	40.0 – 50.0	01	Purola
6.	More than 50.0	06	Bhagwanpur, Roorkee,Narsan, Bahadarabad, Laksar, Khanpur
Total	11.00	54	Garhwal Himalaya

The influence of topographical conditions seconded by their related consequences on the spatial distribution of net sown area in the region is quite obvious. The areas characterised by difficult terrain have less net sown area. The mountainous patches of relatively gentler slope are marked by maximum extension of agricultural land but here, the quality of land is not of standard. On the other hand, the limited portions of important river valleys are flat and boast for better quality land and higher portion of net sown area (Purohit, 1983). All the blocks of Hardwar district, being situated in the upper Ganga plain have maximum portion of their geographical area under cultivation.

As much as eight development blocks of the region are having less than 10.0 per cent net sown area, while a majority (28) of blocks have the net sown area between 10 and 20 per cent. The regional average is 11.00 per cent. The blocks having between 20 and 30 per cent net sown area are characterised by relatively flat land of river valleys.

Agriculture has remained of prime importance in almost all parts of India which, without doubt displays differentials regionally and locally, in response to factor like surface configuration, drainage, climate, vegetation, soil and a number of socio-cultural factors. Such aspects have been responsible to varying degrees of extent, forms, productivity and capacity. It is a well known fact that the nature and type of cultivation in Garhwal Himalaya differ significantly from rest parts of the country due to sharp variations in physiographic, climatic, agronomic and the kind factors.

Mode of Cultivation:

It is a very difficult task to cultivate various crops in the mountainous region. The dearth of levelled land necessitates cultivation in the slopes of various magnitudes by the help of terracing which generally extend from valley bottoms to the ridges or higher slopes. The size and shape of fields and the height of the terraced walls mainly depend on the nature of slope. The fields are generally narrow with higher terraced walls where the slope is high, and on the gentle slopes, the fields are relatively wider. Thus the width of these terraces varies from 1.5m to 6.0m with average height of the walls from 1.5m to 2.5m.

But in the river valleys, Doon and Hardwar, the pattern does not apply and varies greatly due to favourable location and geographic conditions. The width of the fields in the hills is relatively broader along the concave slopes. These terraces are helpful in conserving moisture and soil.

Land holdings

On account of the highly rugged terrain, the operational land holdings in the region are very small in size and of various shapes, which is clearer from the following table–

Table 5: Area and size of Landholdings in Garhwal (2011)

Holidays/Districts	Uttarakashi	Chamoli	Tehri	Dehradun	Garhwal	Rudrapra yag	Hard war	Average Region
Small and Marginal holdings (%)	86.2	90.3	90.6	87.5	79.6	95.9	82.5	85.9
Small and Marginal holdings (area %)	49.4	65.1	67.0	43.7	37.3	75.3	43.8	48.5
Average Size of all holdings (Hect.)	0.9	0.8	0.8	0.9	1.3	0.7	1.2	1.0
Average size of Marginal holdings (Hect.)	0.3	0.4	0.4	0.3	0.3	0.3	0.4	0.3

(Source: Statistical Bulletings Garhwal Mandal, 2011, PauriGarhwal)

The total number of holdings in the region is 4,72,946 covering an area of 4,79,431 hectares. Nearly 2,20,000 holdings are below 1.0 hectare of all the holdings available in the region, 85.9 per cent are occupied by small and marginal holdings which varies from a high of 95.9 per cent in Rudraprayag district to a low of 82.5 per cent in Hardwar. Similarly the per cent area of small and marginal holdings is 48.5 in Garhwal Himalaya, Variable from 75.3% in Rudraprayag to 37.5% in Garhwal district. The average size of all holdings in the whole region is 1.0 hectare, Varying from 1.3

hect. In Garhwal to 0.7 in Rudraprayag and 0.8 hect. each in Chamoli and TehriGarhwal. The respective figures for Uttarkashi and Hardwar are 0.9 and 1.2 hect.

The average size of small and marginal holdings is 0.3 hectare which is almost the same in all districts.

Types of Cultivation

According to the relative location of arable areas in various locations of a valley section, there are three types of cultivation in different altitudes –

(1)Katil Cultivation This type of cultivation is practised as follows:

(i) On the higher parts of slopes.
(ii) Just below the forest lands.
(iii) Mostly occupying the forest-cleared areas where mainly hoe-cultivation exists.

(2) Upraon Cultivation: This type of cultivation is practised on the ridges with permanently terraced but generally un-irrigated cultivation. This is also known as 'dry farming', which is a common phenomenon of upland or ridge slopes where soil is less fertile and scarcity of water affects the mode of cultivation and productivity in many ways. It produces three crops in two years (two kharifs and one Rabi).

(3) Talaon Cultivation: Lower situations near the river banks having high fertility and intensive agriculture, double cropped and well-irrigated, have this type of cultivation. The talaon land may further be divided into three sub-types – Sera, Panchar and Simar cultivation.

In view of the variation in soil types at local level, size of fields with irrigation slope gradient among the agricultural fields, means of irrigation facility, technological inputs and other infrastructure from valley to hill top, there are also marked variations in the practice of cultivation in Garhwal Himalaya. In the whole of Hardwar district and the 'Doon' area of Dehradun district, the practice is quite different.

In the hill areas, non-irrigated agricultural land is of two types – Avval(superior) and Doem (secondary). The former is related to the fields having relatively deep soil with little rubbles, whereas the latter belongs to the fields marginally productive due to little soil and large amount of rubbles. Despite the effective control of altitude, much important factor is of the aspect which exhibits sharp variation of temperature on northern and southern slopes in the hills (Kharkwal, 1993). In the Himalayan region, the southern slopes are more drier or sunny than the northern ones. Though the amount of rainfall is less on northern slopes as compared southern slopes, but due to less intensity of sunlight, the former have more moisture retaining capacity.

Irrigation and manuring occupy significant place in hill agriculture. In Katil lands the burnt ashes are the only form of manure. In Talaon lands, silt brought down by leats is generally considered sufficient to keep the land fertile. Manures are more needed in the upraon cultivation. However in the areas belonging to the 'Doons' and Hardwar district, with the use of a number of fertilizers like, urea etc., the productivity increases greatly. In the hill agriculture, the system of cultivation, types of crops grown and methods of rotation are determined by the nature of soil, physical features and needs of the farmers.

Crop-Rotation

In order to preserve the fertility of soil, a skilful rotation of crops is practised throughout Garhwal Himalaya. In view of the mountainous topography and varied nature of cultivation, different crops are grown in the region. On the upraon lands, three crops are received in two years with a course of rotation of Rice-Wheat–Mandua (finger millet /ragi)–Fallow. In the newly unclaimed un-terraced land, one full rotation occupies five years. The total cultivated area is divided into two categories – SARS*, devoted to two major crops, rice and mandua (finger millet).

{*'SAR' denotes the group of fields under a particular rotation in one locality of the villages.}

The crop rotation in the Talaon lands is practised among four to five crops in two years rotation. In this area, transplantation of paddy is followed by wheat with their regular course and then followed by the Zaid crops and vegetables. Thus, the rotation is paddy –Wheat–Zaid crops–Vegetables. In recent years with the introduction of chemical fertilizers, high yielding varieties of seeds and irrigation facilities more area is being brought under double crops and traditional rotation is being modified.

Crop-Landuse

Wheat and Paddy are two major of crops of Garhwal Himalaya out of the total cropped area as much as 29.17per cent is devoted to wheat crop, followed by paddy (18.18%). The corresponding for Uttaranchal and India are 33.00 and 12.30 per cent and 21.60 per cent and 23.30 per cent respectively. There is however, observed a district to district variation in this regard. The maximum area under wheat is occupied by Rudraprayag (32.71%), followed by 32.69% in Tehri-Garhwal. The lowest figure (26.24%) is found in Hardwar district.

Regarding the paddy landuse, the highest figure (29.60%) is in Rudraprayag and the lowest (13.95%) in Hardwar. Among other important crops are-Mandua (12.0%) and Sawal (8.08%) which occupy a relatively higher area. Sugarcane (10.63%) is confined to Dehradun (8.16%) and Hardwar (34.39%). The total area under the cereal crops is 73.23 per cent as compared to 86.80 per cent to Uttaranchal. The following table brings the clear picture–

Table 6: Crop Landuse in Garhwal Region % to total cropped are, 2011

S. No	District	Rice	Mandua (finger millet)	Jawa	Maize	Bar ley	Wheat	Cereals	Sugar Cane	Oilse eds	Pul ses	Vegeta bles/ Fruits
1.	Uttarkashi	24.98	12.54	4.97	1.05	0.80	31.17	75.55	-	3.56	2.87	4.34
2.	Chamoli	23.77	20.92	6.17	0.36	2.65	30.08	83.97	-	1.38	1.26	3.50
3.	Tehri-Garhwal	15.54	16.01	19.75	2.39	2.89	32.69	89.11	-	1.59	3.40	1.41
4.	Dehradun	17.41	3.81	1.62	16.17	2.10	29.77	70.92	8.16	2.65	2.53	1.72
5.	Garhwal	19.12	22.92	15.14	1.89	5.26	28.05	92.41	0.0	0.54	3.10	0.23
6.	Rudraprayag	20.60	21.22	6.43	0.57	3.52	32.71	94.07	-	0.38	0.9	2.41
7.	Hardwar	13.95	-	-	1.62	0.06	26.24	41.90	34.39	2.37	2.44	0.29
8.	Garhwal Himalaya	18.18	12.03	8.08	3.39	2.41	29.11	73.23	10.63	1.75	2.59	0.25
9.	Uttarakhand	21.60	15.80	9.00	3.8	3.50	33.00	86.80	5.80	1.20	2.10	2.00
10.	India	23.30	-	1.40	3.5	1.00	12.3	60.70	1.60	9.20	13.20	14.80

Cropping Pattern

The agriculture in the hill region of Garhwal is of subsistent nature. Food crops overwhelm the agricultural landscape and account for 73.23 per cent of the total cropped area. Wheat, paddy, Mandua (finger millet) and Jhangora (barnyard millet) are the main crop here. The composition of

mode and practice of agriculture, regional traditions, availability and efficiency of marketing facilities, because each of the factors has a unique influence on the crop mix in the region (Kharkwal & Teli, 1987).

In the Himalayan region, climatic and soil conditions basically determine the cropping structure. In fact, the physical environment in the Himalayan region has infused a high degree of adoptive skill and uncommon physical vigour among the people to cope with the inhospitality of environment. Even with this situation, agriculture in Garhwal Himalaya is a major economic activity from the ecological viewpoint, the distribution of crops in the Himalayan region follows some sort of vertical zonation. Like other parts of the country, cropping activities go on all the year round in Garhwal Himalaya, where there are two crop seasons – Kharif (June-October) and Rabi (November-May).

The main crop of Kharif season are paddy, Mandua, Jhangora, Cheena, Kauni, Maize, Marsa (chaulai), Urad, Gahath and Moong, while the Rabi season embraces on upland slopes are grown as rain fed crops. Generally, mix –cropping is practised among the millets. Mandua is called the 'King of Millets' in all the hill districts.

Double Cropping

The area cultivated more than once in an agricultural year is known as 'double cropped area', which is also known as double cropping. It denotes the practice of replacing of a second crop after the first has been harvested. Thus, two and occasionally three harvests in most suitable geographical conditions are obtained from the same field. Out of the New Sown area of Garhwal, as much as 52.50 per cent is double cropped area, which is variable from district to district and block to block.

Double cropped area needs more fertile and irrigated land and such facilities are comparatively more in plain areas than in the hills. It is 62.19 in Tehri, 53.10 in Dehradun, 52.89 in Garhwal, 61.79 in Rudraprayag and 44.39 per cent in Hardwar district. The block wise description is as under has been given in Table-3.

Irrigation

A well developed agriculture needs irrigation facility in adequate amount. It has been a pressing problem and difficult task to avail these facilities in Garhwal Himalaya, which can be correlated with the rugged topography and thus, most part of agriculture depends greatly on the whims of nature, particularly in the hill areas. However, in suitable locations irrigation is available on a very small scale, mainly along the main streams and other water channels through guls (Gravity Canals). In fact, irrigation helps change and diversify the cropping pattern, technology and use of fertilizers and other innovative measures.

Along the major valleys where the water flows in deep channel, the irrigation facilities are meagre. Only 36.59 per cent of the net sown area in the region is irrigated which is variable from 10.79 per cent in Rudraprayag to 81.89 per cent in Hardwar district. Down at block level the highest figure (94.03%) has been observed in Narsan, followed by 91.19 per cent in Laksar and the lowest 3.05 per cent in Dewal, 3.85 per cent in Ghat and 4.10 per cent in Charkrata. Dehradun also is characterised by better irrigation.

The irrigational facilities are provided by various means such as canals, guls, wells, tube wells and others. Most of the irrigation is available through tube wells (56.1 per cent) mainly confined to Hardwar and Dehradun, whereas 25.5 per cent is constituted by canals and 18.4 per cent by other means.

Cropping Intensity

Cropping intensity refers to the use-efficiency of land for agriculture which denotes the degree of efficiency of crops grown from a particular plot of land during an agriculture year. Thus, the cropping intensity directly influences the use-efficiency of land. In Garhwal Himalaya it has been computed as to show the percentage of gross cropped area to the net sown area which records

152.50. The cropping intensity for Uttarkashi (157.46), Chamoli (152.44), Tehri-Garhwal (162.19), Dehradun (153.06), Garhwal (152.89), Rudraprayag (161.79) and Hardwar (144.39) is variable to a great extent.

In all the blocks of Joshimath, Karnaprayag, Okhimath, Lansdowne and Roorkee tehsils, the intensity is between 140 and 150, while in Dehradun, Pauri, Bhatwari, Rajgarhi, Purola and Chakrata it has been found to be between 150 and 160 which corresponds to the regional average. The high intensity is found in Dasholi, Dugadda, Devprayag, Pratapnagar and Bhillangana (160-170).

Crop-Ranking

In order to determine the relative importance of various crops cultivated in a region, crop-ranking happens to be an important aspect. To illustrate the relative importance of crops in Garhwal, they have been given rank according to the percentage area under each of them. Taking the whole region into consideration, the order of dominance of crops in:- Wheat, Millet and Rice. These three crops cover nearly 75.0 per cent of the total cropped area of Garhwal Himalaya, varying from block to block and district to district.

Down at block level, 30 blocks have the wheat at first rank and rest (24) have it at the second order. Similarly, rice is at first rank in 13 blocks, second in 15 blocks, third in 20 blocks and fourth in 3 blocks. Millet is at first rank in 12 blocks, second in 19 blocks and third in 13 blocks. Sugar cane is at first order in 4 blocks, second in 2 blocks third in 2 blocks of Garhwal.

Productivity of Crops

Agricultural productivity as represented by yield per hectare depends on many physical as well as socio-economic factors. Overall low levels of productivity in the region can be attributed to a large number of factors, viz. variation in the topographic and climatic conditions, availability of irrigation facilities and extension of utilisation of agricultural inputs. About 37.00 per cent of the net sown area of Garhwal Himalaya is irrigated. The utilisation of improved seeds and fertilizers is extremely low. However, there are some suitable locations where crop yield is very high. Mention may be made of the Dun valley, fertile terraces of the Bhagirathi and the Alaknanda valleys, Bhabar and plain region.

A number of crops as mentioned earlier, are produced in Garhwal with varying levels of productivity (Table-7).

Table 7: Average Yield of Crops in Garhwal (Q/H) – 2001

S.No.	Crops	Uttarkashi	Chamoli	Tehri	Dehradun	Garhwal	Rudrap rayag	Hardwar	Garhwal Region
1.	Rice	14.50	12.05	15.15	16.28	10.72	14.50	24.52	15.54
2.	Wheat	10.70	11.54	9.09	14.28	9.35	11.54	27.73	14.61
3.	Maize	9.79	9.29	11.26	13.13	10.16	10.41	15.31	11.33
4.	Mandua	14.81	13.94	13.40	15.19	13.81	13.04	-	14.10
5.	Sawa	16.14	13.72	13.18	11.03	12.58	11.72	-	13.06
6.	Urd	2.68	2.68	2.68	2.70	2.68	2.68	5.50	3.15
7.	Moong	-	-	-	-	-	-	7.60	7.60
8.	Masoor	7.25	7.25	7.25	7.25	7.25	7.25	4.57	6.80
9.	Gram	8.85	-	8.72	8.85	8.85	-	8.74	8.80
10.	Peas	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25
11.	Arhar	5.95	5.95	5.95	5.95	5.95	5.95	6.19	6.00
12.	Oilseeds	4.80	7.16	5.38	6.54	5.69	7.16	7.49	6.18
13.	Sugar cane	-	-	-	611.32	589.92	-	621.16	607.46
14.	Potato	228.17	228.17	228.17	288.17	288.17	288.17	214.79	225.94
15.	Tobacco	70.48	70.48	70.48	70.48	70.48	70.48	60.00	68.73

Thus, it is clear that 15.54 Q/T is the highest yield related to rice, wheat and mandua have almost the same productivity followed by sawa (13.06Q/H). The highest productivity has been observed in the case of sugar cane (225.94 Q/H), which is confined to Hardwar and Dehradun district.

Table 8: Production of Main Crops (M-Tons) in Garhwal (2001)

S. No.	Crop	Uttarkashi	Cahmoli	Tehri	Dehradun	Garhwal	Rudrap rayag	Hardwar	Garhwal Region
1.	Rice	15681	20631	25313	23726	25908	10801	54886	184660
2.	Wheat	16270	17411	30761	33199	42950	11356	115914	267861
3.	Barley	522	1523	2835	1468	6238	860	265	13711
4.	Maize	506	169	2790	16557	2907	178	4263	27370
5.	Mandua	9136	14608	22207	4596	47822	8292	-	106661
6.	Sawa	3915	4248	26671	1399	28719	2259	-	67211
7.	Urad	188	112	381	155	847	26	7	1690
8.	Masoor	291	55	846	675	655	8	1181	37014
9.	Gram	3	-	19	143	58	-	99	322
10.	Peas	114	21	218	199	29	-	247	828
11.	Arhar	109	70	418	62	313	-	30	1002
12.	Oilseeds	836	496	887	1354	466	60	4202	8301
13.	Sugan cane	-	-	-	389655	59	-	3840446	4230160
14.	Potato	48328	40067	33404	30803	8237	2831	7282	130528
15.	Tobacco	155	7	148	127	49	-	522	1008

CONCLUSION

It is clear from what has been analysed above that agriculture is the main occupation of people in the region but a little portion of land is available for cultivation. The landuse pattern exhibits clear inter and intra-regional heterogeneities in Garhwal because of variation in topography, climate, soil, water resources etc. In hill areas, agriculture is being ignored because of outmigration of people, while the agricultural land in plain areas is being swallowed by urban expansion. Most part of land in the mountains is occupied by forests. There is a dire need of providing irrigation and other infra structural facilities for agriculture. The land use of the region is tending to great changes after the creation of Uttarakhand state.

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